

STUDIES IN AMPULLARIA

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STUDIES IN
AMPULLARIA

BY

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WITH NINETEEN PLATES, DRAWN FROM NATURE
BY THE AUTHOR.

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PREFACE

It is perhaps advisable to give some explanation as to the title and scope of this work. The title in particular is open to the criticism that I might have begun my studies by finding out the correct name of the genus which forms my subject.

By the International rules of nomenclature the Boltenian name *Pila* takes precedence of Lamarck's *Ampullaria*. This being the case, I have only an excuse to offer for my disregard of strict priority. It is simply that Bolten's name has not come into general use, and probably never will. A precedence of one year, obtained by an obscure and almost inaccessible publication, cannot efface the associations which have gathered round the genus under its familiar title of *Ampullaria* during the last hundred and twenty years. None of the leading authorities on these shells use *Pila*, museums seem to ignore it, and, most important of all, from my point of view, private collectors are not familiar with it. Since my book is strictly conchological, and largely intended for the use of collectors, I have thought it best to sacrifice the letter of the systematic law, and discuss my favourite genus under a designation well-known to every lover of shells.

The scope of the work is not what was originally intended. I had hoped to accomplish a complete monograph of *Ampullaria*, with original figures of all the established species and their varieties. No one who has worked upon these shells will deny that some such critical revision is long overdue. The two monographs which may be regarded as the classics of *Ampullaria* were both written more than sixty years ago, and the species since added have generally been described in publications of limited circulation, many of which are now quite out of print, and only occasionally to be found even in large public libraries. But it soon became evident that the necessary material could not be got together. The Great War put a stop to collecting, and shells became very difficult to get, either by purchase or exchange. I did all I could in either direction, and should like to acknowledge the trouble taken by Mr. Hugh Fulton, of the firm of Messrs. Sowerby and Fulton, that he might meet my demands for *Ampullariae*, and in particular to thank Mr. W. H. Weeks, of Brooklyn, New York, who most kindly sent me many valuable gifts of these shells. Without his aid, and that of the late Mr. F. J. Ede, of Silchar, I could scarcely have got along, having resolved to make use only of shells in my own possession for the figures and descriptions.

This decision, of course, restricted my work to studies of such species as I was able to procure, and a selection had to be made of the most interesting forms, since the series could not be completed. It seemed to be the only thing to do, for the more one studies this genus, the more evident does it become that casual acquaintances therein are of no profit. Borrowed specimens, the loan of which was kindly offered me at times, cannot help; they will not be at hand when they are wanted. To understand the *Ampullariae*, one must handle them almost daily, and have the whole of one's material ready for comparison and discrimination. On the same principle I undertook the task of drawing all the figures unaided, and no one else has put a single touch to the

designs. These might have been much more artistic had they been done by a regular draughtsman, but I thought it better that they should show the points which only a conchologist, or perhaps I should rather say, an Ampullariologist, could be expected to see.

In several cases I have figured under one name a whole series of shells, the specific identity of which may well be called in question. The utmost latitude has certainly been allowed for variation, but no group of figures has been assigned to the same label

without most deliberate selection and comparison of the subjects, and it will probably be conceded that in this genus such latitude is at least permissible. At the worst it is a change from the methods which in the past have overloaded *Ampullaria* with superfluous species.

No opercula have been figured. There is no particular object in giving representations of these, since what is perhaps their only significant character-their composition-cannot be positively expressed in a drawing. All the shells are figured strictly of the natural size, and therefore no measurements are given in the descriptions. As a matter of fact, *Ampullariae* are hardly ever in perfect condition, and the points most vital to accurate measurement, the apex and the outer lip, are just those where damage most frequently occurs. When these are eroded or chipped, it is obvious that the height and breadth it is possible to give can only very roughly represent the original proportions.

In this genus a good many forms which were given specific rank by Philippi, Reeve, etc., are now recognised as mere varieties. To avoid confusion, I have allowed their familiar names to remain upon the plates, and have explained their real standing and affinities in-the accompanying letterpress. There also a good deal of space has been devoted to the synonymy, and to attempts to clear up the confusion at present existing in the same. Full references to the standard *Ampullaria* literature have been given. These have cost me a great deal of trouble in the hunting down of many scarce books and periodicals, and in making abstracts and translations. I can only hope that the results of my labours may be of use to those who, like myself, are enthusiasts for this beautiful but perplexing genus.

November 19th, 1924.

CRITICAL BIBLIOGRAPHY

THE genus *Ampullaria* appears to have attracted the notice of travellers and collectors in the Jacobean period; at any rate Martin Lister, in his great work on shells (1685) gave figures of *A. urceus*, *A. guyanensis* and *A. glauca*. These are perhaps the earliest *Ampullaria* figures extant.

Rumphius (1705), Seba in his "Thesaurus" (1734-1765), and Gualtier (1742) all gave rough figures of shells belonging, apparently, to this genus. Those of Rumphius and Seba are reversed, owing to the carelessness of the engraver, the effect of which upon these beautifully symmetrical forms is quite startling. We may remark that the sinistral shell thus artificially produced by these ancient authors is perhaps rarer in this genus than in any other. Sowerby states that the only instance he ever heard of is that recorded by Nevill (Hand List Moll. pt. 2, p. 2) in the case of *A. globosa*. He has, however, overlooked the fact that on the next page a similar aberration is ascribed to *A. carinata*.

Linné noticed one or two of these shells, which he seems to have regarded as terrestrial, and consequently he relegated them to the genus *Helix*.

D'Argenville (1757), Martini and Chemnitz (Conch. Cab. 1769-1795), Knorr (1771), Müller (Hist. Verm. 1773), Schröter (Flussconchylien 1779), all figured *Ampullariae* under various generic names, mostly ascribing them to *Helix*, and Müller putting down *A. urceus* to *Nerita*.

Humphrey (Mus. Calonn. 1797) noticed five species under the generic name *Pomus*, apparently the first attempt to give a special designation to these shells. In the next year Bolten formed for them the genus *Pila* (Mus. Boltenianum, 1798).

Messrs. Fischer and Crosse point out that both these names are here " catalogue " productions, with no claim to priority, because they are unaccompanied by diagnoses. It is also remarked that *Pomus*, besides being meaningless, is objectionable, as having been applied by the brothers Adams to Western species only, whereas Humphrey's original five species included at least a couple of Eastern forms; while *Pila* was employed by Klein (1753) for a section of *Nerita* and is, therefore, according to the view of Fischer and Crosse, untenable.

This opinion, at least as far as Bolten is concerned, is controverted in the best and most complete account of the nomenclature that has yet appeared—a paper by W. H. Dall in Vol. XI. of the " Journal of Conchology." "In this we read (p. 51) of the 'Museum Boltenianum' that "though no diagnoses were given, full citations of name, volume, page and figure of previous authors were provided, and there seems to be no way in which we can consistently refuse to adopt the Boltenian name if we accept any names

given without a diagnosis, as has now become a common practice."

Bolten's names being now recognised by the International rules of nomenclature, the correct name for our genus is *Pila*, which, as Dall points out, includes both Eastern and Western species. These, according to the difference in the operculum, are generally kept apart as separate sections, and Bolten's name is often used for the Eastern species only. For reasons stated in the Preface, I have preferred to use the more familiar

Ampullaria of Lamarck for the whole genus. With him its literary interest really begins. The name was first published in his "Prodrome" of 1799, when the type specified was Linné's *Helix ampullacea*, with which was associated a large "Apple Snail," figured by D'Argenville under the popular name of "cordon bleu." In his *Hist. Nat. des anim. sans vert. (1822)* Lamarck called this composite and largely imaginary species—he can hardly have known either shell in *nature*—*Ampullaria fasciata*, under which rather vague title (most *Ampullariae* being more or less "fasciated") all clue to its real identity is lost. It is a point for the student to remember that there is no *A. fasciata* in the genus; the name should be expunged, but, as he will only too surely discover, it was a favourite refuge of the old collectors when puzzled by an *Ampullaria* of doubtful affinities.

Meanwhile, however, in his "Système" of 1801, Lamarck confirmed his genus, and took as type the species which Müller had already described as *Nerita urceus*, but which now appeared, possibly by an oversight, as *A. rugosa*. He also gave as a new generic character "muni d'opercule corné." This is certainly true of *urceus*, and it has been proposed to restrict Lamarck's name to those species that are similarly equipped. But if Bolten's *Pila* included Western species with horny opercula, as seems to have been the case, it is not easy to see why the honours of the genus should be divided between him and Lamarck by the use of sectional names. It seems to me that we can hardly accept *Ampullaria* and *Pila* as such—either one or the other should be used for the whole genus, which, whether in the East or in the West, has too much uniformity of character to be divided by considerations affecting, not the operculum, but its composition. We might just as well make sub-divisions on account of its position in the shell, separating those *Ampullariae* which have it tightly fitted to the peristome from those in which it can be pushed deeply into the interior. Such sub-divisions would each include both Eastern and Western forms. It would be simpler to characterise the whole genus as "operculated," and to regard the appendage, as Philippi seems to have done, merely as a geographical indication according to its character. I have, therefore, on the plates at any rate, disregarded divisions, and used one generic name throughout. For this, the choice lay between Bolten's *Pila* and Lamarck's *Ampullaria*. The right of priority, according to International rules is unquestionably with Bolten, but for practical and frankly unscientific reasons, I have preferred Lamarck's more familiar name, which is hardly likely to be supplanted, seeing that all the principal authorities

on our genus have used it in their writings.

If Bolten has precedence in date, the history of the genus nevertheless takes its real beginning from Lamarck, upon whose foundation practically the whole mass of *Ampullaria* literature has arisen, and it is with the literature that we are immediately concerned. It increased steadily as the remarkably individual character of the genus became apparent, and as its wealth of species was revealed by fresh discoveries. From this point, then, I propose to recount in chronological order the principal notices and monographs published up to the present time.

The first really important contributions came from Great Britain. In his two series of *Zoological Illustrations* (1820-3 and 1829) Swainson devoted a good deal of space to these shells. He had previously noticed some of them in *Tilloch's Philosophical Magazine*, but the new descriptions were enriched with exquisitely drawn and

coloured figures. Swainson was one of the Dryasdust school of naturalists; the letterpress of the first series is very meagre and uninteresting, while that of the second is almost unreadable by reason of the author's obsession with the notorious "circular system" of classification. But as a zoological artist he has perhaps never had a superior, and these figures of *Ampullariae*, absolutely faithful and sober in colour, are a delight to the eye. Unfortunately the books, originally printed for a very small number of subscribers, are now scarce and hard to get.

In 1827 the mollusca collected by Spix in Brazil were described by Professor Wagner in a thin folio, the text of which is in Latin. It is entitled "Testacea fluviatilia Brasiliensia," and was published at Munich. Several fine species of *Ampullaria* were introduced and figured of the natural size, the representations, though rather coarse in design and colouring, being for the most part characteristic. It is curious to note that a small land shell, probably the young of *Borus oblongus*, is doubtfully put forward as *Ampullaria rosea*!

In 1828 the Rev. Lansdown Guilding published a clever paper, which will be found at p. S36 of the third volume of the *Zoological Journal*. This paper is more concerned with the anatomy of the genus than with the strictly conchological aspect which we have to keep in view, but it is too important a contribution to the literature to be passed over without mention. The author's object was to discriminate, on anatomical grounds, between the shells with horny and with calcareous opercula.

In 1839 appeared the Molluscan portion of D'Orbigny's sumptuous work on his South American travels and researches. The *Ampullariae* naturally had a prominent place in the text and figures of this work, which is, unfortunately, scarce and exceedingly costly.

The third volume of Schomburgk's "Reisen in Britisch-Guiana," published in 1848, was devoted to zoology, Troschel contributing the article on the mollusca. Schomburgk states that special attention was given to this department by his collectors, but with little success. It would seem, as von Martens observed in the preface to his "Binnenmollusken Venezuelas," that, even in the tropics, mollusca can only be found with the aid of much patience and special knowledge. Certainly Schomburgk's results were very meagre, but the spoils included a number of *Ampullariae*, and he gives some interesting notes on their habits and localities.

The second edition of Martini and Chemnitz's "Conchylien Cabinet," produced in 1851 the first monograph on our genus. The author was Dr. R. A. Philippi, and his work still stands as, on the whole, the best thing that has been done for the subject. It is remarkable for sound discrimination and for scrupulous appreciation of shell-character-qualities which have enabled the author to make the most of material that was obviously poor both in quantity and quality. Proof of its poverty may be found in the number of damaged and uncoated specimens figured in the plates. These latter, twenty-one in number, are rather slight and crude in execution, and the colouring, as seen in most copies, by no means improves them, being indeed quite of the nursery order. Yet the figures, though little more than outlines, are generally characteristic easier to recognise than some more highly finished examples.

IN 1854 were published the first three parts of Hanley's "Conchological Miscellany." This work was a mixture of hitherto unpublished plates by Sowerby, with certain additions, lithographed by T. Hall. Under the latter designation come four plates of *Ampullariae* in the opening issue. They are of much interest, and assist the elucidation of several critical species. Unfortunately no descriptions are given—nothing more than the name and an occasional line of comment. This work is now very scarce, the lithographic stones having been destroyed untimely. Judging by my copy, these figures also have suffered from the attentions of the colourist, whose work, though neat, is rather crude in tone. I have seen another with plain plates, in which the figures were far more characteristic.

In the same year Ludwig Pfeiffer began the issue of his "Novitates Conchologicae" Series I., and quite early in the course of that publication he gave a general excursus on *Ampullaria*, and described particularly three species from Cuba, in which island he had been resident. The introductory remarks possess interest and value, but the attempt to identify and separate the Cuban species is by no means successful. Swainson's *A. reflexa* is quite obviously misrepresented, as in several other conchological works, and of the two others one, *A. conica* Wood, is now known to be an Eastern species. There are three coloured plates of *Ampullariae* in this first series. Strebel has truly said that these leave much to be desired, but in the second series a good figure is given of the African *A. Wernei*, which is the more welcome because Philippi's original figures of this species are neither of them good, and one has been alleged by Billotte to represent, not *A. Wernei*, but his own new species *A. Charmesiana*.

The second of the two great monographs devoted to this genus is Reeve's, in the tenth volume of the famous "Conchologia Iconica." This part of the work appeared in 1856. In the ensuing year it was severely criticised by von Martens, who pronounced it a mere picture-book for purposes of identification. It is quite true that the "Iconica" was intended to have a strong popular turn, being devised largely to help amateurs at a time when shell-collecting was more popular than it is at present. It is likewise undeniable that Reeve's descriptions are far too loose, considering the special difficulties of the genus. If they stood alone they would be of very little service. Nevertheless, the "picture-book" is, in its way, invaluable to the student. Reeve knew that he was supported by one of the very best artists that ever drew the portrait of a shell, and indeed Sowerby's figures are in general so characteristic, that descriptions are hardly needed. The most serious fault in the book is that it absolutely ignores several fine and well-established species described by Philippi and by others. It is thus, on the one hand, curiously incomplete, but on the other it has enriched science by the publication of a long series of novelties, chiefly derived from Mr. Hugh Cuming's matchless collection. A few obvious mistakes appear, arising, no doubt, from "Cumingian labels." For instance, *A. dolioides* is ascribed to the locality "Bombay," and *A. erythrostroma*, now identified with Lamarck's *guyanensis* from South America, is stated to come from Zanzibar. It is curious to notice how persistently these errors have been copied into later works. Von Martens justly complains that Reeve takes no notice of Philippi's observations on the operculum as an indication of Eastern or Western habitat. With such rich material from divers localities at his disposal, he might have done much to

elucidate these, but he does not once mention the operculum in a description, although he has often caused the artist to represent it *in situ* to the detriment of his figures.

The shells collected on Count Castelnau's South American expedition were duly described in the last of the three sumptuous volumes detailing the zoological results. This part of the work was entrusted to J. R. Hupé, whose contribution appeared in 1857. The plates are excellent, and include three or four devoted to *Ampullaria*. Several new species are described and figured. Strangely enough it would appear that Hupé was unacquainted with the monographs of Reeve and Philippi; he never refers to either. This may perhaps account for the fact that his new species have been practically ignored by subsequent authors. One or two, at any rate, have a suspicious resemblance

to species described by Reeve.

In 1857 there also appeared a very important paper on the *Ampullariae* in the Berlin Museum, by Dr. E. von Martens. This was published in the fourth volume of the "Malakozoologische Blätter." It would seem that the Berlin Museum was not at the

time particularly rich in these shells, and there are many obvious gaps in the Professor's series, while the number of species discussed falls far short of Reeve's total. Dr. von Martens speaks disparagingly of the "Conchologia Iconica" monograph, and exalts that of Philippi. The principal object of his own essay is the sub-division of the genus into groups based on the contour of the shell, and this, so far as the work goes, is carried out with an aptitude which rarely failed von Martens when dealing with conchological affinities, and which, indeed, Dr. Pilsbry has characterised as genius. If the great German had worked upon more extensive material, we might have had an almost final revision of the *Ampullariae*. But his judgment of species which he only knew by figure or description, was by no means on a par with his critical appreciation of actual shells. He does not seem to have possessed what Reeve called "iconographical acumen." This is somewhat strange, considering that he not only came of an artistic family, but was also possessed of considerable skill as a draughtsman, which, however, he seldom employed, preferring to entrust his illustrations to a highly gifted sister. He was certainly an indifferent judge of figures in the works of other authors, and his remarks on the affinities of shells only known to him through these are often surprisingly infelicitous, not only in this paper, but also in the *Ampullaria* section of his later work for the "Biologia Centrali-Americana." Yet, with all defects, the paper in the "Malakozoologische Blätter" is most interesting and valuable, more especially as a supplement to the monograph of Philippi, since both authors worked upon the same material in the Berlin Museum collection.

A small volume entitled "Essai sur les Mollusques Terrestres et Fluviales de la Guyane Française" was published at Paris in 1859. The author was Henri Drouet. It contained several excellent (uncoloured) plates, and the letterpress gave a good deal of interesting information about the shells of our genus, which, of course, is richly represented in the Guianas.

In the third part of "Mollusques nouveaux litigieux ou peu connus," published in 1863, Bourguignat gave an account of the Egyptian *Ampullariae*. It was naturally rather tentative, and several shells now known as varieties of the common *A. ovata* were made into separate species. A few excellent illustrations (uncoloured) accompanied the text.

Von Marten's admirable essay on the inland Mollusca of Venezuela (" Binnenmollusken Venezuelas" 1873) contained a copious and interesting notice of the *Ampullariae* belonging to that fauna, and another valuable contribution to the literature was produced in the same year by Strebel and Pfeffer (Beitrag zur Kenntniss der Fauna mexikanischer Land and Süßwasser-Conchylien "-which portentous title is commonly abbreviated to " Strebel's Beitrag. ") Pfeffer did the anatomical work, and the conchological department was Strebel's. This very acute and judicious naturalist fulfilled his task to admiration. His personal experience was, unfortunately, limited, for his *Ampullaria* hunts were mostly confined to the neighbourhood of Vera Cruz, but his observations, so far as they go, are extremely sound. Being a capital draughtsman, he also contributed two plates of *Ampullariae*, one showing the animal, eggs, etc., and the other a series of outlines lightly filled in to illustrate the forms of that most difficult species, *A. malleata* Jonas (= *flagellata* Say).

Morelet, in his "Séries Conchylioliques," and especially in the fourth part, published in 1875, discussed several species of this genus, on which, as on all land and freshwater shells, he was a commanding authority. In the next year appeared Hanley and Theobald's " Conchologia Indica." This bulky work, chiefly made up of coloured plates, with brief annotations for letterpress, has since been given a continuation by Lieut.-Col. Godwin Austen. There are three plates of unequal merit dealing with *Ampullaria*. Some of the figures are excellent, but on the whole they do not show Sowerby's draughtsmanship at its best, and one or two of the identifications look questionable.

In 1877 Geoffrey Nevill published his "Catalogue of Mollusca in the Calcutta Museum." This was followed by his " Hand List" of the same collection, published in two parts (1878 and 1884). These works contain many notices of the *Ampullariae*, which are fully annotated in the second part of the " Hand List." The Calcutta Museum was apparently not well off for American species, but Nevill's remarks on those of the Indian region are most serviceable. The African species again engaged the attention of Bourguignat in 1879, when he produced his "Mollusques d' Egypte, Abyssinie, Zanzibar," etc. Only a dozen were described, and indeed this section of the genus is still in much need of research. It must, almost certainly, be richer than any author has yet shown it to be. A praiseworthy attempt to exploit it was made in 1885 by René Billotte, who contributed an important paper on African *Ampullariae* to the second volume of the " Bulletins de la Société Malacologique de France." Several novelties, mostly found by Revoil in Somaliland, were described, and one or two figures were given. A fresh list was also given of African species amounting to nineteen. In this list Reeve's mistake as to the habitat of his *erythrostroma* is copied, an error which has proved itself exceedingly tenacious of life, since it was even repeated by von Martens at so recent a date as 1897. Bourguignat unconsciously helped to keep it alive, for in his third attempt to catalogue the African species (" Mollusques de l' Afrique Équator-iale," 1889) Reeve's *erythrostroma* again finds a place among the twenty-two species then enumerated. It must further be added that some of the new species of Bourguignat and Billotte have not found general acceptance. Each, however, has had the honour of making a fine addition to the permanent list, Bourguignat having described *A.*

Letourneuxi, while Billotte introduced one of the most splendid of all *Ampullariae* in *A. Charmesiana*.

Von Marten's admirable "Beschalte Weichthiere Deutsch-Ost-Afrikas," published in 1897, gives a full account of the *Ampullariae* concerned, with very precise localities. One or two important varieties are noted and figured in the text; the plates, which are excellent, contain nothing relating to our genus save only a sketch of the living *A. gordonii* in its shell.

The last nineteenth century works that we have to notice are both very important. One was due to public, the other to private enterprise. The results of the French scientific expedition to Mexico and Central America were published by order of the Government, and the molluscan portion was entrusted to M. M. Crosse and Fischer. Their work was begun in 1870 and was not completed until 1902. It is therefore rather difficult to put this colossal work in its strict chronological place, but the part containing

the *Ampullaria* section (which extends from p. 218 to p. 252 incl. of the second volume) seems to have been issued in 1890. Three of the four plates devoted to the shells had appeared with the previous part in 1888. These plates are exquisitely lithographed and coloured, in the very best style of French zoological art. More than that cannot be said. Several new forms described in the "Journal de Conchyliologie" are here figured to perfection, and much light is thrown on obscure and doubtful species mentioned by

previous authors. The letterpress is, as might be expected, a model of its kind, and the whole work forms a classic in the history of land and fresh-water Mollusca.

Godman and Salvin's monumental "Biologia Centrali-Americana" contained a volume on the land and freshwater Mollusca of the region, then being dealt with by Fischer and Crosse. This work, like its bulkier companion, progressed very slowly, and occupied von Martens, who then held an important post at the Berlin Museum from 1890 to 1901. The parts containing the *Ampullariae* were published in August and September, 1899. The shells are illustrated on three plates, which are perhaps the least admirable part of the work, so far as it concerns our genus. They are rather crudely and thinly coloured, and the drawing, though generally good, is not altogether above reproach. Von Martens' descriptions are excellently done, though it may be that he has not always rightly identified the species of Reeve and other authors. But his work, in conjunction with those of Fischer and Crosse and Strebel, is invaluable to a student of this particular fauna. Rarely indeed can the shells of any one region have been dealt with by four such distinguished specialists.

In the present century we have to record an elaborate paper by G. B. Sowerby (third of the name), published in three instalments in Vols. VIII., IX., and XII. of the Proceedings of the Malacological Society of London. These notes introduced several new species, and Sowerby had previously described three *Ampullaria* novelties in the same publication. The first section dated 1908, deals with Western forms, those from the Eastern regions followed in 1909, and the last paper printed in 1916, contains an account of the sinistral Ampullarioid genus *Lanistes*.

Sowerby's great practical experience of shells enabled him to take a very comprehensive view of the large material he had at hand, chiefly from the collection of S. I. Da Costa. The new species introduced were all illustrated by figures in the text.

A very useful aid to the study of the Eastern forms will be found in Preston's volume on the Mollusca in the "Fauna of British India" series. This was published in 1915. As regards the *Ampullariae* it is not quite up-to-date, Reeve's *A. dolioides* being still localised at Bombay, as in the "Conchologia Iconica," but apart from this one slip, the work is exceedingly serviceable, more especially when used in conjunction with the "Conchologia Indica," whose rather meagre notices of shells it expands and supplements.

From time to time various new species have been described, and, for the most part, figured in the "Journal de Conchyliologie" by Crosse, Hidalgo, Mousson and others. These novelties, when obtainable, I have endeavoured to illustrate in my plates, but some of them seem never to have found their way to England, and, as things are at present, the arrival of fresh specimens is unlikely. One may conclude with the hope that this genus may some day engage the attention of Dr. Pilsbry and that he will do for it what he has already so brilliantly done for the terrestrial mollusca.

INTRODUCTION

THE genus which we propose to consider as a whole under Lamarck's name *Ampullaria*, contains the largest of the fresh-water *Gastropoda*, and is very rich in species. It inhabits the lakes, rivers and marshes of Asia, Africa, and America, but is not found far outside the limits of the tropics in those continents.

The present work being purely conchological, we are not concerned with the habits and anatomy of the animals, which indeed have lately become familiar to the London public, at any rate, through the exhibition of living specimens at the Zoological Gardens. It will suffice, therefore, merely to mention the well-known facts that these snails can breathe either in or out of water; that they bury themselves for long periods in mud when their haunts become dry through drought or other causes; that, unlike some freshwater mollusca (our own *Limnea*, for instance), they exhibit separate sexes, and that the females lay eggs, often very brightly coloured, on the stalks of rushes, etc., just out of the water. For the most part they prefer stagnant streams or pools, but a few species have been found at elevations in the mountains which almost preclude the possibility of still water. They are generally very sluggish, and are much sought after by aquatic birds, more especially the cranes and rails, and in many places they are eaten with relish by the natives.

The shells, though often large and attractive, have not been very popular with collectors. One reason is, perhaps, that they are difficult to get in good condition. The great rivers and swamps from which they come, are full of perils for such frail structures-rapids, floating logs, voracious birds, and the pursuit of savages, who not only eat the indwelling animals, but use the shells for a variety of purposes not compatible with cabinet condition. Thus Bates informs us that the South American Indians employ the larger *Ampullariae* as receivers to catch the juice that trickles from wounded rubber trees; and I have seen specimens which seemed to show the marks of this practice.

But another and more potent drawback to the collecting of "Apple Snails" is the difficulty of identification. This is a large genus, and the species are not only extremely variable, but apt to change very much in successive stages of their growth. Consequently, even in a small collection of these shells, one may generally find several whose identification must be a mere matter of personal opinion. The general collector, who naturally likes to have his treasures correctly named, does not care for specimens which cannot safely be described as "new," nor yet referred to any established designation. *Ampullaria* abounds in these waifs of the cabinet. Some, in the present state of our knowledge, are perfectly hopeless, but the affinities of puzzling specimens may often be discovered by patient attention to detail. The main purpose of this Introduction is to suggest considerations by which these may be traced.

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In the examination of an unfamiliar *Ampullaria* the first thing to be noticed is the operculum. This, though seldom characteristic enough to indicate the species, gives an unfailing clue to the shell's origin. If the appendage be horny, the specimen has come from some part of America, or from the adjacent islands; while a thick calcareous operculum shows that the animal which formed it lived in either Asia or Africa, those terms, as before, including the groups of islands belonging to each continent, in the sense that they contain a similar fauna.*

This broad division between Eastern and Western *Ampullariae* was established by Philippi, and we are now able to improve upon it a little, to the extent of formulating a rough distinction between Asiatic and African opercula, thus sub-dividing the Eastern

series. Whereas the operculum of an Asiatic species is generally thicker in the middle than at the edges, and rather strongly concave on its outer surface, the African type is thinner, flatter, not so sharp at the edges, and of fairly uniform thickness. The differences are not easy to express in words, but they are, as a rule, readily detected in actual specimens.

If, therefore, we have a complete specimen before us, we can at least say, with a certain amount of confidence, that it comes from Asia, Africa, or America, as the case may be. Unfortunately many of the *Ampullariae* in collections are not perfect in this respect. They may be either without opercula or provided with wrong ones. A wrong operculum is usually recognisable at once, for it lacks the close and intimate fit always found in nature, whether the point of contact be actually at the lip of the shell, or, as is sometimes the case, at a certain distance up the interior of the aperture. But, if there be no operculum, or if we are forced to disregard an obvious substitute, the line of the lip, viewed *sideways*, will generally help us to a conclusion. If, on a side view, the lip has a wavy outline, the shell is most likely that of a Western species. But the stiff, unyielding operculum of the Eastern forms requires a straighter and stronger growth in the shell, which not infrequently develops a thickened or grooved lip for its reception, and even in those species which accommodate it higher up in their interior, the external edge will be found to present an almost rigid line.

When the origin of our specimen is determined we have gained a step towards its identification. We can look up in books or Museums the *Ampullariae* of that part of the world with a reasonable chance of finding the right name for it. But there is a strong family likeness among the species—perhaps 150 in number—which constitute the genus; their colours are mostly sombre and much alike in nearly all, and finally they are variable to an extent only known in fresh-water shells, which far surpass the marine or terrestrial kinds in this respect. In the face of this general resemblance, our problem is to recognise the slight and subtle characters which separate the species, and which are least affected by the tendency to variation.

Among these Protean shells one rarely finds an absolutely typical specimen, and perhaps the first thing to be borne in mind by the student is that he should look rather for an association of characters than for any special feature. Of specimens that are

One or two small American species belonging to the sub-genus *Asolene* D'Orbigny, have their horny opercula lined with calcareous substance. The animals are also anatomically different from those of *Ampullaria* proper. The present work is concerned only with the main genus exclusive of *Ceratodes* and *Asolene*.

exactly " according to the book," we shall, perhaps, on an average, find one in twenty. But, infinitely variable as they are, many of the species have a certain individuality, which is more or less evident under all disguises. No other genus of shells more urgently demands the cultivation of an "eye." The student who sees and handles *Ampullariae* daily, learns to note individual subtleties of line, which can hardly be expressed in a figure, and not at all in a description.

Scanty and bad material, together with too rigid a faith in certain characteristics of the shell are chiefly responsible for many of the superfluous species with which the older authorities burdened the genus. Larger series of specimens and a wider acquaintance with the life history of the animals and with the influences that affect it, have shown that some of these species are simple varieties, others immature shells, a few, perhaps, abnormal forms or monstrosities.

The shell characters once regarded as of specific importance were generally

(1) *The umbilicus*. This, though still recognised as important, is now known to be by no means an infallible distinction. One species, named by Philippi *impervia*, because his specimen had no visible perforation, has now become fairly common, and Sowerby states that it is "more often umbilicated than not." Other species might be cited to the same effect, and it should further be noted that the umbilicus, being merely the underside of a coil whose upper surface forms the top of the body whorl, the flatness or convexity of the latter part is just as liable to variation. Shells which have the umbilicus virtually closed, e.g. *A. conica* will, as a rule, be rounded off gradually above; those in which it is large and has a definite edge will have a flat or even channelled surface next the spire, as may be seen in *A. speciosa*. Either set of conditions may occur in different individuals of the same species, so that we cannot regard the presence or absence of the umbilicus, nor yet the flattening or convexity at the suture, as proof positive of specific distinction.

(2) *Malleation*. It is rather surprising that the older authors should have attached so much importance to this character. Philippi at least, very early in his book (*vide* under Species I. in the Monograph of *Ampullaria*) noticed that it was often found on one side, and not on the other, of the same shell. Reeve too, has figured malleated and unmalleated examples of the same species (*vide* *A. Layardi* in the " Conchologia Iconica "). Malleation is merely an incident of the shell's growth, due to external conditions.

(3) *Height of the spire*. This character, apparently much valued by Philippi, is of no practical service whatever. To prove its uselessness, one need only examine a fair series of some well-marked species whose identity cannot be mistaken. such as *A. urceus* or *A. polita*. The reader may refer to my figures of these for confirmation of the above statement.

It is now known that the variations comprised under this heading and the one before are largely due to the properties of the water in which the shells are found. This may be seen in our own *Limnaeae*, which are sometimes quite smooth, sometimes latticed and pitted, high-spined or short, wide-mouthed or contracted. In *Ampullaria* the colour of the epidermis may be affected (cf. my figures of *A. guyanensis* on Plates III. and IV., which display a wide range of colour and texture, possibly due to this cause). But the alterations effected in the shape and sculpture of the shell itself are the most important,

and there can no longer be any doubt that these, especially the malleation, are in great measure due to the composition of the water in which the animal lived. Hence the extraordinary variability of fresh-water shells as compared with those of the sea. Some marine shells, e.g. *Conus magus* are as variable as any *Ampullaria*, but in a different way. In them the mutations—chiefly affecting the colours and marking—are due to what we may call, for want of a better name, the caprice of the animal, which seems to be capable, within limits, of introducing changes in the pattern of its shell. But the *Ampullariae* and other fresh-water shells, seem to owe their instability of form and colour to external influences from which the marine species are entirely free. Sea water, of course, varies considerably in temperature and in saltness, but the term connotes a far more uniform quality than can be expected to obtain in rivers, ditches, ponds, or marshes. These, owing to springs and tributaries, change of soil, discharges from buildings, factories or machinery on the banks etc., may change the nature of their liquid contents half-a-dozen times in the course of twenty miles. The *Ampullariae*, like others of their tribe, are sensitive to these chemical changes, and a species may produce stunted or elongated forms, forms malleated, smooth or granulated, according to the quality of its native water.

As far back as 1857 von Martens, in his review of the *Ampullariae* (*vide* 1. c. *A. melanocheila*) suggested the influences here indicated, but he did not see in them the possibilities unfolded by Hannibal's very clever and interesting paper in the Proceedings of the Malacological Society of London, Vol. X., p. 1 12. That author, as the result of careful experiments, suggests that the chemical agent chiefly responsible is magnesium salt, and he calls the result *syntonia*. The application of his theory to fresh-water shells explains very many of the puzzling variations, which, in the *Ampullariae*, have sometimes been taken for specific characters.

(4) *The banding*. For certain families of snails, notably for the *Orthalicines* and for certain *Helices*, band-formulae have been made and applied with interesting and valuable results, but I do not know of any author who has attempted to fit such to the *Ampullariae*, whose banding seems to be entirely capricious. It may possibly have a significance of its own, but, in the present state of our knowledge, we cannot find the clue to this. Attempts have occasionally been made, by von Martens and others, to lay down a regular scheme of banding for particular species, but the examination of a long series always seem to emphasise the hopelessness of the idea. A few *Ampullariae* are entirely without bands, but these exceptions to the general rule are so individual in other ways that the absence of such markings can hardly be said to assist their identification.

(5) *Formation of the lip*. By a process of exhaustion this is discovered to be the one fairly constant character among those cited by the earlier authorities on the genus. All the others are liable to changes induced, not only by the causes just mentioned, but by accidental injury. The almost helplessly inert life led by these snails, exposes the shell to endless chances of collision and fracture. One disfigurement, apparent in nearly all large specimens, seems to occur very soon—the early whorls of the spire, so important in such genera as *Bulimulus* and *Borus*, get ground down or broken off. We can hardly tell what their significance might be in full-grown *Ampullariae*. Then again, it is a well-known fact that when a living shell is cracked or broken, the next whorl to that in which

the fracture occurs is nearly always pinched and distorted. This may often be seen in *Orthalicus* or *Placostylus*. In *Ampullaria* it is almost chronic among the big, heavy shells. If the reader will look at my figures of *A. insularum* (Plate V.) he will see that most of the examples are heavily scarred, and that there is a most edifying display of variety in contour and proportion.

The moral is that we can hardly hope to find the external aspect of these shells particularly constant. The only parts that are likely to preserve an unblemished pattern of colour and design are those actually in contact with the animal, and buttressed from within by its muscular, if soft, personality. (Bates, who, while he was among the Amazonian savages, tried a diet of these snails, complains that they were very tough). We are thus brought to consider with special attention the contour of the lip and the inside of the mouth. The latter, constantly in contact with the animal, will keep its colour and markings fresh and clear; these are often very characteristic of the species, and, though it is known that they are sometimes overlaid by successive layers of enamel as the shell advances in age, the general scheme of the design is seldom entirely lost.

In some cases they form a better clue to identity than anything else about the shell. and it is a pity that in many excellent figures of *Ampullaria* these important markings are concealed by the operculum represented in *situ*. The contour of the lip is another good character. Here, supported from within, and reinforced by the operculum, the shape will have been preserved while the earlier whorls left vacant by the animal's progress down the shell, have perhaps been knocked and worn quite out of their original likeness.

This attempt to assess the value of the shell-characters usually employed may be concluded by a brief notice of certain forms, which, not being fully appreciated by the older conchologists, have undoubtedly helped to augment the tale of doubtful species.

(a) *Immature forms.* — These may generally be known by the thinness of the shell, the disproportionately wide aperture, and the denser banding. They may also possess some kind of sculpture, which tends to disappear with the growth of the shell, but which, while it lasts, is apt to mislead the investigator, (cf. Morelet's notice of *A. turbinis*. *Séries Conch.* IV. p. 289). As a rule, undeveloped *Ampullariae*, unless taken in company with fully characterised adults, are beyond hope of identification. It would appear that Philippi has described several such as distinct species—e.g. his *A. cingulata* and *A. exigua*.

(b) *Hybrid forms.* These, though very rare, do undoubtedly occur among the mollusca. Morelet mentions the case of a large *Achatina*, which, being introduced in a new locality, mated with another species of the same genus, the offspring having a shell which partook of the colours and markings possessed by each of the parents. And one of the most profound of modern conchologists, Hermann Strebel, in his Revision of the *Orthalicines*, has indicated that certain of the forms figured therein are possibly hybrids. I have long been inclined to suspect that the same explanation may apply to the more puzzling manifestations of *Ampullaria*, e.g. the shell figured at f. I of my Plate III.

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(c) *Sexual forms.* Reeve says very little about the inhabitants of these shells, but Philippi, in the course of an elaborate Introduction, mentions the fact that the sexes are separate. It is a well-known fact that in the allied genus *Paludina*, the sex of the animal has a marked effect on the shape of the shell. May not this be the case with *Ampullaria* also?

A study of large series in this genus shows that most of the common kinds, whose abundance provides a fair test, occur in two forms, roughly, globose with short spire, and ovate, with this feature more produced. Among the rarer species it is not so easy to institute comparisons, yet even with some of these (*A. lymneaeformis* and *A. papyracea*, for example), I have found specimens tending to confirm the view that two distinct forms, possibly representing the two sexes, are the rule.

Of course this view of the case is, and must be, until we have much more detailed knowledge, purely hypothetical, but meanwhile, whenever any *Ampullaria* was available in what appeared to me to be its two forms, I have tried to represent them both. The reader will understand that the ascription in the text of the more elongated forms to the male, and of those which are more globose and compressed to the female, is nothing more than the illustration of a theory, which is at present incapable of proof.

Genus AMPULLARIA, Lamarck Western species, with horny operculum

THE extreme points in this series, which contains the largest quota of species, seem to be marked on the one hand by the shells of the glauca group, discoid and widely umbilicated, with a strong likeness to the allied genus *Ceratodes* Guilding, and on the other by those which Dall has assembled under the name *Limnopomus*. The latter are thick, almost imperforate and *Littorina*-like, in this respect finding their counterpart in the African fresh-water shells-also allied to *Ampullaria*-which Grandidier has named *Leroya*, and of which that author has remarked that, except for being sinistral, they

are so like *Littorina* that " he who has seen one has seen the other."

These affinities are perhaps only superficial, but they help us to realise the limits of our genus, and to comprehend at the outset that the variety of conchological forms which can connect such remote extremes must indeed be very great. These forms also vary individually to a remarkable extent, and few, even among the *Ampullariae*, show a wider range of shape and colour than the species which occupies the whole of our first plate.

AMPULLARIA GLAUCA, Linne'
Plate I. (all figures) and Plate II, fig. i

Helix glauca, Linné, *Syst. nat.*, ed. X., p. 771, no. 594, and ed. XII., p. 1245 *Mus. Lud. Ulr.*, p. 667, no. 369. *Nerita effusa*, Müller, *Hist. Verm.*, p. 175 (in part); *Helix effusa*, Chemnitz *Conch.*, Cab. IX., p. 118, pl. 129, ff. 1144, 1145; *Ampullaria effusa*, Lamarck, *Anim. s. Vert.*, ed. I., Vol. VI., p. 178, and ed. II., Vol. VIII., p. 534; Swainson, *Zoological Illustrations*, Series I., Vol. III., pl. 157; Drouet, *Moll. Guyan*, p. 78; *Ampullaria glauca*, Philippi, *Monograph on Ampullaria in Chemnitz*, ed. nov., P. 43, Pl. 12, f. 4; Reeve, *Conchologia Iconica*, *Monograph on Ampullaria*, f. 85; Martens, *Mal. Blätt*, IV., p. 199 (also *Guadelupensis*, Martens, 1. C.); Martens, *Binnenmollusken Venez.*, no. 62; Sowerby, *Proc. Mal. Soc. Lond.*, VIII., p. 350. Also figured by Lister, *Conch.*, pl. 129, fig. 29; Seba, *Mus.* 3, pl. 40, ff. 3-5; Knorr, *Deliciae*, etc., pt. 5, pl. 5, f. 3; Philippi *Ampullaria*, p. 12, f. I (as *A. castanea* Desh); and Reeve, *Ampullaria*, f. 83 (as *A. Cubensis*, Reeve).

Vide also Hanley's *Ipsa Linnaei Conchylia*, p. 369.

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Though not, perhaps, one of the commonest species, this is very widely distributed, ranging from Bolivia (Thorey) to Trinidad. It is found in nearly all South American collections, and was known to many of the early conchologists, being figured by Lister and Seba. It formed a part of Müller's composite *Nerita effusa*, and was described by Lamarck and Swainson under the same specific name as an *Ampullaria*. But the Linnean name, though not particularly appropriate, is that which rightly belongs to it. Specimens with the lip "effused" (as in our fig. 9 of Pl. I) are sometimes seen in collections under the Müllerian name, which, however, may have been intended to bear a quite different significance, as explained under *A. geveana*, which was the shell Müller had principally under consideration.

Our figures show great variety of shape, and colour. In the former respect the spire of the shell deserves attention. It will be noticed that there are two principal types—prominent, as in ff. 9, 10, I I, 12 of Pl. I., and in f. I of Pl. II.; depressed, as in all the others. The difference may possibly be sexual, and the wider, flatter shells with low spires those of female *Ampullariae*.

Colour and marking show an even wider range of variation, so bewildering that several authors, as G. B. Sowerby iii. and E. A. Smith, have preferred to consider *A. glauca* and four or five others of the same group as varieties or local forms of one species. Examination of a large number of shells leaves me with the impression that this is not feasible. The differences, though slight, are yet individual and constant. They may be tabulated as follows

A. glauca. Bands broad, often not very sharply defined at the edges, and sometimes entirely wanting, their colour generally red-brown, and nearly always with a red tinge. Lip erect or effused, sometimes slightly reflexed, but always acute, not thickened.

A. luteostoma. Bands thin and few in number, blacker than in *A. glauca*, always sharply defined, and never wholly obsolete. Lip, when not reflexed, always slightly thickened.

A. prunulum. A doubtful species. Possibly a small, pale form of the foregoing. Nearly always one band present, as noted by Reeve, but thin and feebly marked.

A. geveana. Umbilicus, much wider than in any other species of the group. Lip always red, somewhat thickened. Epidermis absent, showing the spiral bands in two or three distinct shades of colour on a white ground.

A. oronocensis. Generally larger and more globose than any of the foregoing. Belted with broad and definite blackish bands on green of a characteristic shade not found in any other species or variety of this group.

The forms of *A. glauca* figured in this work have been carefully chosen so as to represent as wide a range of variation as possible. They are as follows

PLATE I.

FIG. I. A rather scarce form, in which the bands of a livid chestnut are so extensively developed as to leave only the sutural ledges, the umbilical region, and three narrow belts; at the upper edge and periphery of the body whorl and above the umbilicus respectively. These are straw-yellow in colour. Interior of the aperture similar

but paler, only the uppermost belt showing here. Columellar margin pale orange. A white callus at the insertion of the outer lip.

Martens (Binnen. Venez.) specially mentions this variety, but does not localise it particularly. I believe the specimen figured came from Venezuela.

FIG. 2. Richly marked with broad brown bands, leaving vivid yellow intervals. Marking almost as definite in the aperture, which is tinged in the depths with reddish.

FIG. 3. A very pretty form densely banded with purplish chestnut. Intervals bright mustard-yellow. Umbilical region and interior of aperture reddish orange, the bands clearly marked inside. Lip pale orange with a broad colourless edge, and heavily marked with square dark spots at the ends of the bands.

FIG. 4. Dark olive, richly banded within and without; mouth and columellar margin orange-yellow. Probably the form figured *ex errore* by Philippi, pl. 12, f. I, as *A. castanea* Deshayes.

FIG. 5. Of all the forms figured this is the most individual, and it may perhaps merit specific distinction. Martens, who ascribed the figure of *A. castanea*, Desh. just quoted from Philippi, to *A. oronocensis*, has given a description of the former (Binnenmollusken Venez., p. 203), which appears to agree very nearly with this peculiar shell. I possess but two specimens, both, however, strikingly different from the general aspect of *A. glauca*.

The shape is much wider and flatter, the outer margin of the lip is considerably produced below, and the umbilicus is very wide. The general colour is a kind of coppery brown, with one or two rather vague and irregular greenish bands. The peristome is pale orange, the bands of the interior are only indicated at the margin, and then in a very peculiar fashion, as shown in the figure.

My specimens are without locality. Martens gives Puerto Cabello and the Orinoco (Gruner) and the upper Pomeroon in British Guiana (Schomburgk).

To this species-if, indeed, it be distinct-I am inclined to attribute two large and magnificently coloured specimens from Guiana, in the Students' series of *Ampullaria* at the British Museum, and there ascribed to *A. glauca*. In these the general colour is reddish, and the aperture of a most vivid orange.

FIG. 6. Dark olive, obscurely banded, spire reddish. Aperture clouded with a livid reddish colour, lip vivid yellow.

A peculiar form, which might be ascribed to *A. luteostoma*, only that the vague banding and the perfectly erect and acute lip are characteristic of *glauca*.

It should be mentioned that in our figure the lip, owing to its brilliant colour, seems to stand out unduly, and might be supposed, by anyone who had not seen the actual shell, to be thickened.

FIG. 7. Pale olive with unusually heavy bands of dark chestnut, some of which are confluent. Interior of aperture and columellar margin pale orange yellow, bands showing rather indistinctly, except near the lip. Labelled "*A. dubia*, Demerara," and agrees with Guilding's shell of that name, and with the figure in Knight's Museum of Animated Nature. But Guilding's description, as quoted by Philippi (*Ampullaria*, p. 67, no. 94) from the *Zoological Journal*, Vol. III., p. 359, is vague and inadequate, and cannot be held to establish a specific form. I have not, therefore, ventured to cite it in the synonymy of our species.

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FIG. 8. An uncoated shell, broadly banded with livid brown. Interior of aperture and columellar margin faintly tinged with yellowish. No trace of epidermis, not even near the lip.

FIG. 9. Probably an immature shell, olive yellow, very regularly banded with red-brown, within and without. Interior of aperture pale yellow, lip very broadly effused. Trinidad.

FIG. 10. Olive yellow, with vague traces of broad reddish bands. Aperture vividly stained with orange-red. Very near *A. luteostoma* in some respects, but the banding, so far as it can be made out, is decidedly that of *glauca*. Trinidad.

FIG. 11. A rather curious form with high spire ; whorls a good deal flattened at the top. Back of the shell olive yellow, with a few traces near the umbilicus of broad reddish bands. Colouring much obscured on the spire and front by blackish stains, probably caused by crushed water-plants. Interior pale yellow, peristome and columellar margin broadly orange, parietal callus blackish.

FIG. 12. Perhaps the most typical specimen figured here. Spire high and conical. General colour reddish olive, broadly banded with red-brown. Interior pale yellow, the bands showing very distinctly in a purple shade. Peristome and columellar margin orange, the former with a colourless edge, on which the ends of the bands are marked by square spots of dark brown.

PLATE II.

FIG. I. A small but apparently adult specimen, high-spined, and very dark in colour, the back of the shell being almost uniformly blackish. A strong light reveals a chestnut tinge here and there, especially in the spire, and traces of bands, which are most apparent in the front near the aperture. Interior greenish yellow with coppery gleams, and broad, irregular dark bands. Columellar margin lemon yellow. Labelled "Demerara."

A. glauca has been recorded from Bolivia (Thorey in Philippi), Venezuela, Cayenne (Drouet), Trinidad (E. A. Smith). Drouet states that it is rare near Cayenne, and of rather small size; larger and more common at Paramaribo in Dutch Guiana. A small form, of which I possess specimens, appears to occur at Caracas, but on the other hand my largest specimens are from Venezuela.

I have not seen a specimen of Hupé's *A. physis* from the Amazon, but, according to the figure (Castelnau expedition, Mollusca, pl. XII., fig. 2), this may be a brightly-coloured variety of *A. glauca*.

Reeve has figured as separate species two forms, *A. cuprina* (Conch. Ic., fig. I) and *A. cubensis* (fig. 83), which G. B. Sowerby iii. has assigned as varieties to *A. glauca*. This judgment is probably correct as regards the latter, but Pfeiffer, in his excursus

on the *Ampullariae* of Cuba (Novitates Conch., Vol. I., p. 49), does not include our species, nor does Morelet in his *Testacea novissima Insulae Cubanae*. Reeve's locality for *A. cubensis*, from which, of course, the name is derived, may be a mistake. As for *A. cuprina*, for which no locality is given, I am fairly certain that it is an immature specimen of Reeve's *A. lymnaeaeformis* from the Marañon River, a Peruvian branch of the Upper Amazon. I have an old and discoloured specimen of this shell, which is actually labelled "*cuprina*."

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A. GEVEANA, Desh. emend. Phil.

Plate II. fig. 2 (wrongly spelt GEEVEANA in the lettering)

Ampullaria Gevesensis. Deshayes in Lam. hist. nat., ed. 2, Vol. VIII., p. 541, no. 12; *Ampullaria Geveana*, Philippi, Mon. Amp., p. 26, no. 34, pl. 7, f. z; Martens, Mal. Blätt., IV., p. 199; *A. Geveanensis*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 350 (as variety of *glauca*).

Geve Belust., t. 3, f. 20, a, b.

Nerita effusa (in part), Müller, Hist. Verm., p. 175.

Helix effusa (in part), Chemnitz, Conch. Cab., IX., 2, p. 118, ff. 1144, 1145.

Most of the varieties of Müller's *Nerita effusa* appear to belong to this shell. Deshayes obviously intended to commemorate the author who first figured it, but, being unfamiliar with Geve's name, gave the form *Gevesensis*, which was corrected by Philippi. The mistake which appears on my plate was discovered too late for alteration.

The name given by Müller probably refers to the loose way in which the shell is rolled up, whereby is produced the singularly wide umbilicus which is the most characteristic feature of *geveana*. Another peculiarity of this shell is that it seems to be always uncoated. Philippi attributes to it "the usual olive-brown epidermis," but his figure does not show anything of the sort, and the wording of the description suggests that this feature was inferred rather than seen. If the shell ever possesses an epidermis, this must be of an extremely deciduous character so as to be lost very early, but I have never found any distinct trace of it.

This species has a very distinctive appearance, and is among the most easily recognised *Ampullariae*. The absence of epidermis leaves the shell almost white, except in the umbilical region, which is buff. On the pale ground the banding shows up prettily; it is very decided, and the broader belts sometimes show three distinct shades of colour-lilac, ashy-brown and chestnut-as in the specimen figured. The lip, which is slightly thickened, is dark red, often very brilliant. The interior of the aperture is enamelled white, the bands showing more or less plainly.

Martens did not know the precise locality of this species. Sowerby gives Cayenne.

A. LUTEOSTOMA, Swainson

Plate II. figs. 3, 4, 5

Ampullaria luteostoma, Swainson, Zool. Ill., 1st series, Vol. III., pl. 157; Philippi, Mon. Amp., p. 42, no. 56, pl. 12, f. 2; Hanley, Conch. Misc. Ampull., pl. IV., f. 18 (not 17 as in letterpress); Reeve, Conch. Icon. *Ampullaria*, f. 84; Martens, Mal. Blätt., IV.,

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p. 198; Drouet, Moll. Guy. Fran., p. 79; Martens, Binn. Venez. in Festschr. Nat. Fr., Berlin, p. 203, pl. 1, ff. 20, b, c.; Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 350 (as variety of *glauca*).

Also, as *Ampullaria guyanensis*, Lam. (*ex errore*) in Guérin, *Iconograph. regn. an. moll.*, pl. 13, f. 5; as *A. pachystoma*, Philippi, in Zeitschr. f. Malak., 1849, p. 17, and Mon. Amp., p. 44, no. 59, pl. 12, f. 5; and as *A. balteata*, Philippi, Mon. Amp. 1. C., p. 27, no. 25, pl. 5, f. 7; and pl. 17, f. 4. Perhaps=*A. crocostoma*, Philippi, 1. c., p. 42, no. 57, pl. 12, f. 3.

In several particulars this species differs constantly from *A. glauca*, than which it is much less variable. The epidermis is smoother, thinner and lighter in colour, and the banding is more sparse and definite. The general hue is a pale greenish yellow, only slightly darker in an occasional specimen. The bands are always comparatively narrow and dark, and are never wholly absent, the lowest being clearly marked in the mouth or on the lip if not elsewhere. The lip, when not reflexed, is slightly thickened,

but is generally turned boldly over so as to produce a bell-mouthed appearance, and it is sometimes more inclined to pink than to the yellow or orange from which the shell derives its specific name. Hence the traveller, Carl Appun, who met with this variety at Puerto Cabello, Venezuela, alludes to it in his book, "Unter den Tropen," as *A. rhodostoma*. Other recorded localities are Caripe and Caracas in Venezuela, Cayenne and Martinique, the last according to Drouet, who notes that in the island specially fine examples are to be found. I have not seen any Antillean specimens, and in fact some doubt has been cast upon Drouet's localities (v. Pilsbry and Tryon's Manual of Conchology, 2nd series, Vol. XI., p. 39). Martens, however, records a specimen in the Berlin Museum with the locality Guadeloupe.

The specimens figured here are as follows

PL. I I., F. 3. A small, rather dark example, with widely expanded lip, representing Philippi's *pachystoma*. Two thin, dark bands, one of them double, near the umbilicus, their terminations showing distinctly on the lip. Interior pale orange-brown, Venezuela.

PL. II., F. 4. A large light-coloured specimen, representing Philippi's *balteata*. Two thin bands, below the periphery and above the umbilicus respectively, distinctly shown in the interior, which is brownish white. Lip bright orange-yellow. Parietal callus blackish. Probably, from its shape and prominent spire, a male specimen.

PL. I I., F. 5. An unusually large shell of a clear greenish yellow colour, profusely marked with black smears, which are distinctly visible under the bluish parietal callus. One dark band above the umbilicus, complete and distinct within and without; two others indicated near the lip, which is widely reflexed. Several varices, marking the

sites of former lips. Peristome and interior livid buff, inclining to reddish in the depths of the shell.

The eggs of this species are said by Appun to be of a light blue-green colour.

A. CROCOSTOMA, Philippi
Plate II. fig. 6

Ampullaria crocostoma, Philippi, Mon. Amp., p. 42, no. 57, pl. 12, f. 3 ; Martens, Malak. Blätt., IV., p. 197; Binnenmoll. Venez., p. 203 (as variety of *luteostoma*).

With some misgiving I have figured a specimen, which, if it be not Philippi's *crocostoma*, is at least unlike any other that I have seen. It is an old and massive shell, largely uncoated on the back, and may be simply an overgrown *glauca*, with which its reddish banding and squarely spotted lip agree well. The upper angle of the mouth is so much produced as to be almost on a level with the top of the body-whorl, and the excavated suture, which is the cause of this, as well as the general shape of the aperture a trifle too acute below in our figure—are those of Philippi's species. The epidermis, where it remains, is of a horny olive colour, the lip and columellar margin bright orange. The bands show faintly purple inside. The very wide umbilicus goes almost right through the shell to the apex of the spire.

Martens seems at first to have regarded *crocostoma* as distinct, but he afterwards reduced it to a variety of *luteostoma*.

The locality given by Philippi is Caracas ; Martens gives Puerto Cabello for specimens collected by Appun.

A. ORONOCENSIS, Ziegler Plate II. fig. 7

Ampullaria Oronocensis, Ziegler, Mus. Cuming (*fide* Reeve) ; Troschel in Schomburgk's Reisen Brit. Guian., Vol. III., p. 348; Reeve, Conch. Icon. *Ampullaria*, f. 45; Martens, Malak. Blätt., IV., p. 199; Binnenmoll. Venez., p. 204; *Oronocensis*, Reeve, as variety of *glauca*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 351.

This species was not figured by Philippi, though Martens at different times attributed to it that author's Pl. 12, f. 1 and Pl. 12, f. 2 in the Monograph of *Ampullaria*. Neither represents it in reality, the first, lettered *castanea*, Desh.—an allocation which Martens justly queried—being referable to a large and boldly-marked form of *glauca*, while fig. 2 evidently represents Swainson's *luteostoma*, as it professes to do. The only genuine figure of *oronocensis* with which I am acquainted is Reeve's no. 45 in the Conchologia Iconica monograph.

This shell is more uniform in size than others of the group. It is a large, globose form, well distinguished by its bold maroon or purple-black banding, its characteristic green epidermis of a peculiarly cool and pleasing shade, and by its lovely orange-red lip. This fine colour is liable to fade through exposure to the light, and those who are fortunate enough to possess good specimens should keep them carefully in the dark.

This is not a common species, and appears to be confined to the Orinoco and to

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the Upper Pomeroon River in British Guiana. According to Schomburgk, the animal prefers rapid, shallow woodland streams, thus differing from the majority of the genus, which favour stagnant creeks and pools in marshes. Troschel says that its anatomy approaches that of *Lanistes*, and the same authority states that old shells become uniform brown in colour. The animal is eaten with relish by the South American Indians.

I once saw a specimen of this shell in which the whole aperture was of a most vivid scarlet, without definite spots or bands. Behind the lip it is usually coffee-brown, as Troschel states.

A. PRUNULUM, Reeve Plate II, fig. 8

Ampullaria prunulum, Reeve, Conch. Icon. Amp. Mon., f. 82; *Ampullaria glauca* var. *prunulum*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 350.

A small species of simple character, possibly a local form of *luteostoma*. As a rule very pale in colour; the specimen here figured is unusually dark, perhaps through age; it is of a brownish yellow colour with several black smears, interior of aperture reddish grey, peristome pale orange. One faint band showing in the upper part of the mouth.

In most specimens one thin band, or at least a trace of the same, appears, as noted by Reeve, but the shell is sometimes uniform greenish yellow externally, without any marking at all. Reeve gives New Granada as locality. My specimens are marked "Colombia," a term which in Reeve's day covered the three separate states of Venezuela, Colombia and Ecuador. It is now restricted to the district indicated in the Conchologia Iconica.

A. TERES, Philippi
Plate II. figs. 9, I o, II

Ampullaria teres, Philippi, in Zeithschr. f. Malak., Feb. 1849, p. 19, and in Mon. Amp., p. 38, no. 57, pl. 10, f. 4; Pfeiffer, Novit. Conch., 1 p. 52 no. 86 pl. XIV. ff. 6-9 Pl. XV., ff. 1-6; Reeve Conch. Icon. Amp., f. 97. May possibly (*vide* Pfeiffer) be the same as Morelet's *Amp. Cubensis*, Testac. noviss. Ins. Cub. 1, p. 24, no. 61, 1849 (not *A. Cubensis*, Reeve, Conch. Icon. Amp., 1856).

This species, which Sowerby has ignored altogether, is one of the most difficult to identify with certainty, because (a) the authorities quoted seem to be entirely at

cross-purposes with regard to it (b) the figures of Philippi and Reeve are obviously drawn from immature specimens, and (c) those of Pfeiffer are very crude both in drawing and colour.

Some discrepancies in the diagnoses are

"Mouth-with very oblique axis," Philippi. "Mouth parallel to the axis," Pfeiffer.

"The lip is simple, the columellar margin very broad," Philippi.

"Columellar margin white, somewhat thickened," Pfeiffer. "Apertura marginibus incrassatis," Morelet.

"Spire occupies more than two-fifths of the total height," Philippi. "Spira producta," Morelet.

"Spire more or less produced, the height very variable," Pfeiffer. "Spire short," Reeve.

The last set of discrepancies may obviously be due to the ages of the shells examined, and in any case the height of the spire is not, as I shall often have occasion to show, of any great importance in *Ampullaria*.

The points on which the descriptions agree are the wide umbilicus, the deeply incised suture, and the general colour, which is somewhat peculiar. One of Philippi's figures-badly drawn and coloured-shows a banded interior, and herein Pfeiffer's figures agree, but Morelet describes his shell as "intus concolor." It is known, however, that *Ampullariae* sometimes deposit successive coatings of enamel, which obliterate or alter the interior marking; and Morelet's shell, which he describes as "crassa," was probably old. Philippi's figures, as observed by Pfeiffer, were obviously made from an immature individual, described as "testa tenui," and the same may be said of Reeve's figure, an excellent portrait of a small shell still in the British Museum collection. It would seem, therefore, that Pfeiffer's figures form our sole pictorial authority for the appearance of the adult shell. Unfortunately they are very indifferent, and the great German conchologist's excursus on the *Ampullariae* of Cuba-which is the patria of our species-is one of his least happy efforts. In it he has attempted to discriminate three species-Swainson's *reflexa*, Wood's *conica*, and finally, Philippi's *teres*. His ideal of *reflexa*, like those of Reeve and Philippi, is totally mistaken, as Crosse and Fischer have pointed out, and his *conica* cannot by any possibility be Wood's species.

It must be admitted that Pfeiffer had not much to go upon. When he was resident in Cuba and collecting there, very little had been published about the *Ampullariae*, and his only authority for *conica* was the figure in Gray's Supplement to the Index Testaceo

logicas of Wood, pl. 7, fig. 22. This figure is reduced and not at all characteristic-it might be almost anything. Reduced figures are not usually helpful, and in a genus like *Ampullaria*, where specific distinctions are often extremely subtle, they are well-nigh hopeless.

Hanley afterwards sought out Gray's type and gave an excellent figure of it in his Conchological Miscellany (*Ampullaria*, Pl. III., f. 13). It is evidently the well-known Eastern species, forms of which are figured by Reeve as *A. javanica*, *A. lubrica*, etc.

What, then, is Pfeiffer's *conica*? Considering that Cuba is very poor in species of this genus, I believe that all the shells figured on plates XIV. and XV. of the Novitates Conchologicae are forms of one extremely variable species. My own three figures, which, it will be noticed, present great superficial differences, may help to elucidate this theory.

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Pfeiffer's pl. XIV., f. I (*conica*) corresponds almost exactly with my pl. II., f. 1o; the same, except for the ground-colour, may be said of his pl. XV., f. I (*teres*) and my pl. II., f. II. My figure 9 is obviously a larger edition of the little shell figured by Reeve. All the shells from which my figures were drawn came from Cuba, and, unlike as they may appear at first glance, they have many points of resemblance. Chief among these is the long and slender columellar margin, naturally bent in the compressed form at fig. II (which I take to be a female shell), but elsewhere straight, and in all three accordant with Philippi's description in that it is longer than the inner lip proper. The whorls are flattened at the top-which is also *en règle* for *A. teres*-and the suture very deep. This, in fig. 11, effects a difference in shape at the top of the aperture, where the lip rises boldly from the insertion, before bending downwards. Pfeiffer says this is the mark of an old specimen; he seems to assume that the sutural channel becomes deeper as time goes on.

All three shells have a peculiar cast of colour, which I can only describe as clayey. Numbers 9 and II are brownish-yellow; no. 10 is paler and of a greener tint. They are all more or less distinctly banded, and the aperture in each has a decidedly purplish shade, and shows fairly definite bands. The lip has a definite colour-edging of its own yellow in 9 and 11, reddish in 10. I am inclined to regard this edging as distinctive. The only one precisely localised is no. 11, marked "Rio Nipe, Cuba."

While not absolutely prepared to assert that all three figures belong to *A. teres*, I think it may be said that each represents a type which has been or may be referred to this difficult species, and that fig. 11 definitely corresponds with the low-spined form described and figured by Pfeiffer.

A. URCEUS, Müller Plate III. figs. z, 2, 3

Nerita urceus, Müller, Hist. Verm., p. 174; *Ampullaria rugosa*, Lamarck, hist. nat. ed. 1, Vol. VI., p. 177, ed. 2, Vol. VIII., p. 532, no. 2; Blainville, Manual de Mal., p. 35, f. 1; Encycl. méth., pl. 457, f. 2, A.B.; *Bulimus urceus*, Blainville, Man. de Mal., p. 35, f. 1; *Ampullaria urceus*, Férussac, Syst. Conch., p. 68, no. 3; Philippi, Mon. Amp., p. 54, no. 75, pl. 17, f. 1; Reeve, Conch. Icon. Ampullaria, f. 18; Martens, Malak. Blätt, Vol. IV., p. 190; Troschel in Schomburgk's Reisen, Vol. III., p. 548; Martens, Binnenmoll. Venez., p. 201; *Ampullaria leucostoma*, Swainson, Zool. Ill., 1st series, Vol. III., pl. 175; *Ampullaria dolium*, Philippi, Mon. Amp., p. 40, no. 53, pl. II., f. 1.

Other figures or notices-Lister, Conch., pl. 125, f. 25; Favanne Conch., pl. 61, f. D. 10; Schröter, Fluss.-Conch., p. 253, no. 63, and Einleit. Vol. II., p. 143; Chemnitz, Conchyl. Cab. IX. 2, p. 108, pl. 128, f. 1136.

A. urceus, *A. oblonga*, Swains and *A. papyracea*, Spix, are the only *Ampullariae* consistently devoid of spiral bands within and without. It may be mentioned in passing

that there is a very strong superficial resemblance between *urceus* in its earliest stages, before the umbilicus has been developed, and the practically imperforate *A. oblonga*. This resemblance is increased by the fact that the spire of each-nearly always eroded even in young shells-has a strong reddish tinge. That of *urceus*, however, is always more slender and pointed, and this shell invariably shows traces of its characteristically rough network of sculpture, whereas *oblonga* is comparatively smooth. An intermediate stage is shown in Swainson's beautiful figures of *A. leucostoma*, which is a half-grown specimen of *urceus*. Though devoid of colour-pattern our species varies a good deal in the tint of the epidermis, which is sometimes yellow-brown, sometimes nearly black, and generally reddish chestnut. The interior is always milk white or yellowish, and the columellar lip, which is widely expanded in typical specimens, is generally white, but there is a not uncommon variety, mentioned by Philippi, in which this part is more or less stained with red. The shell grows to a very large size, and has an extremely wide range, having been recorded from the Mississippi (Dall), Trinidad (Cutter), the Orinoco, all three Guianas (Lister, Schomburgk, etc.), Venezuela (Martens), etc. According to Schomburgk it shares with *oronocensis* a preference for small, shallow, woodland streams and for running (not stagnant) water. The animal is eaten by the Indians, and according to Appun, who himself ate it in time of scarcity, the tribes highly value this diet as a restorative to sobriety after the debauches which accompany their brewing of the piwarri drink.

The specimens which I have figured show great diversity of shape and colour.

PL. III., F. 1. Almost entirely uncoated on the front of the shell, but showing on the back the uniform yellow-brown epidermis, and in places the netted sculpture of *urceus*. The denuded parts show very faint traces of delicate spiral bands, also a kind of vertical striping characteristic of *A. nobilis*. Other affinities with that species are the shape of the spire, which is finely and regularly formed, the generally smooth surface, and the very definite dark red border of the columellar margin, but the breadth of this part, the shape and colour of the body-whorl, the yellow aperture, and the patches of sculpture indicate *urceus*. On the whole I am inclined to think that this very curious shell is a hybrid between the two species, sharing their distinctive features pretty equally, but with enough of inclination to *urceus* to justify the name given to it on the plate.

PL. III., F. 2. A curiously elongated specimen; spire and vertical tracts of the bodywhorl almost completely uncoated, showing a yellowish-red under surface. Epidermis, chocolate brown. Probably, from its shape, a male shell.

PL. III., F. 3. A finely developed typical specimen of the globose form which I associate with the female. Dark greenish-olive; network sculpture very distinct. Spire low, and almost entirely uncoated, whitish, not reddish. Interior warmly tinged with yellow.

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A. GUYANENSIS, Lamarck

Plate III. figs. 4, 5, 6, and Plate IV. figs. z, 2, 3) 4

Ampullaria guyanensis, Lamarck, hist. nat., ed. , Vol. VI., p. 176; ed. 2, Vol. VIII., P. 532; Philippi, Mon. Amp., p. 68, no. 95 ; Troscchel in Schomburgk's Reisen III., p. 508; Hupé, Castelnau Exped. Moll. in Zool., Vol. III., p. 65; pl. XII., f. 1 ; Drouet, Moll. Guy. Franc., p. 77; *A. erythrostoma*, Reeve, Conch. Icon. Ampullaria, f. 59 (*teste*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 363) wrongly included among African species by Billotte (Bull. Soc. Mal. France, Vol. II., p. 109), by Bourguignat (Moll. Afrique Équat., p. 167) and not the *erythrostoma* of Martens (Beschalte Weichthiere Deutsch OstAfrikas, p. 154-figure of variety on next page probably represents *A. Nyanzae*, Smith). *A. haemastoma*, Reeve, Conch. Icon. Ampullaria, f. 34. Not=*A. olivacea*, Spix (Troscchel l.c.), nor *eximia*, Dunker (Martens, with ? Binnenmoll. Venez, p. 202), nor Guérin's figure of *Guyanensis* Lam. in Iconograph. regn. an. moll., pl. 13, f. 5, which represents *A. luteostoma*, Swainson.

Other notices and figures-Lister, Conch., pl. 128, f. 28; Deshayes, Encycl. méth. vers., Vol. II., p. 33.

Von Martens thinks that the notice in Moll. Guy. Franc., quoted above, may refer to *A. urceus*, but the description agrees well with our present species, although Drouet states that specimens of his shell were found at the foot of a cataract on the Oyapoc River. This does not well accord with the habits of *guyanensis*, as noted by Schomburgk, who says that in the Savannah region of British Guiana it lives in marshes and stagnant pools, whereas *urceus* seems to prefer running water.

A. guyanensis, besides inhabiting British and French Guiana (Hupé and Drouet) is likewise found far up the Amazon in Peru, which is the locality given by Reeve and Morelet (Sér. Conch. III. P. 218) for the form *haemastoma*. One of the specimens I have figured came from Peru, along with *Liguus (Corona) regalis* and *Drymaeus expansus*. It is a common species, exceedingly variable, but never at all like some of those which, in the absence of any figure or quotation, have been taken for Lamarck's *A. guyanensis*. Reeve figured it as *A. erythrostoma*, a supposed new species, and gave the wrong habitat "Zanzibar." This error has been copied into a number of works on African mollusca. G. B. Sowerby iii finally recognised *guyanensis* in *erythrostoma* after inspection of Lamarck's Gastropoda at Geneva.

Noting this identification we should doubtless consider as typical specimens the large, dark, red-lipped shells with roughly striated fibrous coating, such as are found at Pl. III. of 6, and Pl. IV. f. 3. These are without bands, and the striated epidermis is a feature of Lamarck's description not usually found in Spix's *olivacea*, another large species, which in virtue of its orange mouth, has sometimes been mistaken for *guyanensis*. The latter, however, is often quite smooth, and its colour varies from reddish brown to green. Texture and colour in the epidermis would appear to be affected by the quality of the water in which the animal lives, as is the case with our *Planorbis corneus*.

PL. III. F. 4. A small orange-mouthed specimen, darkly banded in the interior, the bands, however, ceasing abruptly at an early stage of the shell's growth. This is often

seen in *olivacea*, to which this particular example bears a strong resemblance in colour, and also in the peculiar style of erosion. But the general shape, the wide umbilicus, and the flattening of the whorls on top are unmistakably characteristic of *guyanensis*. There is a curious protuberance, probably pathological, on the parietal callus.

PL. III. F. 5. A large, smooth shell, greenish olive, unbanded. Aperture yellowish white, the very strong parietal callus and a broad band round the lip-not sufficiently indicated in the uncoloured figures-pale brick-red.

PL. III. F. 5. Reddish brown, roughly striated. Lip red, interior of aperture orange, clouded with blue grey.

PL. IV. F. . Rusty green, regularly banded. Parietal callus and outer lip, except for a rather wide colourless margin, red. Interior purplish chestnut, lighter above and below, and distinctly banded. Amazon, Peru. Probably, from its wide mouth and general shape, a young specimen.

PL. IV. F. 2. A beautifully polished shell, slightly malleated on the front; dark madder red, mouth orange-yellow, darker behind the lip.

PL. IV. F. 3. This much battered specimen is by no means a beauty from the collector's point of view, but I have figured it because it seems to represent the limits of typical *guyanensis*, both as to size and colour. Dark chestnut, streaked and smeared with black. Mouth orange, with a broad blood-red lip and callus.

PL. IV. F. 4. A very peculiar form, of which I have several specimens. Distinctly but thinly banded with bluish inside and out. General colour rich yellow-brown, with some ruddy vertical stripes and varices. Mouth ashy pink, with a pale salmon-coloured lip.

I should consider this pale mouthed form as distinct, only that I have a specimen, labelled "Guyane," precisely similar in shape and size, and in the colouring of the aperture, but externally covered with the rough, reddish epidermis of typical *guyanensis*. This seems to show that the character of the epidermis varies with local conditions.

Hupé figures a young many-banded specimen, for which he claims that it corresponds perfectly with Swainson's *A. puncticulata* (Zool. Ill. 1st series, Vol. III. pl. 143) and snakes the latter superfluous. His figures are certainly not convincing on the point, and Swainson's shell, in typical specimens, shows no marks of immaturity. But as a species it is, perhaps, not altogether satisfactory. The minute puncturation from which the name is derived, may, as Philippi remarks, be seen in other species-e.g. in *A. papyracea* Spix-it is often (*vide* Drouet, Moll. Guy. Franc. p. 8i, and Martens, Mal.

Blätt, VI. p. 61) sparse and difficult to make out, even with the lens, and finally its character is by no means constant. Sometimes it appears as rows of minute granules; in other specimens as a series of tiny pits. The latter effect is perhaps due to the wearing away of the tops of these pustules or bubbles in the epidermis, but the fact remains that the aspect of the shell under the lens is thereby very much altered. If my theory is correct, may not an extended period of wear and tear efface the puncturation entirely?

If we set aside this character for a moment, and compare *A. guyanensis* and *A. puncticulata* as seen by the unassisted eye, the only distinctions that remain are the occasionally perform shape of the latter, and the more or less obvious difference in size. It is true that *puncticulata* is generally much the smaller shell, but I have several specimens which might be either giants of this or small *guyanensis*. The pyriform shape on

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which von Martens so much insisted as to question Reeve's excellent figure of *puncticulata*, is likewise very inconstant-the shell shows almost as much variety of form as we have found in *guyanensis*.

Each has practically the same range as the other-I possess *puncticulata* from Cayenne and from Bogota-and their general resemblance in colour is remarkable. Both are red-lipped, in typical specimens, and have a rusty green or brown epidermis. Both are extremely variable, and the colour variations of *puncticulata* seem to reproduce precisely those of *guyanensis*. My series of the former is not large, yet it includes specimens which are practically copies in miniature of four out of the seven forms of *guyanensis* figured here-i.e. those at Pl. III. ff. 5 and 6, and pl. IV. ff. and 4. In all these the puncturation is strongly expressed.

It is difficult to accept Hupé's view that *puncticulata* is an immature shell, for its lip is generally thickened or reflexed, and these characters, though but slightly developed, indicate maturity. It may, however, be a small or stunted form of *guyanensis*, analogous, perhaps, to the dwarf *A. speciosa*, which Reeve figured as Lamarck's *canaliculata* (Conch. Icon. f. 79) Reeve's *A. vexillum* (Conch. Icon. Amp. f. 20) has been placed by Sowerby as a synonym of *puncticulata*. I have not seen many examples of this shell, which appears to be rare; it has a somewhat similar puncturation, but, except for this it is widely and constantly different from the species with which it has been associated. The spire is more acute, the mouth much wider, and the bands of the interior are vividly marked, often extending right across the lip, which is yellow. In *puncticulata* the lip may be red, orange, or even of an ashy tint, but the bands do not cross it. The characteristic thickening or reflexion of this part is absent in *vexillum*, though it often has the lip widely effused. The general appearance of *vexillum* is also much lighter, and its colour-scheme is far more definite and constant than that of *puncticulata*, which, as we have seen, is very variable, and follows the mutations of *guyanensis* with singular closeness. Whatever may be the true relation of the two lastnamed species, *vexillum* seems to be quite individual, generally recognisable at a glance, and providing no imitations or counterparts in miniature of *guyanensis*. The only *Ampullaria* that is at all like it is Reeve's *A. Metcalfei* (Conch. Icon. Amp., f. r9). I have been fortunate enough to obtain two specimens of the latter, and am inclined to think that it is merely a smooth and much-effused variety of *vexillum*. Reeve gave no locality, and my specimens unfortunately had their labels broken off short, but there was some reason to assume that they came from Ecuador. Reverting, finally, to the comparison drawn between *guyanensis* and *puncticulata*, it should be said that the ordinary sculpture of the former includes, besides the vertical striation diagnosed by Lamarck, a closely-set transverse striation of rather wavy lines, sometimes producing here and there a granular appearance such as characterises certain phases of *puncticulata*. In fact most of my larger specimens show patches of distinct "punctication."

Ampullaria nobilis, Reeve, Conch. Icon. Ampullaria, f. 8; Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 355.

I have represented an ordinary specimen of this shell, because Reeve's type would appear to have suffered some unusual development at the lower part of the aperture.

In his figure the mouth is very much wider below than above, which would not be the case in a shell of normal growth, if its general shape were pyriform, as testified by the description. The type may have been exceptionally effused at the base of the outer lip. Normally this is erect and curves gently inwards from the periphery. The deep red of the lip mentioned by Reeve is usually seen faded to pale salmon-colour, as in the specimen here figured, which also shows a much lighter general tone than the type. The prevailing tint is a clear golden olive, remarkably uniform and only interrupted by the very decided dark brown varices, and by a certain characteristic vertical striping, not shown in Reeve's figure, but very frequent in ordinary specimens. It reminds one of a somewhat similar decoration in the Eastern *A. dalyi*, but is less definite than in that species. Two or three thin bands are faintly indicated. The inside of the aperture is pale with a pink tinge.

The species presents some noteworthy characters. Chief of these is the broad development of the upper part of the body-whorl, which gives the spire an appearance of isolation; an effect also seen in many specimens of *A. urceus* (cf. Pl. III., f. 3). Another point of resemblance is the almost total absence of bands, which are so delicate in *nobilis* as to be barely perceptible. The two species have a good deal in common, and I have already stated my reasons for believing that one shell here figured as *urceus* is really that of a hybrid between them.

A. nobilis inhabits eastern Peru, and is stated to have been taken in company with the widely different *A. Petiti* of Crosse. Reeve, on the authority of Yates, gives River Marañon, a Peruvian branch of the upper Amazon, as locality.

A. INSULARUM, D'Orbigny Plate V. all figures

Ampullaria insularum, D'Orbigny, Voy. Amér. Mérid. Moll., p. 374, pl. LI., ff. , 2; Philippi, Mon. Amp., p. 37, pl. , f. 2; Hanley, Conch. Miscell., *Ampullaria*, pl. , ff. 2, 3; Reeve, Conch. Icon. Amp., ff. 42, 43; Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. ³⁵³. Also as *A. australis*, D'Orbigny, Voy. Amér. Mérid., p. 375, pl. LI., ff. 3, 4; Guérin, Mag. de Zool., 1835, P. 32; as *A. gigas*, Spix, Philippi, Mon. Amp., p. 47, no. 66, pl. 14, f. ; as *A. vermiformis*, Reeve, Conch. Icon. Amp., f. 54; as *A. fasciata*, Reeve, l.c., f. 41; as *A. canaliculata*, Lam. (in part) Martens, Mal. Blätt. IV., p. 191.

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This species has been curiously misunderstood by the leading German conchologists, who have persistently attributed it to the very different *A. gigas* of Spix. Under that name Philippi figures a large and obvious *insularum*, yet he notices the latter expressly, and gives a special figure, D'Orbigny having apparently sent him authentic examples of his species. As Philippi identified it with *gigas*, and stated that in his experience the shell, though variable in colour, was constant in shape, we must take it that his ideal of Spix's species was represented by the shell we know as *A. Insularum*.

A. haustum, *A. immersa*, *A. insularum*, *A. vermiformis* and *A. gigas* were all put together by von Martens under Lamarck's *canaliculata*. The first two are probably one species, as Sowerby (Proc. Mal. Soc. Lond. VIII., pp. 351 and 363) pointed out; the same may be said of the second pair, Reeve's *vermiformis* being hardly even a variety of *insularum*, while specimens intermediate between *immersa* and *insularum* are occasionally found (cf. Pl. V., f. 2, and Pl. VI., f. 2). But there is a wide gap between *insularum* and the true *gigas*, so wide that one is almost tempted to think that Philippi and Martens never saw the latter. Spix's original specimens were partly lost or destroyed when Philippi wrote his book (vide Mon. Amp., p. o, Bemerk. 2 under *A. zonata*) and Martens to a large extent employed the same incomplete material. The type may thus have disappeared before either of these eminent conchologists got to work on our genus, and it may not have been replaced, for *A. gigas* is always rare in collections. But it is hard to account for their opinions in view of Spix's figures, which, though rough, are admirably characteristic. Both of them cite these figures, and Philippi also quotes the exquisite representation of true *gigas*, wrongly given to illustrate Lamarck's *canaliculata* in Delessert's Recueil, pl. 3 r, f. 3.

Sowerby gives Nevill the blame for uniting *gigas* and *insularum*, but the curator of the Calcutta Museum, while he did not reject Philippi's identification, marked it with a query, and in any case had only one specimen before him (vide Nevill's Hand List of Mollusca, Part II., p. 9). This specimen, which was from the Rio Plata, was probably *A. insularum*, as *gigas* seems to be exclusively Brazilian.

The several constant differences between these species are fully detailed under *A. gigas*, and I am inclined to think that the two do not even belong to the same section of the genus. Apart from the channelled suture, almost the only thing they have in common is their large size, for, as will be seen from the central figure on Plate V., *A. insularum* is sometimes truly gigantic. On the other hand, it comes, in certain of its forms, very near to *A. haustum*, which, however, even in large specimens, is always much thinner. *A. insularum* is a rough, heavy shell, and when adult is generally somewhat battered, in spite of its solidity. It will be seen that most of the specimens I have figured are scarred on the body-whorl.

The colour is very variable. I have selected five specimens in order to show the principal phases.

PL. V., F. . A small grey-green form, prettily banded with rather thin reddish lines. Aperture dark chestnut, passing into fulvous on the lip and columellar margin. The bands are distinctly apparent in the interior.

Very like the shell figured as *A. canaliculata*, Lam. Var., by Hupé, Voy. Castelnau, I I I., pl. XI I I., f. . A more globose example of this banded form seems to have served Reeve for his illustration of the obsolete *A. fasciata* of Lamarck.

PL. V., F. 2. A large, depressed shell, practically identical in colour with that figured at Pl. VI., f. 2. (*A. immersa*.) Dull verdigris green, narrowly belted. Aperture deep brown, with broad, dark edge, relieved by a light coloured tract on the inside. Parietal callus lemon-yellow.

PL. V., F. 3. An exaggeration of the typical form. Externally reddish-olive, a good deal malleated, but with hardly any trace of bands. Aperture light orange with one or two fragmentary blackish bands.

PL. V., F. 4. Near Reeve's *Vermiformis* in shape. Very oblique, with widely effused mouth. No bands on the rich green outer surface, which, where not broken or worn, is highly polished. Lip, columellar margin and callus light brick-red. Interior of aperture dark brown, turning to fulvous yellow just before the lip.

PL. V., F. 5. Shell pale olive, the reddish under-colour showing on the spire, and where the epidermis is eroded on the body-whorl. Regularly malleated in front. Interior of aperture light reddish, divided from the buff-coloured lip by a breadth of pale violet at the last growth-line.

A very pretty form, the colour-complement of the ordinary dark specimens with " morgen-roth " interior. It is not uncommon in collections, but seems to be always of small or medium size.

Nearly every South American lot of *Ampullariae* includes *A. insularum*. It is probably abundant where it occurs. D'Orbigny found it at the islands of Parana, in La Plata, a location apparently close to the sea, and Bridges met with it in Bolivia. Another very large, rough and heavy *Ampullaria*, *A. megastoma* Sow. is likewise found in a situation that is almost marine, at the mouth of the great Rio Uruguay. It is somewhat suggestive that these two shells, showing a preference for such a habitat, should be the most massive and rugged of the Western species. Another big species, *A. eximia*, Dunker, lives, according to Martens, in a Venezuelan lagoon that is actually salt.

A. IMMERSA, Reeve A. HAUSTRUM, Reeve, and A. AMAZONICA, Reeve

A. IMMERSA, Reeve Plate VI. figs. , 2, 3

Ampullaria immersa, Reeve, Conch. Icon. Amp. f. 52; *A. canaliculata*, Lam. (in part), Martens, Malak. Blätt., IV., p. 191; as var. of *A. haustum*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 35 r, vide also p. 363.

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Ampullaria haustum, Reeve, *Conch. Icon. Amp.*, f. 23; ? *A. canaliculata*, Lam. (in part), Martens, *Malak. Blätt.*, IV., p. 191 ; *A. haustum*, Sowerby, *Proc. Mal. Soc. Lond.*, Vol. VIII., p. 351, vide also p. 363.

A. AMAZONICA, Reeve

Ampullaria Amazonica, Reeve, *Conch. Icon. Amp.*, f. 55; Sowerby, *Proc. Mal. Soc. Lond.*, Vol. VIII., p. 346, vide also p. 363.

G. B. Sowerby iii., in his notes on *Ampullaria* quoted above, at first gave Reeve's *Amazonica* place as a species "allied to *haustrum* and *gigas*," and reduced *immersa* to the rank of a variety of *haustrum*. But later on in the same paper he spoke of the three forms named at the head of this section, as belonging, in his opinion, to one species only. His first conception of them was probably more correct, and von Martens, who made *haustrum* and *immersa* parts of his ideal of *canaliculata*, discreetly forbore to include *Amazonica* in the same.

It will, perhaps, be most convenient to discuss the last-named species before the others. To my regret, I am unable to give a figure of it, having at present only a couple of immature and ill-conditioned specimens. Their peculiar purplish colour may be due to the latter cause, but an apparently fresh specimen in the British Museum, supposed to be the young of *Amazonica*, has the same effect, the epidermis being very thin. I have seen but few specimens of the adult shell, which appears to be rare. They were mostly old and faded, and none of them in their present state quite agreeable to the figure in the *Conchologia Iconica*. Nevertheless, I am unable to accept Sowerby's view that *Amazonica* is specifically identical with *haustrum* and *immersa*. It differs from them in several important particulars. Its suture, as Sowerby notes, is depressed, but not channelled, and the umbilicus is much narrower. The colour too is peculiarly light, almost uniform, greenish grey, with a pale orange lip and columellar margin. In the specimens I have examined, which were mostly large and fully developed, the banding was not conspicuous, and less definite than in either *haustrum* or *immersa*. Finally *Amazonica* appears to come from the main stream of the Amazon, which is not given as a habitat for either of the others.

As to these latter shells, there can hardly be any doubt that they are two forms of one species, but *immersa* is so much the more frequent in collections as to suggest that the so-called typical *haustrum* is really the variety. The differences are not great, and are mostly concerned with points on which *Ampullariae* are notoriously unstable. Speaking generally, one may remark that *haustrum*, apart from its produced spire, is the more elegant in shape, tapering considerably above and below, whereas *immersa* is somewhat slabsided, and has an indefinitely stunted appearance. Both shells are of rather thin substance for their size—*immersa* is generally smaller than its fellow—and have a very slight epidermis. It is this rather fragile structure which mainly separates

them from *insularum*. The umbilicus of the latter is generally larger and less oblique, but this character is not quite constant, and indeed I have seen specimens of *haustum* and *immersa* which were much more difficult to separate from *insularum* than any figured here. Von Martens unites all three, but he probably had not seen *immersa* at any rate, for otherwise he would not have expressed his astonishment that Reeve should have described it as "thin."

If we regard *haustum* and *immersa* as one species, it is, I suppose, inevitable that we take the former as the type. Both were originally described in the *Conchologia Iconica*, and since this work was issued in parts, *haustum* has priority, not only of some few pages, but in actual time. Nevertheless it is much the rarer of the two. Possibly they are local forms, *haustum* inhabiting the Marañon branch of the Amazon, and *immersa* being a more southerly product from Bolivia.

On Plate VI. I have represented three specimens of *immersa* and two of *haustum*, as follows.

A. IMMERSA, Reeve

PL. VI., F. . A small specimen, which has apparently met with rough usage in its lifetime, and is, perhaps, a trifle mis-shapen in consequence. Unusually fresh in colour, bright green, regularly and closely banded with a darker shade. Aperture above yellowish, below tortoiseshell brown, also regularly banded with broad and sometimes coalescing stripes. The same colours in the same disposition occur on the columellar margin. East Bolivia.

PL. VI., F. 2. A larger example, thinner in substance and duller in colour. Greygreen, with regular, thin bluish bands. Interior yellow above, dark brown below, the bands only showing distinctly in the yellow tract. Lip broadly bordered with purple brown, relieved by a light-coloured zone behind. Very like Pl. V., f. 2, but much less solid and smoother in texture.

PL. VI., F. 3. A light-coloured specimen, with a great deal of the thin epidermis missing. What remains on the front of the shell is of a horny yellow colour. Thinly but distinctly banded with bluish at and below the upper insertion of the lip. Interior light chocolate brown, with bands faintly marked.

A. HAUSTRUM, Reeve

PL. VI., F. 4. A small, apparently young example, green and distinctly banded only on the last two growth stages before the lip. Otherwise almost devoid of epidermis and grey-green shading to purplish on the front of the shell, where the bands have almost entirely disappeared. Spire prominent, and much darker in colour. Aperture and lip above yellow, decisively banded in dark brown, below rust-coloured with a clear lilac zone behind the dark outer edge, on which the bands show black. Columellar margin yellowish.

PL. VI., F. 5. A full-sized typical specimen, almost exactly like Reeve's figure. Spire dark reddish. Body-whorl greenish yellow, varices rusty red, the bands, otherwise bluish, being also partly expressed in this colour. Interior and columellar margin light above, below livid reddish with a very broad dark edging on the lower lip.

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A. CANALICULATA, Lamarck Plate VII. figs. , 2

Ampullaria canaliculata, Lamarck, Hist. Nat. etc., ed. , Vol. VI., p. 178; ed. 2, Vol. VIII., p. 534; Philippi, Mon. Amp., p. 66, no. 92; Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 346 and p. 363.

NOT *Ampullaria canaliculata* of Delessert, Recueil de coquilles decrites par Lamarck, pl. 31, f. 3, a, b; nor of Reeve, Conch. Icon. Amp., f. 79; nor of von Martens, Malak. Blätt., Vol. IV., p. 191; nor of Hupé, Castelnau Exp. Moll., p. 64, pl. XIII., f. I

This much discussed species *may* be identical with Philippi's *A. Lamarckii*, as that author himself at first believed, but his figure (Mon. Amp., pl. 21, f. 5) is too rough for certainty, and I believe that true *A. canaliculata* is represented for the first time on our plate. It was only identified beyond question in 1909 by G. B. Sowerby iii., on inspection of Lamarck's Gastropoda at Geneva. Our fig. is a portrait of a specimen obtained from Messrs. Sowerby and Fulton.

The vicissitudes of *canaliculata*, which thus waited over a century for authentic recognition, constitute a classic instance of the confusion that may arise from a loose and unassisted description. Lamarck's meagre account of his species, with no figure given or quoted, left it a prey to the wildest speculation. For many years collectors assigned every *Ampullaria* with a channelled suture to *canaliculata*.

When Delessert in his " Recueil " (1842) essayed the task of representing Lamarck's unfigured shells, he made things, in this instance, worse instead of better. Disregarding the modest dimensions given by Lamarck, he displayed under the name of *canaliculata* the largest Western species of the genus, already figured by Spix under the appropriate title of *A. gigas*.

This was obviously wrong, and even Philippi, who went grievously astray on the subject of *A. gigas*, would have nothing to do with Delessert's identification. He conjectured that the species was as yet undetermined, but might be re-discovered in the habitat given—the island of Guadeloupe.

Reeve, less cautious than his predecessor, figured a young or dwarf form of *A. speciosa* as Lamarck's *canaliculata*, giving Cashmere as locality. This must surely be accounted a double mistake, since *A. speciosa*, a characteristically African species, would not be found in Cashmere, nor indeed would any *Ampullaria* be likely to inhabit such a country.

Von Martens in 1857 outdid all his predecessors by lumping together *gigas*, *haustum*, *immersa*, *insularum* and *vermiformis* under one designation. He says : " I do not scruple to allow this species, widely distributed and variable, yet linked up by imperceptible transitions, the name of *canaliculata*, Lamarck." Later on, in Malak. Blätt., Vol. XV., 1868, p. 192, Von Martens added yet another shell to the list, remarking of Reeve's *dolioides*, Conch. Icon., f. 75, " In this figure I can see nothing more than a still immature *canaliculata*." He also quoted, as a variety of the latter, *A. Orbignyana*, Philippi (*sic*), which he had formerly emphasised as a distinct species (Mal. Blätt., IV., p. 192). Philippi had not seen this shell, but he described it from D'Orbigny's figure, and strongly

maintained its independence, on the ground of certain obvious peculiarities. In that opinion von Martens, six years later, had fully concurred, adding that neither Philippi nor he had met with intermediate specimens between this and *canaliculata*. It is true that the latter was not certainly known to either of them, but now that it has been re-discovered, the accuracy of their original conclusions is, to our mind, even more strikingly apparent.

The second thoughts of von Martens with regard to our species were hardly in accordance with the proverb, nor, perhaps, were those of Sowerby, who, just when he seemed to have laid the ghost of *canaliculata* for ever by his discovery at Geneva, added a footnote to *D'Orbignyana*, saying, "This is *A. canaliculata*, Lamarck," and again, "Philippi's *D'Orbignyana* is the same, only the spire is more immersed." There are other peculiarities about Philippi's species which seem to characterise it as distinct, and I have preferred to figure it as such from a specimen, which, though not typical in

all respects, can hardly be anything else.

Lamarck's species, when at length it was identified, proved to be of moderate size, as the original description had stated, and also of a somewhat individual character quite unlike the giant forms that had been so persistently mistaken for it. The most

striking feature in its general aspect is a certain squareness of the body-whorl, which is noticeable even in quite young specimens. The shell is rather thick for its size, which never greatly exceeds that of the specimens figured. These are

Pl. VII., r. . Spire reddish on the upper whorls ; the rest of the exterior grey-green, regularly and narrowly banded. The back of the shell much malleated. Interior of aperture reddish, the bands showing distinctly and produced on to the outer lip, which, with the columellar margin, is yellow.

PL. VII., F. 2. Greenish yellow on the back, passing into buff on the front. No malleation. More broadly banded than fig. ; bands greenish on the back, inclined to red on the front. Aperture pale red, distinctly banded in the interior, and on the margin.

The locality Lamarck gave for his species; was the island of Guadeloupe. Very little has been published about the mollusca of this part of the world, and none of the recent lists I have seen contained any mention of *canaliculata*. The whole appearance of the shell suggests a South American origin, the probabilities inclining to La Plata.

A. D'ORBIGNYANA, Philippi

Plate VII. fig. 4

Ampullaria D'Orbignyana, Philippi, Mon. Amp., p. 65, no. 91, Pl. ? I, f. 4 ; *Ampullaria Orbignyana*, Martens, Mal. Blätt., IV., p. 192; *Ampullaria D'Orbignyana*, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 348.

As variety of *A. canaliculata*, Lam.-D'Orbignv, Voy. Amer. Mérid., pl. IV., f. 4.

The remarkable specimen here figured was received from Mr. Weeks under this name, and marked "Miguete River, Monte-video." I have no doubt that identification and locality are correct.

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It is a large light shell of inflated shape, the body whorl protruding greatly into the interior, and thus, together with the rapid attenuation of the basal part, producing the comparatively narrow, crescent-shaped aperture mentioned by Philippi as characteristic. The channelling of the suture is so profound that the lower whorls of the spire, though fairly deep, to some extent conceal one another, and for the same reason, the upper angle of the aperture is on a level with the top of the body-whorl, the lip rising high above its insertion before it turns over and slopes downwards.

The external colouring is a light greenish yellow without bands. In the latter respect the specimen differs from Philippi's figure. The aperture is light 'reddish, as he has represented it, and here the bands show faintly in places. The columellar margin is much more strongly curved than is usual in *canaliculata*, with which this species can hardly be identical, as supposed by Sowerby. It is highly individual, and both Philippi and Von Martens state that it shows no transition-forms to other species of the group.

A. GIGAS, Spix Plate VII. fig. 3

Ampullaria gigas, Spix, Testac. Fluv., Bras., p. . pl. , f. ; Reeve, Conch. Icon. Amp., f. 3 ; Hupé, Castelnau Exp. Moll., p. 64; Sowerby, Proc. Mal. Soc. Lond., VIII., P. 350. As *A. canaliculata*, Lam., Delessert, Recueil, pl. 31, ff. 3, a, b.

NOT the *A. gigas* of Philippi, Mon. Amp., p. 47, no. 66, pl. 14, ff. 1, 2. Included by Von Martens among the synonyms of *A. canaliculata* (Malak. Blätt., IV., p. 191) along with other incongruous species; possibly not known to him by specimens.

In view of the strange mistakes noted under *A. insularum* and *A. canaliculata*, I have thought it best to figure *gigas*, which, after all, has not been represented very frequently in conchological works. It is indeed strange that the great German authors should have confounded so independent a species with either of these others. It appears, in fact, to represent a quite different section of the genus, and even an average specimen of *immersa*, the lightest species of the *canaliculata* group, looks heavy and clumsy in comparison with a full-grown *gigas*.

The general lightness of design appeals to the eye at once, but on examination of details we find it carried out in every part. The whole shell is thin; its surface is smooth and brilliant, only very rarely showing traces of malleation. The lip is acute, the columellar margin long, slim and beautifully arched in a very gradual bow. There is hardly any perceptible callus, and the aperture is oval, with a gently curved outer edge.

All this is in strong contrast to the sturdy lines of typical *insularum*-a rugged, heavy shell, with thick lip and strongly developed callus springing from a generally short and substantial columellar margin. The varied, often bright colours and rough

texture of *insularum* are equally diverse from the smooth and sober uniformity of *gigas*, which shows no gay tints, and is probably the least variable of all the large *Ampullariae*.

The specimen figured, though not of the largest size, is fairly typical. Its general colour is a pale greenish olive, inclining to fawn-colour in places, and delicately banded with narrow blue lines, which for the most part run closely in pairs, but are not very distinct or continuous. The columellar margin, outer lip and upper part of the aperture yellowish white; the rest of the interior clouded with livid reddish. The hands show faintly purple, their terminations marked by bold, oblique dashes of dark brown. The latter are strikingly characteristic, and indicate that *gigas* is related rather to the *lineata* group with its "hook" markings near the edge of the aperture, than to the *canaliculata* forms with which it was formerly associated.

Even when quite immature *gigas* is unmistakable. I have a young specimen, which, except in size, only differs from an adult in the outline of its lower part, this being produced almost in a peak.

A. gigas, in strong contradistinction to *insularum*, is seldom scarred or battered, comparatively frail though it be. One would conjecture from this fact that it lives in still, deep waters. It appears to be only recorded from the Brazilian Amazon, and is rather rare in collections.

A. AVELLANA, Sowerby
Plate VII. fig. 6

Ampullaria avellana, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 360 (figure in text).

This remarkably distinct little species was only described by G. B. Sowerby iii. in 1899, but it was evidently known to collectors in this country at a much earlier date. I have found specimens in an old collection under the too familiar name of *canaliculata*. It has nothing in common with that species or its allies, save only the rather depressed suture, and obviously belongs to the group of *dolioides* in virtue of its long, boat-shaped form, thin substance and slim columellar margin. It appears to vary little in size, being always a small shell, but is often darker and more strongly marked than the specimen figured, which shows only the faintest trace of bands. The spire, in all the specimens I have seen is very deeply eroded. External colour olive, with a tinge of grey, closely banded with thin lines of a darker shade, which are more distinctly seen in the aperture. The latter is olive above, the central portion reddish. Columellar margin very slender and white.

The locality given by Sowerby is Lagunella, Venezuela.

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A. DOLIOIDES, Reeve

Plate VII. fig. 5, and Plate VIII. fig. r

Ampullaria dolioides, Reeve, Conch. Icon. Amp., f. 75; Sowerby, Proc. Mal. Soc. Lond., VIII., p. 348.

As immature *canaliculata*, Lam., von Martens, Malak. Blätt., XV., p. 192.

As Indian species (ex errore and following Reeve), Nevill, Hand List of Mollusca, Part II., p. 7, and Preston, Fauna of British India, Moll., p. 100 (as *Pila dolioides*). Philippi's second figure of *A. gigas* (Mon. Amp., Pl. 14, f. 2) appears to represent *dolioides*.

This shell, well figured in the Iconica, was, in spite of its horny operculum, wrongly localised by Reeve, who gave Bombay as its habitat. Nevill attributed it to Ceylon and Preston, following Reeve, included it among Indian *Ampullariae*. Reeve's figures of course represent the true South American shell, but the mistake of Nevill was probably due to wrong identification, for the locality of his specimen, whatever it was, would almost certainly be correct. It is a common and well-known species, not, as it seems, markedly inclined to variation, except in depth of colour, and I only figure it in order to show its affinity with *gigas*, and the points in which it differs from *lineata*. Like the former it is thin and glossy, with a long, slim, gently curved columellar margin, giving an appearance of bulbous projection to that part of the body-whorl which surmounts it. This abrupt protrusion makes the aperture look almost cavernous, the opposite wall of the shell seeming to be unusually distant. The suture is deeply sunken and the spire rather short. The body-whorl is somewhat barrel-shaped, and does not taper downwards so rapidly as in *lineata*.

The latter species—often, superficially, very like *dolioides* in its general colour and markings—may be further distinguished by the shape of its spire, which is higher, more sharply pointed, and wider at the base. The penultimate whorl, seen from the back of the shell is much larger and deeper, and, consequently, on a front view, the insertion of the outer lip is set much lower down the side of the shell than in *dolioides*. The suture is not so deeply sunken, and the top of the body-whorl is often flattened, not rounded, in its neighbourhood. The columellar margin is shorter, straighter, and stronger. Finally, *dolioides* is, in general, the larger of the two. When young it has a strong reddish tint, and is extraordinarily brittle, the shell being a mere film. At pl. VIII., f. , I have represented an immature specimen, as is shown by the very wide mouth. In this example some of the thin belts on the upper part of the body-whorl have coalesced into a broad reddish band. The adult shell represented on pl. VII. is of a fine green colour, very regularly banded within and without. The interior of the aperture is dark brown.

Sowerby gives La Plata as locality.

A. LINEATA, Spix

Plate VIII. figs. 2, 3, 4

helix lineata, Spix, Testae. Bras., pl. V., f. 2; *Ampullaria lineata*, Wagn., in the text, p. 3, no. 6; Philippi, Mon. Amp., p. t, no. 8, pl. 2, ff. 5, 6; Hupé, Castelnau Exp. Mollusca, p. 66, pl. XI., f. 2; Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 354 (exclusive of most of the synonymy).

As *Ampullaria fasciata*, Swainson Zool. Ill., 1st series, Vol. II., pl. 103, and 2nd series, Vol. II., pl. 64; as *A. Linnaei*, Phil. (ex errore), Reeve, Conch. Icon. Amp., f. 115.

This shell, another common South American species, was apparently first figured by Swainson under the name of *A. fasciata*, which has now no place in the genus, Lamarck having misapplied it to Linné's *ampullacea*.

The difficulties which attend the identification of the latter species have been discussed by Hanley in his *Ipsa Linnaei Conchylia* (p. 368), and will be set out in their proper place. For the present it will suffice to say that Philippi, having received from Hanley a drawing of the marked specimen in the Linnean cabinet, published a species which he called *A. Linnaei*, and illustrated it, not with a copy of Hanley's sketch, but from a shell which he believed to be of the same species (Philippi, Mon. Amp., p. 62, pl. 20, f. 6). Intending to represent this supposed new species, Reeve, who altogether omitted *A. lineata* from his descriptions, gave excellent figures of the latter, curiously enough from specimens in Hanley's collection. This fact has escaped notice hitherto—indeed the Iconica figures have been cited in quite recent times as representations of Philippi's species—but it has sometimes suggested itself to me that G. B. Sowerby really meant to give the reference to Reeve when he included *A. Linnaei* among the synonyms of *lineata*, and inadvertently made the stock quotation of Philippi's figure instead. Be this as it may, the figures of Reeve and Philippi have nothing in common but the name.

Unlike *dolioides* this shell is very variable. It is often much lighter than the specimens figured, and the bands are reduced to mere threads of colour. On the other hand they sometimes coalesce, so as to produce broad reddish belts, as in our f. 2. The ground-colour is usually a charming tint of French grey (admirably shown in Reeve's figures), but it is sometimes a light, horny brown, or even reddish.

A very characteristic feature of this species, and in fact of the whole group to which it belongs, is the marking of the interior. This consists of well-defined dark bands, which just before their termination bend sharply downwards as though to avoid the edge of the lip, which, when the latter is entire, they do not quite reach. (In *dolioides* these internal bands generally run straight on to the margin.) The final bend is marked by a spreading and intensification of the colour, the result being a kind of "hook" pattern inside the edge of the shell. This peculiarity is well shown in Reeve's figures of the supposed *Linnaei*.

PL. VIII., F. 2. A small prettily marked specimen, grey, regularly banded with reddish. Interior also reddish, with a grey belt behind the lower part of the lip. On

the back of the shell a warm yellow tinge overspreads the grey ground, especially near the aperture.

PL. VIII., F. 3. A larger specimen very thin in substance. Light corneous olive, regularly banded, the bands especially well marked in the mouth, which is pale corneous above, blue-grey below, and shining brown in the central part. The interstices of some of the hook marks are filled up with blue-grey.

PL. VIII., F. 4 A large and apparently old specimen, much thickened and malleated. On the front of the shell, which beyond the first growth line is partly reddish, the malleation has quite obscured the bands for a space, but they can be clearly made out on the grey earlier structure. Interior of the aperture, except for a light belt near the base, chocolate brown, almost entirely obscuring the markings. Columellar margin and extreme edge of the lip whitish. Very like Hupé's pl. XI., f. 2.

Ampullaria lineata is a native of Brazil, and appears to be particularly common in the province of Bahia.

A. SWAINSONI, Hanley
Plate VIII. figs. 5, 6

Ampullaria Swainsoni, Hanley, *Conchological Miscellany*, *Ampullaria*, pl. , f. ; Reeve, *Conch. Icon. Amp.*, f. 128; ? Hupé *Castelnau Exp. Moll.*, p. 66; ? Mousson, *Malak. Blätt.*, Vol. XII., p. 182. As synonym of *lineata*, Sowerby, *Proc. Mal. Soc. Lond.*, VIII., p. 354.

NOT the variety of *A. lineata* figured as *fasciata* by Swainson, *Zool. Ill.*, 2nd ser., Vol. II., pl. 64, and re-named *Swainsoni* by Philippi, with copy of Swainson's figure (*Mon. Amp.*, p. 53, no. 73, pl. 16, f. 5) ; nor the *Swainsoni* of Sowerby, *Proc. Mal. Soc. Lond.*, VIII., p. 358, for which these authorities are quoted.

This species has a somewhat curious history, and I do not think it has ever before been attributed to the author who first published it.

In the second series of his *Zoological Illustrations* Swainson figured a large *Ampullaria* from Brazil, which he considered to be an unbanded variety of the shell he had figured in the first series as *A. fasciata*. The latter name has now no place in the genus, but Swainson's figures are too good to leave any room for doubt that his original shell was an example of that subsequently named *A. lineata* by Spix, and that his attribution of the larger specimen to it as a variety was perfectly correct. We may note, by the way that one of the figures of the latter flatly contradicts the description in the text. Swainson was an exquisite artist, but at times a strangely careless writer, and his variety, as it appears in the lower figure of the plate is certainly not devoid of bands, as stated.

This figure attracted the attention of Deshayes and Philippi. The former was content to accept it as a portrait of a variety of *lineata*, but Philippi had doubts of this, and copied Swainson's figure (very badly), giving it the new name of *Swainsoni*. In

consequence our species is generally quoted as *A. Swainsoni*, Philippi, and regarded as a synonym or variety of *lineata*. Attempting to illustrate this supposed new species, Hanley figured in the Conchological Miscellany an entirely different shell, the subject of our present notice. It is much larger and thicker than either true *lineata* or the variety figured by Swainson and Philippi; it has a quite different shape, being much swollen at the top of the body-whorl, while the spire, always eroded, should, judging by its remains, be decidedly obtuse, not sharply tapering and pointed as in *lineata*.

Hanley suggested that "A. *lineata* of Spix is perhaps the young." I have figured what appears to me to be an immature *A. Swainsoni*, and it will be seen that even in this early stage it is quite distinct from *lineata*, and is in fact not strikingly different from the adult.

I may remark that Hanley's figures are much more characteristic in uncoloured copies of his plate. The colourist has almost effaced the banding, which is notable in this shell as being perhaps more regular than in any other *Ampullaria*.

Reeve in the Iconica figured from Hanley's Collection, but apparently from another specimen therein, a true *A. Swainsoni*, but regarded it as a synonym of Spix's *lineata*, not being aware that he had given unmistakable figures of that very different shell under the wrong name of *A. Linnaei*, Phil.

The notices cited with a query from Hupé and Mousson possibly refer to our species; Hupé mentions certain particulars which seem to be characteristic of it; Mousson considers its identification doubtful, and his description hardly indicates true *Swainsoni*. Both authors give Brazil as habitat. Hupé, by the way, being, apparently, unacquainted with Philippi's work, takes unto himself the credit of the species, and cites it as "*Ampullaria Swainsonii* (Nobis)."

The colour of the adult is a clear olive-yellow, beautifully banded with greyish blue; the aperture is white at the lip and columellar margin, but tinged with fulvous in the interior, and here most of the bands do not appear very decidedly marked until their hook-shaped terminations are developed; these in the larger specimen figured are filled up with orange-brown. The young shell is excessively fragile and darker in colour. To this extreme brittleness I am inclined to attribute the rarity of the adult shell, whereof I have only seen two specimens. Mine is labelled "Guyane" - probably a mistake. The most likely habitat is the Amazon.

A. LEVIOR, Sowerby

Plate VIII. figs. 7, 8

Ampullaria levior, Sowerby, Proc. Mal. Soc. Lond., Vol. VIII., p. 361, with figure in the text.

Possibly represented by Philippi's figure of *A. figulina*, Mon. Amp., pl. 4, f. 8.

This species from the Amazon was described and figured 1. c. by G. B. Sowerby iii in 1909. Its light colour, rather rough texture and widely expanded aperture make it

very distinct from others of the *lineata* group. The aperture is boldly striped in the manner characteristic of these, but the species has a certain individuality, and once seen can hardly be mistaken.

Though this shell is comparatively recent addition to the genus under its present name, I am inclined to think that a small specimen of it, such as that figured at pl. VIII., f. 8, served Philippi for one of his illustrations of Spix's much discussed *A. figulina*. This conjecture cannot, of course, affect for one moment the acceptance of Sowerby's species, but anyone who will take the trouble to look up Philippi's figure as cited may see the resemblance. The other representations of *figulina* on the same plate are rather different in several respects.

I have given two figures of *levior* from specimens supplied by Messrs. Sowerby and Fulton.

PL. VIII., F. 7. An old shell, very pale in colour, a good deal scarred and ridged on the body-whorl. General hue a kind of ashy cream-colour; bands, only showing clearly near the lip, green. Lip, inside, cream-colour, interior of aperture rufous, with the characteristic hook marks. Columellar margin very thin.

PL. VIII., F. 8. A smaller specimen, rather darker in colour; the bands inside and out much more distinct. The lip perhaps not fully formed, for the hook marks go right across it, leaving no pale margin. Probably a younger shell than the preceding, and much smoother externally.

A. FIGULINA, Spix

Plate VIII. fig. 9

Ampullaria figulina, Spix, Test. Fluv. Bras., p. 3, pl. IV., f. 4; Philippi, Mon. Amp., p. 17, no. 18, pl. 4, ff. 8, 9; Reeve, Con. Icon., *Ampullaria*, f. 6; von Martens, Malak. Blätt, IV., p. 192; Sowerby, Proc. Mal. Soc. Lond., VIII., p. 349; *fide* von Marten 1. c.= *A. testudinea*, Reeve, Conch. Icon. Amp., f. I 14.

This much discussed species cannot now be identified with certainty, and perhaps does not merit the amount of attention bestowed upon it by various authors. Spix's original figure is lettered on the plate *figulina*, but the editor of the letterpress, Prof. Wagner, has reduced it to a mere variety of *lineata*. Besides this the figure itself is very small, presents a back view of the shell—thereby of course concealing the aperture, umbilicus, and other important traits—and is finally an indifferent design quite devoid of characterisation.

Alluding to the last reference given above, Nevill, in his "Hand List of Mollusca," Part II., p. , says, apropos of Reeve's *testudinea*, "*Spix's* fig. of *A. figulina* is very bad; it seems to me it can hardly be this species." Nor indeed does it seem to have much affinity with Philippi's exposition of *figulina*, and still less with that of Reeve, whose figure is conjectured by Sowerby to be founded on an extreme form of *Hopetonensis*

(=*paludosa*), a shell belonging to a different section of the genus. It is hardly worth while to attempt a solution of these difficulties, inasmuch as Spix's original figure appears to represent an immature shell. In this genus it is impossible to identify such with certainty, and we may therefore, perhaps, best dismiss *figulina* from the list of species, noting that Philippi's ideal of it is probably, in part, *A. levior*, and that Reeve's appears to be a variety of *lineata*-indeed I have a specimen of the latter which is very like it. My plate was engraved before I came into possession of Spix's work. Had it been otherwise, my figure 9 would not have been allowed to stand. Whatever the shell there represented may be, it is not Spix's *figulina*. It is possibly a variety of Reeve's *testudinea*, but does not correspond exactly therewith, and it has neither label nor note of locality. In colouring it is pale brownish yellow, the bands very indistinct outside, but definite in the aperture, the ground colour of which is reddish. I have a companion shell, obtained along with it, which is somewhat like Philippi's second presentment of *figulina* (Mon. Amp., pl. 4, f. 9). But who can say what this figure really represents?

A. BUXEA, Reeve Plate VIII. fig. z o

Ampullaria buxea, Reeve, Conch. Icon. Amp., f. 112; Sowerby, Proc. Mal. Soc. Lond., VIII., p. 346.

Variety of the same, *A. bilineata*, Reeve, Conch. Icon. Amp., f. 1 .

The shell represented in our figure is a pretty variety of this common species. The ground-colour is rich orange-yellow, very decidedly banded with reddish and clouded about the upper part with the same. The interior is tinted with pale yellow and lilac, the bands showing up smartly in various shades of brown.

Reeve did not know the habitat, but the headquarters of *A. buxea* would seem to be Jamaica, whence I have several specimens, said to have been taken when crawling up the sides of a bathing-shed. I have also one or two specimens marked "*A. depressa*, Florida." This locality is not altogether unlikely for our species, but I have not found any confirmation of it, and it is probable that here is a mistake in identification due to

Reeve's figure of *A. depressa* Say (Conch. Icon. Amp., f. iii). The name of *depressa* having been found to be pre-occupied for a fossil species, was changed by its author in 1829 for *paludosa*, and the species thus designated is that which Lea in 1839 described as *Hopetonensis*. Under the latter name Reeve gave a good figure of it in the Conchologia Iconica Monograph) Pl. XIII., fig. 60), and thus represented the same species twice over, but his second figure, that of the alleged *depressa*, is not so characteristic as the, first, and was apparently made from a younger shell. This representation is not, except for its darker colour, easily distinguishable from that of *A. buxea* the umbilicus being undeveloped as is usually the case in immature shells (*buxea* is practically imperforate). A shell deceptively like this figure would easily be attributed to Florida,

the habitat of the species variously known as *depressa*, *paludosa* and *Hopetonensis*. *A. buxea* is not very variable for an *Ampullaria* and nearly always retains the buffyellow colour to which the specific name is due. It is seldom, however, so decidedly marked as in our figure ; the bands are, as a rule, faint and sometimes vague in outline. The characteristic warm ground-colour sometimes gives place to a dull yellowish white, and then the bands become definite and dark. One such example, sent me by Mr. Hugh Fulton, who kindly drew my special attention to it, has convinced me that Reeve's *A. bilineata*, figured on the same plate of the *Conchologia Iconica* as *A. buxea* was really nothing more than a stunted specimen of this variety. Von Martens, strangely enough, considered *A. bilineata* as allied to Philippi's *A. Gruneri*-apparently a form of the Eastern *A. ampullacea* 1 (vide *Malak. Blätt.*, IV., p. 185).

A. DA COSTAE, Sowerby Plate VIII. fig.

Ampullaria Da Costae, Sowerby, *Proc. Mal. Soc. Lond.*, VIII., p. 359, with figure in the text.

Described by G. B. Sowerby iii from specimens in the collection of the late S. I. Da Costa. The type is now in the British Museum collection.

Sowerby's figure-apparently a reproduction of a photograph-is rather above the average size of the specimens I have seen. This is a smooth shell of rather sombre appearance, the underlying violet colour, which shows plainly on the worn spire, obscuring the green of the thin epidermis. The inside is very dark with traces of closelyset lines apparent where the colour passes into the white of the outer lip. The character of the interior is partly concealed in the original figure, which shows the operculum *in situ* a little way up the aperture.

The infirmities of *Ampullaria* seem to me to be occasionally characteristic. Everyone who has examined a series of *A. urceus*, for instance, will remember the circular pits, probably due to vermicular parasites, which so often disfigure the shining white or yellow interior of the shell. The external surface of our present species is thickly beset with scaly-looking patches, which are quite smooth to the touch, but break up the epidermis in all directions. The type figured iii the *Proceedings of the Malacological Society of London* shows this peculiarity very clearly, but it is more or less evident in all the specimens I have seen. Another Western species liable to the same disfigurement is *A. olivacea*, Spix, which generally shows whole constellations of circular, colourless "blisters" in the epidermis.

A. Da Costae is assigned by its author to Costa Rica. The specimen figured on our plate is of rather lighter colour than usual, and shows fairly regular and distinct banding on the back of the shell.

A. COSTARICANA, Martens

Plate IX. fig.

Ampullaria costaricana, Martens, Biol. Central. Amer. Moll., pp. 418, 644, pl. XXIV., ff. 14-17. Perhaps the shell figured by Reeve as *A. reflexa* Swains. in the Conch. Icon. *Ampullaria* monograph, pl. 15, f. 69. *A. Costaricana*, Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 347.

A small, well-defined species of rather triangular shape, scarcely umbilicated, and of a clear yellowish brown colour, closely and regularly belted with narrow lines. In the specimen figured the upper part has two distinct pairs of these in dark brown! then a broader, reddish peripheral band, beneath which the belts run in groups of three, and are dark brown as above. Where the thin epidermis has been worn away the shell shows a somewhat violet ground-colour. The mouth is dark reddish grey, the bands showing clearly, but not so definitely as on the outside; the lip is white, barred by the ends of the bands, which often, as von Martens states, appear plainly even on the columellar margin. Even when immature this species has a distinct individuality. The young shell is lighter in colour, and has a very high polish, which gives it an almost glassy appearance. The original description says "umbilicus moderately large." In my specimens it is much narrower than in von Martens' figures, but most *Ampullaria* species show a good deal of variation in this respect.

Von Martens conjectures that his species may be what Reeve has figured (without locality given) as Swainson's *A. reflexa*. The beautiful representations of the latter in the Zoological Illustrations (1st series, Vol. III., pl. 172) do not even remotely resemble the *A. reflexa* of the Conchologia Iconica, but Reeve is only one of several authors, who have strangely misconceived this shell. Philippi has figured under the same name five forms which are totally distinct from it, and also from each other. Hanley has figured (with a query, it is true) a small, unlocalised shell with a broad yellow lip, and Pfeiffer, in his Novitates Conchologicae, has represented a whole series of shells from Cuba which appear to belong to *A. paludosa* Say (= *Hopetonensis* Lea). The real *A. reflexa* is a very different thing from any of these-peculiar both in shape and colour and, apparently, not an insular form at all, but coming from the mainland of South America. Localities given for *costaricana* include Nicaragua and N. Panama, besides the State from which it takes its name.

A. DELATTREI, Reeve (emend. Fischer and Crosse Plate IX. fig. 2

Ampullaria lattarei, Reeve, Conch. Icon. Amp., fig. 22; Tristram, P.Z.S., 1863, p. 414; Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 354; *A. delattrei*, Fischer and Crosse, Miss. Scient. Mex. Moll., ii., p. 246, pl. 45, ff. 4, 4a, and pl. 48, ff. 7, 7a; von Martens, Biol. Centr. Amer. Moll., p. 419, pl. XXIV., f. 8.

First described by Reeve as *A. Lattrei*, apparently because that author took the discoverer's name to be de Lattre. The mistake was corrected by Fischer and Crosse in their joint work on the Mexican mollusca. Reeve's figure represents a specimen larger than any I have seen, and is somewhat over-coloured. This is, in fact, rather a dull shell, and Reeve has rightly noted one of its characteristic traits when he describes it as "not shining," a peculiarity conspicuous among such brilliantly polished shells as the majority of the Western *Ampullariae*. It is a rather thick and stony-looking species of a light grey-green colour, hefted on the back with fairly broad and regular bands of a darker shade. The inside of the mouth is pale orange-yellow, marked with bundles of narrow, dark stripes, which are cut off abruptly just before the edge of the lip, where their colour is somewhat intensified. Behind the lip the lower part of the aperture is tinged with bluish, passing into pale dusky red higher up. The columellar margin is pale yellow.

The dark ends of the internal stripes often coalesce so as to form a broad stripe just behind the yellow lip, as shown in the figures of Reeve and von Martens. The latter author, being doubtful of some of Crosse and Fischer's figures, does not endorse the Mexican locality (Isthmus of Tehuantepec) given by them, but states that the species is found at several places in North and East Guatemala and plentifully in the valley of the Polochic River. Nevertheless it is seldom seen in English collections, and I believe it is not represented at the British Museum. The rather small specimen figured was chosen because it shows the markings of the interior more plainly than others in my possession.

Large specimens of *A. Cumingii*, King from Panama are often rather like *delattrei* in shape and colour, but *Cumingii* is always smaller and thicker, and more flattened at the sutures. Moreover the internal markings of *delattrei* are fine and regular, whereas the mouth of *A. Cumingii* displays a characteristic scribble of heavy belts, which do not run evenly parallel to each other, but sprawl all ways, especially at their terminations. These markings are almost as specific as the unmistakable "clouds" in the same region of *A. impervia*, *Philippi* and its variety *nubila*, Reeve.

A. PULCHRA, Gray
Plate IX. fig. 3

Ampullaria pulchra, Gray, Griffith Ed. Cuvier, pl. I., f. 6; Sowerby, Proc. Mal. Soc., London, VIII., p. 356; *vide* Sowerby, 1. c. = *A. Hanleyi*, Reeve, Conch. Icon. Amp., f. r 3; von Martens, Malak. Blätt., IV., p. 193. NOT *A. hanleyi* of Nevill, Hand List of Mollusca, pt. II., p. 8.

Sowerby makes Reeve's *A. Hanleyi* a synonym of this. The type specimen of *Hanleyi* at the British Museum is a very thin shell, and appears to be the young state of our present species, which when adult is rather solidly built than otherwise,

A. pulchra well deserves its name; it is a beautiful shell, strong and graceful in form, yet of a singularly light appearance, due to its delicate colouring. It is almost the palest of the Western species, the general tint being a kind of ivory yellow, well characterised in von Martens' description of *Hanleyi* as "griseo-flava." My figure is taken from a remarkably fine specimen, but a larger, strongly malleated example, which I obtained later on, has a more decided tinge of green in its colouring. This second specimen is marked "La Plata," which locality is probably correct. No habitat is given for Reeve's *Hanleyi*, and *pulchra* is only assigned vaguely to South America.

The spiral whorls, which are of a dark lead-colour, make a beautiful contrast to the body-whorl. The latter is very regularly belted with narrow bands, which are partly obsolete on the front of the shell, but appear distinctly in the mouth. The general colour of the aperture is pale reddish; the lip and columellar margin are light yellow. The columellar margin is not quite sufficiently oblique in my figure.

The darker and thinner *A. Hanleyi*, which I believe to be the young shell, has been the occasion of a curious mistake on the part of Nevill, who records a series of seven in the Calcutta Museum as from Ranomafana, Madagascar! Reeve gave no habitat for his species, but his figure, especially in the markings of the aperture, bears a superficial resemblance to certain states of the much more recently described *A. madagascariensis*, Smith. I have no doubt that it was the latter species which Nevill actually had before him. Reeve's figure, though a fair likeness of the type specimen, is not very highly finished, and would hardly suggest to anyone who had not seen the shell a connection with *A. pulchra*, which, by the way, appears to have been at one time known among collectors as *A. sordida*, Sowerby. The real *A. sordida* which anticipated this, was a Swainsonian species of quite different character, and the name must soon have ceased to be used for our species, but it sometimes appears on old labels, and is in fact attached to one of my specimens.

A. REFLEXA, Swainson
Plate IX. figs. 4, 5, 6

Ampullaria reflexa, Swainson, Tilloch's Philosophical Magazine, Vol. 6r, p. 377, 1823, and Zool. Illust., Ser. I, Vol. III., pl. 172; the latter copied in Philippi, Mon. Amp., pl. 3, f. , with descript. no. 9, p. 12; Mousson Malak. Blätt., XII., 1869, p. 182; Fischer and Crosse, Miss. Scient. Mex., Vol. II., p. 238; von Martens, Biol. Centr. Amer. Moll., p. 409. As var. of *Hopetonensis*, Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., P• 353.

NOT the *Ampullaria reflexa* of Philippi, Mon. Amp., pl. 9, f. 6, pl. 14, f. 3, pl. XVIII., f. 4, and f. 6; nor of Pfeiffer, Nov. Conch., I., p. 50, pl. XIII., ff. r-9; nor of Hanley, Conch. Miscell. Amp., pl. IV., f. 14; nor of Reeve, Conch. Icon. Amp., f. 69.

I have already, under *A. Costaricana*, Martens, referred to the widely different forms described under this name. Some of these mistakes in identification are

possibly due to the scarcity of Swainson's Zoological Illustrations, which, being issued for a very limited number of subscribers, soon became difficult to procure. Anyone, however, who has studied the original figures of *A. reflexa* will agree with Fischer and Crosse that the shell is "perfectly characterised." Opinions differ as to whether it is a variety of *A. flagellata* or an independent species, but it is in any case a highly individual form.

Its chief characteristic, apart from the reflected lip to which the name alludes, is, perhaps, the high-shouldered appearance of the shell, which shows quite a long line between the top of the body-whorl and the upper angle of the aperture. The spire is high, having a very gradual and elegant slope at the sides, and the outer edge of the aperture is beautifully curved. The bands are narrow, well-defined and continuous. Swainson did not know the locality of his species, though he seems to have been acquainted with numerous specimens of it. Philippi gave Mexico, Yucatan and Honduras for various samples of his composite *reflexa*. One of these items—that figured at f. 6 of his 9th plate has been taken by Hanley as representative of the species, and that author has figured a similar, but smaller specimen under the same name in his Conchological Miscellany. Hanley's figure appears to me to represent a small form of *A. paludosa*, Say, of which I have specimens from Cuba. One of these is figured (pl. IX., f. 4) for purposes of comparison, though it is right to add that Hanley questioned the identity of this form with Swainson's species. The Cuban example is a pretty little shell, lightly malleated and dark in colour—glossy olive outside and brown within, the outer lip salmon-coloured and slightly reflected. But this is not Swainson's *reflexa*, of which the habitat remains almost as doubtful as the identification. In the *Biologia Centrali Americana* von Martens states that specimens very like the original figures were found near Cordova in Mexico. But he would not definitely name them *reflexa* because Mousson l.c. had applied this to specimens from the Magdalena River, and because the Berlin Museum possessed shells from Cuba which were even nearer to the type than those from Mexico. Messrs. Fischer and Crosse noticed specimens in the Morelet collection labelled "Central America," and others in the Sallé Collection marked "Mexico," but these localities were not based on the personal knowledge of the owners. Two beautiful specimens in the British Museum (original label "*zonata*," corrected) are without locality. My big specimen has an old MS. label "Magdalena Colombia" Mousson's locality, which is probably correct.

PL. IX., f. 5. A young specimen in which the colouring is not fully developed inwardly or outwardly. Epidermis rich olive yellow, tinged with reddish on the spire. Bands hardly visible on the front of the shell, but definite and continuous on the back. Mouth apparently still wanting the last coat of enamel, fulvous brown, closely banded, and clouded near the lip with bluish grey. Lip already well reflexed, dirty white crossed by the brown internal bands.

PL. IX., f. 6. A very old shell, much larger than that figured by Swainson. As that author states to be the case, with large examples, the general hue of the mouth is rather chestnut than purple. The epidermis in this specimen is obviously somewhat discoloured by age, and on the front of the shell inclines to brown, but is greener at the back, where there is a good deal of heavy malleation in the last growth-stage. Banding regular and continuous on the front.

A. FLAGELLATA, Say (A. MALLEATA, Jonas)

Ampullaria flagellata, Say, New Harmony Disseminator 11., p. 22 (1827); Haldeman, Monogr. Limniades N. America VIII., p. ; Philippi, Mon. Amp., p. 36, pl. 9, f. 7; W. G. Binney, Check List of Shells of N. America, fluv. gastr., no. 459; Land and Freshwater Shells of N. America, pt. I I I., p. 7; Strebel, Beitr. Mex. Land and Süßsw. Conchyl.

1, P. 26, pl. 3, f. 14, pl. 3a, ff. 14a-k and 15; Fischer and Crosse, Miss. Scient. Mex. Moll. II., p. 239; von Martens, Biol. Centr. Amer., p. 405, pl. XXIII., ff. r, 4, 4a, 4b (several varieties also figured and named); Pilsbry, Proc. Acad. Philad., 1891, P. 325 as var. of *Hopetonensis*, Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., P. 352.

Ampullaria malleata, Jonas, Zeitschr. fir Malak., 1844, P. 35, and Abhandl. Ges. f. Naturw. Hamb., r, P. 122, pl. X., f. I r (1846) ; Philippi, Mon. Amp., p. 58, pl. 18, f. 6 (as var. of *A. reflexa*; figure numbered only in the letterpress); von Martens, Malak. Blätt., IV., p. 89; Reeve, Conch. Icon. Mon. Amp., f. 32; W. G. Binney, Check List of the Shells of N. America, flay. Bast., no. 460; Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., p. 234, pl. XLV., f. , and pl. XLVI, ff. r, 2, 2a, 2b; *Ampullaria flagellata* var. *malleata*, von Martens, Biolog. Centr. Amer. p. 411, pl. XXII, f. ¹⁰

; Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., P. 352 (as var. of *A. Hopetonensis*, Lea =*paludosa*, Say).

The greater part of the Western *Ampullaria* region is inhabited by a species, apparently very abundant, and variable to an extent which fills the investigator with dismay. It is in fact the *Ampullaria, par excellence*, of America, and is seldom absent from any collection made in the tropical portion of that continent.

Considering its immense abundance and wide distribution we may reasonably infer that this shell was among the first of its genus to reach the collectors of Europe and it may have been one of the five species of "Pomus" catalogued in the "Museum

Calonianum" of Humphrey ⁽¹⁷⁹⁷⁾. At that time and for long afterwards conchologists

had few opportunities of comparing extensive series from different localities, and many forms of this shell were taken for independent species. Reeve's *A. veta* and *A. flatilis*, for instance, may be fairly put down as simple varieties of it. When its enormous variability began to be suspected, reaction carried the "lumping" process much too far, and most shells having the characteristics of the group were assigned to one or other of the two early names given above-to *malleata* if they were malleated,

and to *flagellata* if they were not.

We do not now ascribe so much importance to malleation as a specific character, and its absence from Say's diagnosis affects very little our estimate of his species. Unfortunately he omitted to figure it, and gave no definite locality; his description was not very precise, and his type was, apparently, supposed to be lost. This at all events seems to have been the view of Messrs. Fischer and Crosse, who state that "It is nearly impossible at the present time (1890) to recognise with certainty the *Ampullaria flagellata* of Say." They give no figure, and declare that they have seen no specimen like the representation supplied by Philippi from a shell collected at Vera Cruz, where Say began his journey to Mexico. Also that Strobel, who collected at Vera Cruz and gave a series of figures from local *Ampullariae*, has depicted nothing like Philippi's *flagellata*.

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Dr. Pilsbry, however, after examination of the types, was able to assert the identity of *malleata* and *flagellata* in 1891, one year after the latter had been thus given up as hopelessly unrecognisable. This identity had been suspected by Strebel and by Fischer and Crosse themselves, but had not before been definitely established. Of the two names at the head of this section *flagellata* will now take precedence as the older, and *malleata* will rank as a varietal name. In the latter capacity it has been employed by von Martens (*Biologia Centrali-Americana*, p. 41) for a particular form of this almost universal Western species.

A. malleata and *A. flagellata* being one species to what particular phases of it were these names originally applied? The second, which, as we have seen is really the rightful designation of the species is restricted by von Martens to the specimens from Eastern Mexico, and those similar to them. These, according to his figures and description, are of comparatively small size, and show an *ovate* form, a rather obtuse spire, a superficial suture, and an outer lip more or less expanded in its lower part. His *malleata*, agreeably to the figures of Jonas and Reeve, is a somewhat larger and more globose type, with a more acute spire and a lip less prominently expanded.

According to the same author, malleation is, as one would expect, common to both, but it appears to be more conspicuous in *malleata*, having earned for this form its original designation.

Of *flagellata*, von Martens writes as follows : "Say does not mention the malleated impressions, but his name *flagellata* (lashed, scourged) can hardly be understood otherwise than as an allusion to them."

Messrs. Fischer and Crosse have what appears to me to be a better suggestion as to the origin of the name: " It may just as well be derived from the obscure belts adorning the shell."

This is a useful hint, and its significance in regard to *flagellata* is enhanced by the fact that *malleata*, as appears from the figures and descriptions of Jonas, Reeve and von Martens himself, is devoid of bands altogether. We may therefore, perhaps, consider *flagellata* as an ovate shell, very variable, but mostly banded, and *malleata* as a fairly constant variety, globose and without bands.

But, with all respect for so great an authority, I must take exception to one character which von Martens has cited for typical *flagellata*-viz. the obtuse spire and to the figure which illustrates it- *Biolog. Centr. Amer.*, pl. 23, f. 4. The shell there represented agrees precisely in shape with my pl. IX., f. 8-an utterly distinct type, which I believe to be Philippi's *A. phaeostoma*. Moreover the figures by Strebel, which von Martens quotes for his typical *flagellata* are all against him. Variable as the species is, a conchologist's imagination cannot conceive of any form which would bridge the gap between this figure of von Martens and Strebel's series. The latter

all have an acute spire and a quite different general shape. The shells figured by both authors appear to have come from Vera Cruz, and it is practically impossible that *the same district* should have produced two such divergent forms of the same species. I cannot avoid the conclusion that Strebel's figures represent true *flagellata*, but that von Martens, making too much allowance for the notorious variability of this shell, has represented, in the particular figure referred to, an entirely different species.

Indeed, as already hinted, the process known as " lumping " has been carried much too far in this particular group of *Ampullariae*. Messrs. Fischer and Crosse (*Mission*

Scient. Mex. Moll., Vol. II., p. 237) write: "This species (*malleata*) has been confounded with several forms which we consider distinct." This observation, made over thirty years ago, needs to be repeated and emphasised. G. B. Sowerby iii. in his revision of *Ampullaria* assembled twenty-two named forms under sixteen headings as varieties of *A. Hopetonensis*, Lea (= *paludosa*, Say) an entirely distinct species and belonging, apparently, to a part of the Western region not frequented by any form of *flagellata*.

These so-called varieties include *flagellata* itself, and also *malleata* I Apart from the latter I have selected for illustration five forms which appear to me to be quite distinct from *flagellata*, although of course they may be merely local phases or varieties of that Protean species. Authorities are pretty evenly divided in the case of most of them. But before I proceed to give detailed notices, I should like to conclude this general summary with a few words on a difficult and doubtful species included by Messrs. Crosse and Fischer among the six forms which they consider to have been confounded with varieties of the common shell.

A. VIOLACEA, Valenciennes

Ampullaria violacea, Valenciennes in Humboldt and Bonpland's Obs. Zool., II., p. 259 (1833); W. G. Binney, Land and Freshwater Shells of N. America, pt. 111., p. 7; Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., P. 241, pl. 46, ff. 4, 4.1 and 8, and pl. 48, f. 6; von Martens, Biol. Centr. Amer., p. 414, pl. 22, f. 3; Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 358.

NOT the *Ampullaria violacea* of von Martens, Malak. Blätt., ?III., p. 52.

Of Fischer and Crosse's four figures two (pl. 46, ff. 4 and 4a) were made from Valenciennes' type specimen in the Paris Museum. On the others (one of which, after a sketch by Morelet, includes the living animal) doubt has been thrown by von Martens, who considers that they represent *A. flagellata*, and that Morelet's localities for *violacea*-ucatan and Tabasco-cannot be safely accepted. Bonpland and Valenciennes simply indicated Mexico; specimens in the Deppe and Dunker collections were said to be from the western coast of that country, in particular Acapulco (Dunker).

One of Dunker's specimens has been figured by von Martens 1. c. It is much larger than the figure of the type, and is otherwise so entirely unlike it in shape, colour and marking that it is difficult to see how von Martens could have assigned it to the same species.

Unfortunately Fischer and Crosse's figures which should have been authoritative -I refer to those made from the type specimen-are not altogether satisfactory, and hardly come up to the standard of almost unsurpassable excellence exhibited in most of their *Ampullaria* portraits. They represent front and back views of the same shell, yet one, unless I am altogether mistaken, is a trifle larger than the other, and the proportions, more especially in regard to the spiral whorls, do not seem to agree perfectly.

What von Martens means by "the peculiar shape of the type" is, in view of his

own very different figure, rather hard to understand, nor are the distinguishing characters given by Fischer and Crosse at all decisive. They are all concerned with points on which *Ampullariae* are very inconstant, and the light colouring of the upper part of the aperture, on which von Martens rather insists, is a character which may be found in almost any Western species.

I have seen several alleged examples in collections and have myself possessed some, which might fairly be referred to one or other of the figures quoted as authorities, but have refrained from giving portraits of any of them, having found nothing either in my own specimens or elsewhere which could satisfy me that these supposed *violacea* were not small forms or varieties of the common *A. flagellata*. As von. Martens himself says : "The species must remain doubtful until further examples are obtained."

We will now pass on to discuss in brief detail the forms figured from pl. IX., f. 7, to pl. X., f. 4, inclusive. All of these may be, and indeed have been, regarded as phases of one species, but they are here, with a single exception, advanced as distinct. The exigencies of space have put them out of their correct order on the plates. The strict sequence should be

A. flagellata

„ var. *malleata* *A. livescens*

A. dysoni

A. phaeostoma

A. oajacensis

A. porphyrostoma,

but, for convenience of reference we will take them in the order of their representation.

A. MALLEATA, Jonas (Var. of *A. FLAGELLATA*, Say

Plate IX. fig. 7 (for synonymy see above)

Globose, with regular, lattice-like malleation, especially evident on the front of the shell, where the epidermis is almost entirely worn away, showing the blue-grey ground colour. Spire tinged with purple. Back of the body Whorl uniform olive-green with no trace of bands. Aperture livid reddish, the upper part, lip and columellar margin ivory white. A few dull red dashes, probably indicating the sites of obsolete bands, on the lower part of the lip.

Ampullaria phaeostoma, Philippi, Mon. Amp., p. 45, no. 62, pl. 13, f. 3 ; as *A. flagellata*, Say, von Martens Biol. Cent. Amer., p. 409, pl. 23, f. 4; as var. of *A. Hopetonensis*, Lea (=*paludosa*, Say), Sowerby, Proc. Mal. Soc., Lond., VIII., p. 352.

Perhaps the *Ampullaria* collected by Wallis on the Magdalena River and described by Mousson as Philippi's *A. phaeostoma* in Malak. Blätt., XII, 1869, p. 182.

The shell here figured agrees perfectly in all essential points with Philippi's rather rough but characteristic figure. It is ovate in shape, with a high and broad, bluntly pyramidal spire, narrow umbilicus, and slightly reflected lip. These characters may also be remarked in the figure and description of von Martens, l. c., which I believe to be wrongly assigned to typical *flagellata*, and they are present in the note by Mousson cited above.

Martens' figure, which is rather defective in its general colouring, does not show very plainly the characteristic dark aperture from which the shell takes its name, but his description states that the interior is usually dark purple-brown with yellowish peristome. This corresponds very well with Philippi's figure and with my specimens, which came from Cordova, Mexico, a locality given by von Martens. Philippi did not know the locality of his specimen. Mousson, whose description seems very apt, gave "lower Magdalena River" a widely distant habitat but not by any means impossible for a member of the widely distributed *flagellata* group, to which this shell undoubtedly belongs, though it seems to me to be a quite independent species.

The surface is highly polished and the colouring very attractive—in the main a cool, deep olive-green with numerous faint but perceptible linear bands and vertical streaks (the latter well indicated in Philippi's figure). The mouth, as noted above, is dark with a purplish tinge, and the lip and columellar margin generally pale yellow.

A. LIVESCENS, Reeve Plate IX. figs. 9 and 10

Ampullaria livescens, Reeve, Conch. Icon. Amp., f. 21 ; as var. of *A. Hopetonensis*, Lea (=*paludosa*, Say), Sow. Proc. Mal. Soc., Lond., VIII., p. 352.

NOT the var. *melanostoma* of *A. flagellata* described and figured by von Martens in the Biol. Centr. Amer., p. 41, pl. 22, f. 7, as =Reeve's *liveocens* and with references to Philippi and Strebel.

This is very like *A. flagellata*, var. *malleata*, but it is constantly smaller and darker, has a proportionately broader spire, and is regularly banded. The last character is somewhat significant, inasmuch as *malleata*, which is, for an *Ampullaria*, rather constant in type, as a rule shows hardly a trace of bands.

Reeve's *A. livescens* was at first considered by von Martens to be the same as *malleata* (Mal. Blätt., IV., p. 190), but in the *Biologia Centrali Americana* (Moll., p. 411) he gave them equal rank as separate varieties of *flagellata*, putting Reeve's name, however, into the synonymy, and adopting Parreyss' *melanostoma* on the strength of a figure which Philippi gave of the latter. Philippi meant by this figure (Mon. Amp., pl. 18, f. 4) to illustrate Swainson's *reflexa* or a variety thereof, which was obviously wrong, but von Martens, who in all probability had not seen a specimen of Reeve's *livescens*, was equally mistaken in supposing that it was represented here. The specimen shown has a nearly flat spire, and is much too ovate for *livescens*. The reference to Strebel is not in any way happier. Apart from an obvious mistake—the references given by von Martens to page and plate do not tally—the *Beitrag*, so far as one can judge from its outline figures, gives no representation of any form which can be referred to Reeve's species. Nor do Crosse and Fischer figure any *Ampullaria* which is like it. The *A. melanostoma* of von Martens himself is a small and not uncommon variety of *flagellata*, having the ovate form characteristic of that species.

Reeve gave no locality for his *livescens*. Fischer and Crosse conjectured that it might come from Mexico or Guatemala, but gave no detailed notice of it, and indeed it is somewhat remarkable that the three great works which deal principally with the mollusca of Mexico include no account of the real species. It is probably not found in that country. My specimens apparently came from Guatemala, and are labelled "Quirigua," a place about sixty miles from the coast. I have figured two of them as

follows •

PL. IX., f. 9. A young specimen, very thin-shelled, and of a reddish olive hue, regularly and thinly banded. Aperture still rather light in colour, generally of a vinous red, barred with a deeper tint of the same. Upper part of the mouth lip and columellar margin yellowish white.

PL. IX., f. 10. A well developed shell, much malleated on the back. Dark sagegreen, regularly banded, spire lead-coloured. Aperture dull purplish, the upper part and the whole peristome yellowish white. The bands show plainly in the mouth above, where the ground colour becomes lighter. A bluish patch inside the base of the columellar margin.

A. OAJACENSIS, Fischer and Crosse

Plate IX. fig.

Ampullaria malleata, var. *oajacensis*, Fischer and Crosse, *Miss. Scient. Mex. Moll.* II., p. 235, pl. 46, ff. 3, 3a, 3b; *Ampullaria flagellata*, var. *oajacensis*, von Martens, *Biol. Centr. Amer.*, p. 41 r.

It is rather hazardous to place this as a separate species, inasmuch as its original describers, and also von Martens, regarded it as a mere variety of *malleata* or *flagellata*. But among the forms of this group I do not know of one that approaches it at all closely, and I cannot see the resemblance which von Martens found between this and Philippi's supposed *flagellata* (Mon. Amp., pl. 9, f. 7). The nearest to it in colour is Reeve's *A.*

flatilis, Conch. Icon. Amp., f. 31, but this has a different shape, and also, apparently, a different kind of sculpture. It is described as "longitudinally striately scratched," whereas our present species has a very regular and pretty system of minute malleation.

The shell selected for figuring is broader than my other specimens, and therefore less like Fischer and Crosse's presentment. It was chosen on account of the freshness of its colour, whereas its companions have the greyer tone of the original figures. The spire is lead colour, with a black tip; the body-whorl is of a bright greenish umber, with several slender bands on the back, having also a series of vertical stripes of a warmer tint, which probably indicate growth-stages. These are well shown by Fischer and Crosse. The mouth is dark brown inside, paler above as usual, and the lip bright orange, not yellow as in Reeve's *flatilis*.

The operculum, of which Fischer and Crosse have given an excellent figure, is singularly characteristic, being light coppery red, instead of the usual horny brown.

The shell is named after its habitat in Mexico—the state of Oajaca, where it has been found at Monte de Mistan.

A. PORPHYROSTOMA, Reeve

Plate X. fig.

Ampullaria porphyrostoma, Reeve, Conch. Icon. Amp., f. 30; as var. of *A. Hopetonensis*, Lea (= *paludosa* Say), Sow. Proc. Mal. Soc., Lond., VIII., p. 353•

Fide von Martens (Malak. Blätt., IV., p. 188), Reeve's *A. porphyrostoma* = *A. Chemnitzii*, Philippi, Mon. Amp., p. 39, no. 52, pl. to, f. 5, exclusive of Philippi's references to Chemnitz. Apparently not the *A. Chemnitzii* of Drouet, Moll. Guy. Fran., p. 80, pl. IV., f. 47.

The specimen here figured is not specially typical of *A. porphyrostoma*, which is an abundant and well-known species, rather constant, for an *Ampullaria*, in its colour and markings, and also remarkably uniform in size. It usually appears as a light, ovate shell, with thin epidermis of a pale yellow or green hue, the slender banding faint, but distinct. There is seldom much malleation. The interior, light above, is in the main dark violet brown, the lip yellowish, generally, but not always, darker in its lower part, and showing traces of the internal bands. In some of my specimens the lip is dark orange-red, without markings. In that figured, a pretty variety from Ecuador, the body-whorl is straw-yellow, the bands more clearly marked than usual, and the lip bright orange.

Reeve gave no locality for his species, nor did Philippi for his *Chemnitzii*, which von Martens, considered to be identical with this. I have one or two small specimens which look very like Philippi's figure, but this was made from an uncoated shell and consequently shows the bluish ground colour common to many *Ampullariae* in that state. On this account Philippi seems to have considered that his shell was identical with the larger "Cordon bleu" figured by d'Argenville in 1757, adopted by Lamarck, along with *A. ampullacea*, as the type of *Ampullaria*, and subsequently (1822) re-named by

him *A. fasciata*. Under the latter designation (now obsolete) it appears in Enc. méth., p1. 457, f. 3, a, b. Philippi's reference to a figure in Chemnitz, presumably the reason for the name he gave to his species, is rejected by von Martens, on the ground that the figure quoted occurs among others representing *A. globosa*, and is not distinguished from them in the text. Indeed, Philippi's own figure does not afford much assistance towards correct identification, partly on account of the unsatisfactory state of the specimen, which he seems to attribute to a deciduous epidermis ("epidermide - tenuissima? caduca?-" in the diagnosis), and partly because the design itself is very rough and ill-coloured; in the latter respect it is quite at variance with the description, which corresponds much more closely with Reeve's *porphyrostoma*. If we could establish its identity with the aid of the figure, Philippi's *Chemnitzii* would, of course, take precedence of this, Lamarck's *fasciata* being obsolete. Drouet's *Chemnitzii*, from the Oyapoc River in French Guiana, appears to me to be quite a different shell; it is described as having "a deep suture, as it were channelled," whereas *porphyrostoma* has here the characteristic level slope of the *flagellata* group. From all the other members of this, however, it seems to be quite distinct, being in fact, as observed above, rather constant for an

Ampullaria, always instantly recognisable and providing no intermediate forms. Its nearest ally is probably *A. reflexa*. It comes in abundance from Colombia, and would also appear to occur in Ecuador.

A. FLAGELLATA, Say

Plate X. figs. 2 and q.. (For synonymy see above).

PL. X., f. 2. On account of its bright coloration and well-developed bands-the latter being presumably the reason of the specific name-I have chosen this shell from a small series that appears to have been taken in Nicaragua. Central American specimens are generally, as far as I have observed, better marked than those from Mexico.

The spire is smaller and more acute than in the last species, and the whole shell shorter and squarer in shape. The bands are broader and better defined, and the general colouring is more variable than in *porphyrostoma*.

This particular specimen is a very pretty example of its kind, bright olive yellow, darker on the spire (which is tinged with reddish) and closely banded within and without. The ground colour of the interior is fulvous brown, warming to orange on the extreme edge of the lip.

PL. X., f. 4. An unlocalised variety, very like Fischer and Crosse's *A. Yucatanensis*, but lacking its peculiar sinuation of the outer lip. Upper whorls of the spire reddish, apex black. The rest of the shell delicate grey-green, the bands faintly marked, but quite distinguishable. Closely striated, vertically, with thin green lines. Mouth dark purple-brown, with the usual pale upper area, in which the bands show reddish. Peristome white.

This small specimen, although very unlike the preceding in colour, and also somewhat different in shape, the body-whorl sloping more abruptly downwards, is only one of the

endless varieties of *flagellata*. It agrees fairly well in shape with Strebel's fourth variety of that shell as figured in outline in the "Beitrag," pt. 1, pl. I I I., a, f. ^{14h}, and is entirely in accord with the description on p. 30 of the same part, making due allowance for fresher condition in my specimen. Strebel's was apparently sent from a distance "dead." It came from Misantla in the State of Veracruz, Mexico, but without any precise indication of locality, and Strebel seems to hint that it may have had a more remote origin. He says it "is quite characteristic . . . the colouring and the epidermis . . . different from any that have been described hitherto." Apparently he regarded it as an unusual form, and I have seen no other specimen than that figured here.

A. DYSONI, Hanley

Plate X. fig. 3

Ampullaria Dysoni, Hanley, Conchological Miscellany, *Ampullaria*, pl. 2, f. ;
 Reeve, Conch. Icon. Amp., f. ⁴⁹, von Martens, Biol. Centr. Amer., p. ⁴¹⁷, as var. of
A. Hopetonensis, Lea (= *paludosa*, Say), Sowerby, Proc. Mal. Soc., Lond., VIII., p. 352 (all the synonymy given by Sowerby should be expunged).

Sowerby is probably the only author of repute who has denied specific rank to this very remarkable *Ampullaria* from Honduras. It appears to be rare, and the few examples that I have seen were much alike. Hanley's original figure gives a very fair idea of it, but Reeve's is less characteristic, the specimen from which it was taken, then in the Cuming collection and still, apparently, preserved at the British Museum, being the least typical that I have met with.

The general colour is a peculiar reddish grey, almost exactly the tint of freshly cut cedar wood, darker on the spire, and relieved by a narrow edging to the suture of the body-whorl, and a thick varix on the front of the shell. These are buff yellow. The whole shell is very stout and strong, highly polished and much malleated. There are several thin bands, as shown in Hanley's figure, principally in the region of the umbilicus. The interior of the aperture, buff yellow at the top, is, in the main, pale livid reddish, and the peristome is edged with dull orange. The parietal callus is pale, marbled with grey from the underlying marks showing through.

A. Dysoni concludes the series of forms in the *flagellata* group, which are here figured as distinct species. There are, however, several other forms which should, possibly, be recognised as independent. Some of these I possess in defective condition, others appear to be, at present, unprocurable. I am obliged, therefore, to be content with the repetition of a remark already made, viz. that the "lumpers" would seem to have been too busy with this group. Variable *A. flagellata* undoubtedly is - very much so - but too many varieties have been attributed to it. This species has become a kind of dumping ground for every perplexing *Ampullaria* from America. It is time that some of these supposed varieties were carefully investigated.

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A. GHIESBREGHTI, Reeve (emend. Fischer and Crosse Plate X. fig. 5

Ampullaria Ghiesbrechtii, Reeve, Conch. Icon. Amp., f. 123; *Ampullaria Ghiesbreghti*, W. G. Binney, Land and Freshwater Shells of N. America, pt. III., p. 7; *Ampullaria Ghiesbreghti* Reeve, Strebel, Beitr. Mex. Land- und-Süssw-Conch., pt. 1, p. 31 and 32,

pl. III., f. 16, vide also p. 30 and pl. VII., f. 15a; *Ampullaria Ghiesbreghti*, Reeve (emend.), Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., p. 233, pl. 47, f. 8; *Ampullaria Ghiesbreghti*, Reeve, Sowerby, Proc. Mal. Soc., Lend., VIII., p. 349.

This species has normally a broad and brilliantly red lip. But like other *Ampullariae* which are ornamented in similar fashion, it varies a good deal in this particular. *A. guyanensis*, as may be seen on plates III. and IV. of this work, has the peristome sometimes red and more rarely orange, or even pale salmon-colour. Another red-lipped species, *A. speciosa*, shows a variety of tints ranging, in various examples, through orange and yellow to ivory white. A similar phenomenon, but less marked, is to be noted in the case of *A. globosa*, where the lip is normally orange-red, but not infrequently appears absolutely devoid of colour, even in the freshest specimens.

I have seen examples of our present species in which the lip was pale brown or citron, but only one, besides the subject of our figure, in which it was white. This second specimen, now in my possession, is old and chalky, but the lip shows no trace of any former colouring. The large shell figured, is, on the other hand, in excellent condition, but, as will be seen, it has been slightly cut down along the lower part of the lip. Just below the middle a trace of the normal red colour may be distinctly seen, but the white lip is not in any way due to fading.

The front view of the shell shows hardly any malleation, but the back is almost entirely covered with the elaborate lattice-work characteristic of *Ghiesbreghti*. In other respects the shell is entirely normal, and shows all the marks of the species—the low sharp spire with rather sunken suture, defined by a belt of lighter colour, the almost complete freedom from external bands, the swollen shape of the body-whorl, broadest above the middle, and the deep, funnel-shaped umbilicus. In colour it is externally almost uniform olive-green, the interior of the aperture reddish brown with a dash of purple; the upper part light-coloured as usual. There are a number of indistinct, closelyset bands in the mouth.

This shell is without locality, but the species is known to occur in several parts of Mexico. My smaller white-lipped specimen bears the label "Rio de Tabasco, Mexico.

Berendt."

A smaller red-lipped species, Reeve's *A. miltocheilus*, Conch. Icon. Amp., f. 120, has been ascribed to *A. Ghiesbreghti* as a variety by von Martens (Biol. Centr. Amer. Moll., p. 418). Fischer and Crosse, to whom it was apparently unknown in nature, retained it as a separate species, while Sowerby, by what must surely have been an oversight, put it among the synonyms of *A. Cumingii*, King, with which it has no affinity whatever. Although it was originally described from Mexico, it is almost certainly identical with *A. quitensis*, V. d. Busch (P.Z.S., 1859, p. 168), said to have

been found in Ecuador and at an altitude of between 2000 and 2800 mètres. If this is correct and the British Museum's specimen of *quitensis* seems to be indistinguishable from *miltocheilus*—the range of the latter species is very much extended. Indeed the Museum has also specimens of *Ghiesbreghti* said to be from New Granada, and it may be that both of Reeve's species have a wider distribution than was known to the standard authors on our genus. But, apart from this possibility, it is very unlikely that the same district in south-eastern Mexico should have produced a species in two such distinct forms as *Ghiesbreghti* and *miltocheilus*, and the first locality given by von Martens for each is the Province of Chiapas, in which they were collected by Ghiesbreght. I have had but few specimens of *miltocheilus*, and have found it rare in collections, but it appears to me to be very constant and quite distinct from *Ghiesbreghti*. It is much more globose, the greatest width being below not above the middle of the body-whorl, the spire is proportionately wider at the base, and the whole shell thicker. In size it is remarkably uniform, and seems never to approach the proportions of adult *Ghiesbreghti*, the latter being among the largest of the Western Ampullariae. *A. miltocheilus* is also regularly and distinctly banded on the outside. The absence of this almost universal ornamentation is characteristic of *Ghiesbreghti*. Only the faintest indications of it are seen in occasional specimens.

A. NOTABILIS, Reeve

Plate X. fig. 6

Ampullaria notabilis, Reeve, *Conch. Icon. Amp.*, f. 63; Sowerby, *Proc. Mal. Soc.*, Lond., VIII., p. 355.

Reeve gave no locality for this species; Sowerby assigned it to Peru. The British Museum specimen is unlocalised, and I feel some doubt as to the real habitat, not having found in any collection a specimen with a really authoritative label. *A. notabilis*, in spite of its name, has not been much noticed by conchological writers, and it may, perhaps, be only a local form of the next species (*A. paludosa*, Say), which is notoriously variable. The chief points of difference in *notabilis* are the (generally) lower spire, the wider aperture, beginning nearer the top of the body-whorl, and more contracted in its lower part, and the longer, straighter and more slender columellar margin. Minor differences are the thinner shell, the usually profuse malleation (not, of course, a constantly dependable character), the pale colour and thin external banding, and the remarkable vividness of the bands in the widely expanded mouth. The shell is generally seen in a rather worn state, and its colour has an indefinably "washed out" appearance.

I have not met with any other specimen in the fresh condition of that here depicted which seems to me to throw quite a new light upon many of the characters shown in Reeve's figures. The low, stumpy spire of the latter, undoubtedly ground down, is here seen in sharply-cut perfection, the malleation, though present, is not extensively developed, and the faded colouring of Reeve's shell is replaced by a rich olive tint on the body whorl, and a warm fulvous tone (instead of pale yellow) on the columellar margin and outer lip. The external bands are beautifully defined, especially on the back of the shell.

In the Introduction I have stressed the importance of internal markings and colour in *Ampullariae* for the reason that these are at the last point of contact with the living animal's body, and have therefore been protected from the changes due to accident or fading. The present specimen of *notabilis* seems to supply corroboration of this principle. In its extraordinary fresh condition it amounts almost to a resuscitation of Reeve's species, yet the one point in which it has no advantage of the *Conchologia Iconica* figure is the handing of the aperture. This is equally vivid in both - dark brown in colour -and seems to be as characteristic of the species, as the "cloud marks" of *A. nubila* or the sprawling internal bands of *A. Cumingii*. Here it shows up strongly against the ground-colour of the aperture, which is pale yellowish brown. The whole shell is one of the most charming specimens of *Ampullaria* that I have met with. Unfortunately it is without locality.

I have seen young specimens of undoubted *A. paludosa* from Florida, which were so like *notabilis* in their pale colour, in their thin malleated shells, and, above all, in the widely expanded aperture, generally, in this genus, characteristic of immaturity, that I do not feel quite certain of the independence of Reeve's species, more especially as its habitat seems to be obscure. Moreover these young shells, the final enamelling of the aperture being still to seek, are often very brightly banded in the interior. But in them this banding never seems so free and dashing as in *notabilis*; the design is, so to speak, stiffer, and the dark streaks either stop short of the outer lip or are only developed thereon in very tentative fashion, instead of being carried boldly forward. In short, *notabilis* is one of the many *Ampullariae* whose "points" are more easily appreciated by the eye than defined in words. They may not amount to much, but are perhaps sufficient to give it specific rank, at any rate for the present.

A. PALUDOSA, Say Plate X. figs. 7, 8, 9, o

Ampullaria paludosa, Say, New Harmony Disseminator, 1829, Vol. II., p. 260; J. E. De Kay, Zoology of New York, pt. V., Mollusca, p. 124; Philippi, Mon. Amp., p. 52, no. 72, pl. 16, f. 4; as synonym of var. *Dysoni* under *A. Hopetonensis*, Lea, Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 351, emend. Bryant Walker, Vol. IX., p. 64.

Ampullaria depressa, Say (ex errore), Exped. St. Peter's River, 1824, Vol. II., p. 264, pl. 14, f. 2; Reeve, Conch. Icon. Amp., f. 111.

Ampullaria Hopetonensis, Lea, Trans. Amer. Phil. Soc., Vol. V., pl. XIX., f. 84 (1839); J. E. De Kay, Zool. of New York, Moll., p. 124; Philippi, Mon. Amp., p. 51, no. 71, pl. 16, f. 3; Reeve, Conch. Icon. Amp., f. 60; Sowerby, Proc. Mal. Soc., Lond., Vol. VIII., p. 351 (exclusive of all the synonymy except *A. paludosa*, Say).

This well known and characteristic species has experienced several changes of name. It was first described by Say as *A. depressa*, but two years previously Lamarck had appropriated that designation for a fossil species. The shell was then re-introduced as *A. paludosa*, Say, but owing, perhaps, to this alteration, it so far escaped recognition as to be once again described as a new species by Lea, and denominated *Hopetonensis*.

Its metamorphoses evaded Reeve, who figured both "*depressa*" and "*Hopetonensis*," but Philippi not only recognised that *depressa* and *paludosa* were identical, but also remarked of the latter, "It resembles in the highest degree *A. hopetonensis* . . . and differs solely in that the spire is lower to an inconsiderable extent." Philippi thus evidently suspected that the three names covered one species only, and in fact his figures -most excellent and characteristic-represent different states of the shell which we

now know as *A. paludosa*, Say. This name has priority over *Hopetonensis*. The latter was employed by G. B. Sowerby iii, as by most conchologists of the time, but Mr. Bryant Walker pointed out that that author, through using a reprint, had post-dated Say's name by eleven years-an oversight which just gave a fictitious priority to that of Lea.

Sowerby also placed *Hopetonensis* (sic) at the head of the *flagellata* group. It has nothing to do with these shells, and in fact occupies a region from which they appear to be absent. It is found in Georgia and Florida, in Cuba, and perhaps also in other islands of the West Indies. Apart from reasons of priority, it is well that this name, which Sowerby himself stigmatised as "rather unfortunate," has now been rightly

replaced by *paludosa*.

It is a common, but handsome and characteristic species, variable in colour and marking, albeit, when adult, pretty constant in shape and size. The spire, which is rather low and blunt with distinctly graded whorls, at once distinguishes it from all the *flagellata* forms with their sharper apex and flat sutures. The body whorl is globose, a good deal flattened at the top and sloping rapidly below. The outer lip is sometimes, especially in small and stunted specimens, enormously effused, and even a little reflexed.

PL. X., f. 7. A small specimen, unlocalised. Olive-green, streaked vertically with reddish. Distinctly banded on the front. Aperture pale yellow, clouded and streaked with tortoiseshell brown. Columellar margin pale yellow.

PL. X., f. 8. Dark olive with reddish varices. Bands very regular and plain. Mouth ruddy fawn-colour, beautifully banded with dark brown. A broad lilac stripe just behind the lip. Columellar margin very pale reddish. Cuba.

PL. X., f. 9. Olive green, the back vertically streaked with reddish, and distinctly banded. Aperture coloured almost exactly as in the preceding, but the hues and markings are not so well defined. Florida.

PL. X., f. 10. A large and handsome form, regularly malleated and thicker than usual. Early whorls of spire dark reddish, the rest of the shell olive yellow with a strong golden tinge and obscure green bands. Interior livid grey, passing into reddish, separated by a narrow light belt from a wide tract of rich orange, which extends to the lip, and upwards over the columellar margin and parietal callus. A dark brown crescent just behind the outer margin from centre to base. Florida.

The little Cuban shell which I figured at pl. IX., f. 4, to illustrate some early ideals of Swainson's *reflexa*, also belongs to *paludosa*. Certain local forms of the latter appear to have furnished Pfeiffer with material for his article on *reflexa* in the *Novitates Conchologicae*, Vol. , p. 50. The shells there described from South-western Cuba and illustrated on Pfeiffer's plate XIII., ff. r-9, do not belong to Swainson's species, but the descriptions accord pretty well with *paludosa*. Unfortunately the accompanying figures leave much to be desired, as Strebel truly remarked of them (*Beitrag. Mex.*, etc., pt. r, p. 29). On this account I have refrained from quoting Pfeiffer in the synonymy of our present species.

A. PRODUCTA, Reeve

Plate XI. fig.

Ampullaria producta, Reeve, Conch. Icon. Amp., f. 68; Sowerby, Proc. Mal. Soc., Lond., VIII., p. 356.

This singular species differs from every other *Ampullaria* known to me in its curiously drawn out aperture and evenly spotted lip. The appearance of tension, from which of course the shell derives its name, is increased by the rigid-looking columellar margin, and the wrinkling noticed by Reeve at the upper part of the body whorl. The whole shell has a "drawn out" effect. It appears to be rare, and I have seen it in but few collections.

One of my specimens is much darker in colour than Reeve's figure; the others are lighter. From the latter I have chosen one for figuring which shows some fresh characters. The spire, unusually complete and therefore hardly "rather obtuse" as in Reeve's description, is purplish grey, a colour which here and there on the body-whorl shows plainly through the thin green epidermis. The bands are regular and narrow, but not very distinct. Parietal callus broadly edged with black. Columellar margin and outer lip ivory yellow, interior of the aperture pale reddish, the bands well-marked and often coalescing. Their terminations are marked with singular emphasis by abrupt dashes of dark colour on the edge of the lip. These in the specimen figured are redbrown, and appear only on the upper and lower margins, but in the dark example already mentioned they are vividly black, and extend all round the circuit of the lip, from upper angle to base. This curiously characteristic spotting, whether partial or entire, is a feature of the species which can hardly escape recognition.

As was the case with so many of Reeve's new species, the locality of *producta* was unknown to him. Sowerby gives the rather vague habitat "Amazon River." The species palpably belongs to Dall's section *Limnopomus*, composed of solid, imperforate, or nearly imperforate species, which inhabit the highlands and mountain streams of South America. If *producta* is really an Amazonian species, we must probably locate it pretty high up the course of the great river. My dark specimen is very rough in texture, and the spire is ground down, as in Reeve's figure. These are generally indications of a mountainous habitat and of troubled waters.

A. OBLONGA, Swainson

Plate XI. fig. 2

Ampullaria oblonga, Swainson, Zool. Illust., 1st Ser., Vol. III., pl. 136; Philippi, Mon. Amp., p. 21, no. 24, pl. 5, f. 6, and pl. 10, f. 1; Reeve, Conch. Icon. Amp., f. 70; von Martens, Malak. Blätt., IV., p. 187, and Binnenmoll. Venez., p. 202; Sowerby, Proc. Mal. Soc., Lond., VIII., p. 355.

I venture to think that this rare and curious shell has not before been figured from so representative a specimen as that here shown, which was kindly presented to me by Mr. Weeks. The few published figures in standard works do not altogether show the species at its best either in size or colour. Swainson's drawings were made from a very small and apparently immature specimen; they were copied (badly) by Philippi, who added an original portrait of a somewhat larger and darker example in the Berlin Museum, and finally Reeve, as usual, gave excellent figures of a specimen in the Cuming collection. But even this example seems to have been an under-sized shell and perhaps a little faded.

When in fresh condition, as shown in our figure, *A. oblonga* is of a rich olive brown, not the drab fawn-colour shown in most of the above figures. It is one of the very few *Ampullariae* that are totally devoid of bands, and the only real contrasts in its colour scheme are furnished by the characteristic reddish tint on the early whorls of the spire, and by the spotless white of the aperture.

My specimen is a trifle darker in tone on the back of the body whorl, and the upper part immediately below the spire has lost a good deal of epidermis in minute flakes, showing the white ground of the shell underneath.

Neither Swainson nor Reeve gave any locality. The Berlin Museum's specimen figured by Philippi came from Caripe in Venezuela, and von Martens, on the authority of Gruner, states that the species is found in the Orinoco. The Caripe in Guadeloupe cited by von Martens (Malak. Blätt., l.c.) is of course a mistake, which, oddly enough, escaped its author's notice when he came to correct the identical error in the case of his *A. Guadelupensis* (= *A. glauca*). It appears that there is, or was, a Caripe in that island, but that the real locality where these *Ampullariae* were found is near Cumana in Venezuela (*vide* Binnenmoll. Venez., footnote on p. 204).

A. PRASINA, Fischer and Crosse

Plate XI. fig. 3

Ampullaria malleata, Jonas, var. „*Prasina*, Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., p. 235 and 236, pl. 48, ff. 4, 4a; *Ampullaria strebeli*, v. Martens, var. *prasina*, von Martens, Biol. Centr. Amer. Moll., p. 416.

I have been unable to identify this shell with confidence, partly because no authenticated specimens exist in the collections available for examination, and partly also because Fischer and Crosse's figure of its frontal aspect includes the operculum *in situ*. A great many *Ampullaria* figures are marred by this arrangement, which has really nothing to commend it. If the operculum happens to possess a distinctive character, it cannot be studied in such a position, whereas its presence conceals altogether or in part such important points as the colour and markings of the aperture, the shape of the columellar margin, etc. And, in this particular case, the defect is not made good by exactitude in the description.

With its operculum inserted the specimen drawn on my plate comes very near to Fischer and Crosse's figure. It is one of a pair received from Mr. Weeks, and, believing at first that I had got hold of quite a new species, I intended to name it after the kind ` donor. This may have been the more correct view of it, but a study of its characters decided me not to inflict another new species on this already overloaded genus.

Deferring for the present the discussion of this particular specimen, let us first consider the true position of *prasina*, which is evidently a very peculiar and interesting form.

It will be gathered from the synonymy that whereas Fischer and Crosse regard it as a variety of *malleata* (= *flagellata*), von Martens makes it a variety of a form which Strebel described as probably independent, but did not venture to name (Beitrag. Mex., etc., pt. , p. 25, pl. III., f. ₁₃, and pl. IIIa., ff. _{13a} and b).

Fischer and Crosse gave Strebel's shell equal rank with *prasina* as a variety of their *malleata*, and named it after its discoverer as *A. Strebeli*. These authors had, apparently, no first-hand knowledge of the shell, but von Martens, after inspection of one of the original specimens, first published it as an independent species with the varietal name given by Fischer and Crosse. To this species, still very little known, *prasina* has been assigned as a variety by von Martens, and to *malleata* (*flagellata*) by Fischer and Crosse. Which is the juster view? or are they, perhaps, equally mistaken?

Arguing rather from Fischer and Crosse's authentic figure than from my own doubtful specimens, I submit that it is very difficult to accept *prasina* as any form of *flagellata*. The spinal whorls are described as convex, and they appear in the figure with steeply graded sides, quite different to the flat slopes and superficial suture characteristic of *flagellata*. The very long and wide aperture and long columellar margin are other points of difference. It should be added that, according to von Martens, Fischer and Crosse's measurements of the aperture, make it even wider and longer than in their figure.

Von Martens was evidently uneasy about this last detail, and inclined to prefer the smaller dimensions of the figure. Every extra millimetre here prejudiced his view of the relationship between *strebeli* and *prasina*. But when one comes to investigate his own figure of the former and those of Strebel himself, they really seem beyond hope of reconciliation with *prasina* as portrayed by Fischer and Crosse. The spires of both agree fairly well, but one is a dark brown, rather short shell, with narrow mouth and notably straight-edged outer margin, the other shows a somewhat elongated shape and a wide mouth with a beautifully curved edge. The colour question, of course, may be solved by variation, but what conceivable variation can justify these differences of shape and proportion?

Practically the only feature than these shells possess in common is a peculiar sculpture, very evident in Strebel's figures, and quite discernible in the specimen I have represented under the name of *prasina*. It consists of stray, irregular ridges crossing the body whorl transversely, but not continuous or symmetrical. This probably induced von Martens to consider *strebeli* and *prasina* specifically identical. But, singular as it is, it can hardly be regarded as conclusive in face of the opposing discrepancies. These are so considerable that, with the leading authorities at variance, I have thought it best to avoid choosing between them, and to let *prasina* stand on the plate, not as a variety, but as an independent form.

The example thus tentatively figured hardly justifies its name (*prasina* meaning grass-green) on the front aspect, which is encumbered with a yellowish variceal streak and several reddish vertical striae. But on the back it shows as fresh a green as anyone could wish to see, and is ornamented, agreeably to Fischer and Crosse's diagnosis, with several narrow dark bands. The mouth is prettily coloured, the peristome broadly pale orange, with a lilac band behind the outer margin. This, by the way, is clearly indicated in Fischer and Crosse's figure, where a patch of the same colour may be seen just below the lower edge of the operculum. The interior of the shell is yellowish, brightly banded with dark brown.

This specimen is unlocalised. The locality given for *prasina* by Fischer and Crosse is Misantla in the State of Vera Cruz, Mexico.

A. GRANULOSA, Sowerby
Plate XI. fig. 4

Ampullaria granulosa, Sowerby, Proc. Mal. Soc., Lond., Vol. I, p. 49, pl. IV., f. 22 (1894), and Vol. VIII., p. 351.

This remarkable species from Cayenne was introduced by G. B. Sowerby iii. in 1894. The figure accompanying his description is unfortunately reduced. Such figures, however, excellent of their kind, are not usually helpful in dealing with *Ampullariae*, but here we have a species of remarkable individuality. Sowerby says, "The curious granulation of the surface is such as I have not observed in any other species of the genus." Here he has surely overlooked *A. Catamarcensis* from Peru, described and figured by G. B. Sowerby ii. (P.Z.S., 1874, p. 600, pl. LXII., f. 4). This "fine species of the type represented by *A. columellaris*" -i.e. the solid, imperforate, highland group named by Dall *Limnopomus*-has an almost precisely similar texture to that of *granulosa*, which is also practically imperforate, and probably stands very near to it. The colouring of *A. Catamarcensis* is, however, quite different, and it is a much larger shell.

The specimen here figured, although unusually fresh and intact is smaller than Sowerby's type, which was also more depressedly globose in shape and duller in colour -differences which I am inclined to think are due to a diversity of sex in the former animal inhabitants. The peculiar granulation (unfortunately somewhat obscured in the coloured copies of my plate) being associated with a strong superficial gloss, gives a certain effect of richness to the external colouring, which is reddish chestnut with several broad but not very clearly defined darker bands. These are more distinctly shown in the interior, the ground colour of which is pale reddish, suffused with blue-grey at the growth stages. The lip and columellar margin are ivory yellow, the lip having a distinct, but narrow blackish edge.

This shell has an old MS. label, "Guyane."

A. CERASUM, Hanley

Plate XI. fig. 5

Ampullaria cerasum, Hanley, Conch. Misc. *Ampullaria*, pl. 1 1., f. 7; Reeve, Conch. Icon. Amp., f. 99; W. G. Binney, Land and Fresh-water Shells of N. America, pt. III., p. 7; Strebel, Beitrag., etc., pt. I., p. 32; Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., p. 252; von Martens, Biol. Centr. Amer., p. 421, pl. 24, ff. 1-6; Sowerby, Proc. Mal. Soc., Lond., VIII., p. 346.

Ampullaria aurostoma, Reeve (Lea MS. Mus. Cuming), Conch. Icon. Amp., f. 131.

This pretty little species was, for some considerable time after its publication, an object of doubt and uncertainty among conchologists who had not actually seen it. Strebel considered it to be possibly the young of some species already known. Fischer and Crosse doubted its occurrence in Mexico, the habitat given by Hanley and Reeve. The fact that these eminent specialists on the Mexican fauna had not met with *cerasum* indicates that it may be rather local and perhaps uncommon, but von Martens records that H. H. Smith obtained a number of specimens at Teapa in Tabasco, S.E. Mexico.

All the figures quoted for typical *cerasum* show more or less distinct external and internal bands. The specimen represented on our plate has none of these, being of a uniform dark olive outside and yellowish white in the aperture. It is apparently an old shell, rather above the average size, and the lip, which is bright reddish, is effused to an unusual extent. Except for the red lip, it might, perhaps, be more fittingly assigned to *aurostoma*, a simple colour-form, which hardly deserves even varietal distinction, and which assuredly should not have been branded with so terrible a sample of *vox hybrida* as the name which Reeve adopted from Lea's MS. This designation, apparently intended to mean "golden mouth," indicates its principal departure from the type, the lip being orange or yellow instead of red. It is generally of smaller size, has a more produced spire, and is darker and more uniform in colour, so that the bands, if any, do not show clearly. This form, for which Reeve gave no locality, seems to be more frequent in collections than typical *cerasum*, and perhaps has a wide range. I have noticed that in the more globose specimens of *cerasum* the banding is generally better marked. These are, perhaps, the shells of female animals. Young shells of *aurostoma* are very thin, almost transparent, of a pale green colour, with the orange lip just indicated.

A. INTERRUPTA, Sowerby

Plate XI. figs. 6, 7

Ampullaria interrupta, Sowerby, Proc. Mal. Soc., Lond., VIII., p. 361, with figure in the text (1909).

This species, the type of which is now in the British Museum, was described by G. B. Sowerby iii. from small specimens taken at Laguna Urao, Venezuela, according to Mr. Da Costa, in whose collection they were found.

A few years ago I bought a small collection made in South America, in which **was** a box of uncleaned shells, labelled "Merida, Venezuela." They included about forty *Ampullariae* of small to medium size, all obviously belonging to Dall's section *Limnopomus*, but not otherwise familiar to me, except that three or four of the smallest were easily identified as *interrupta*. When cleaned up they proved to be in "live" condition, and nearly all had their opercula.

After prolonged study of these shells I came to the conclusion that they were all of one species, and arranged a carefully graded series to show the development in growth and colour. This series was exhibited at a meeting of the Malacological Society of London in December, 1923, and its extreme points are here represented by typical *interrupta* (Pl. XI., f. 6), and the very different-looking shell figured at Pl. XI., f. 7. The intergradation was complete, and the inference was that *interrupta* had been originally described from an immature shell.

Sowerby says "It is chiefly distinguished by its prettily coloured varices, which are scarcely raised, but rendered conspicuous by dark brown spots bordered with yellow."

These spotted varices, which are obviously remains of a former lip ("labrum . . . ad marginem fusco tessellatum," Sowerby l.c.), are characteristic of the *Limnopomus* group, but are always seen in the earlier growth of the shell. A good instance may be noted in my figure of *A. columellaris* (Pl. XI., f. 8) on the body-whorl to the left. Owing probably to the failing vigour of the animal, these spots, the terminations of obsolete bands, become fainter as growth progresses, and there is generally no sign of them on the final lip of the adult shell.

The fact that Sowerby's type had a spotted lip lays it open to suspicion of immaturity, and another indication is the surface of this specimen, described as "apparently smooth, but beneath the lens . . . very finely corrugately striated." The *Limnopomus* species live in the highlands of South America, presumably among turbid rued boulder

strewn waters. However that may be, they are almost invariably, *when adult*, battered and scarred to such an extent that any sculpture they possess can hardly be made out, even with the lens.

There can hardly be any doubt that my figure γ on plate XI. represents the adult state of Sowerby's *A. interrupta*. I gave a duplicate block, made from my original drawing for this figure, to the Malacological Society of London, and it was reproduced, together with my description, in Vol. XVI. of their Proceedings, pp. 50-52 (April, 1924).

PL. XI., f. 6. Typical *A. interrupta*. Small, dark green, with yellow, blackspotted varices. Aperture livid in the depths, somewhat reddish behind the lip. Peristome dull white, heavily spotted with dark brown.

PL. XI., f. γ . Shell thick and solid, spire reddish chestnut, which colour is also spread in patches over the upper part of the body whorl, and down solve of the growthlines. Elsewhere olive yellow, with thin dark bands, only marked distinctly on the front of the shell. Aperture livid reddish in the depths, lighter behind the lip, which is somewhat corrugated and bright orange-yellow in colour.

Several of my specimens are heavily malleated, and are suffused with a strong, rusty-red tinge often seen in Western *Ampullariae* and possibly due to some chemical agent in the water that they have inhabited. One or two, that are regularly banded and show a spotted lip, recall Philippi's unrecognised *A. Columbiensis* (from an unknown locality), Mon, Amp., pl. 5, f. 5. Philippi ascribes the species to Sowerby, but states that

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he could not find any description, and he seems to have simply taken the name from Jay's Catalogue. My specimens agree fairly well with his account of it, but the figure presents some differences of outline, though it may have been intended to represent a similar shell.

A. COLUMELLARIS, Gould

Plate XI. fig. 8

Ampullaria columellaris, Gould, "Otia," p. 51 (1848); Dall, Journal of Conchology, Vol. XI, pp. 52 and 54; Sowerby, Proc. Mal. Soc., Lond., VIII., p. 347; (?) *Ampullaria robusta*, Philippi, Mon. Amp., p. 50, no. 69, pl. 15, ff. 4, 5; *Ampullaria Sprucei*, Reeve, Conch. Icon. Amp., f. 134. Probably not = *Ampullaria solida*, V. d. Busch, P.Z.S., 1859, p. 168, and hardly = *Ampullaria modesta*, V. d. Busch, P.Z.S., 1859, p. 168.

This well-known and certainly very inconstant species is yet another of those which stand in need of careful investigation. It has been overloaded with varieties, most of which have not even been named. It is, therefore, very difficult to make precise reference to them, but most collections seem to contain a more or less incongruous little heap of shells put together under this specific name. I am inclined to think that *columellaris* is quite guiltless of some of these aberrations, and that they ought to stand criticism on their own account as separate species.

This is the type of Dall's very natural section *Limnopomus*, of which its author says: "In the highlands of Colombia, Ecuador and Peru, a small group of species is found, in which the pillar is heavy and callous; the umbilicus closed with a pad of callus as in *Natica clausa*, while the other characters are usual in *Ampullaria*." In a footnote to this Dall says: "*A. castelloi*, Sowerby, appears to belong to this group," but Sowerby himself, writing of that species, remarks, "The umbilicus of some specimens is completely closed, in others partly open. In view of the inconstancy of this latter character, it is hardly practicable to maintain Dall's section *Limnopomus*."

The selection of this particular trait was not, perhaps, altogether happy, for most *Ampullariae* show a great deal of variation in respect of it. Nevertheless the sectional name, though its precise application is not easy to define, indicates a markedly recognisable type of shell which has a place of its own in the genus. The structure is thick and solid, the spire usually both broad and high, and less generally eroded than in other *Ampullariae*. The spotted varices noted under *A. interrupta* are also characteristic of this group. The growth stages would appear to be separated by long periods of rest, in which the scanty pigment of the bands-elsewhere but feebly marked as a rule accumulates in dark, stitch-like marks on lip or varix, according to the age of the shell.

The great elevations from which some of these shells have been recorded suggest extremely cold water as their habitat, and this may partly account for their apparently torpid growth, as well as for their solidity, needed as a protection against cold and the obstructions of rapid mountain streams. It would seem in fact that they are freshwater rock-shells, with the same suggestive development as we observe in our familiar *Littorina* among marine species. The recognised forms of this interesting group are at present few in number, and are not very common in collections. The most familiar is .A.

columellaris, here represented by the largest specimen I have seen. As a rule the shells of this group are notably uniform in size. The present example is of a fine stoneyellow colour, brighter on the varices, which are characteristically black-spotted. The interior is white, the bands indicated here and there in pale red or grey. The very widely effused lip and massive columellar margin are pale citron. Labelled " Amazon." I have hinted above that shells assigned to *columellaris*, but apparently quite distinct, are often found in collections. Of such form; I have several, each represented by two or more specimens, quite consistent with each other, but unlike any species hitherto described or figured. Some have the III) flatly expanded and yellow, as in typical *columellaris* or in Reeve's *Sprucei*, which is the same thing. In others it is solidly

rolled round, and livid white, the whole shell being also darker in tone and very thinly and regularly banded. One of these latter is labelled *A. modesta*, but V. d. Busch's species from Ecuador is described as being without bands and as distinguished by " some dispersed fore-ribs upon the last whorl, visible to the naked eye." The ribs are very evident in the British Museum specimens of *modesta*, which seems to me to be quite a distinct species. On the other hand, V. d. Busch's *A. solida*, also from Ecuador, suspected by its author to be a variety of Reeve's *Sprucei* (= *columellaris*) appears from my specimen and those in the British Museum to be a variety of Swainson's *A. crassa*.

Of Philippi's *A. robusta* Sowerby says, " This may be a variety of *A. columellaris*, but it is perforate, and the aperture is rather more oblique." Philippi's figure certainly indicates a shell belonging to this group. It shows the characteristic sudden emergence of otherwise obsolete bands, in dark "stitch marks" on lip and varix. In regard to the perforation, Sowerby apparently overlooked his own remarks on -4. *Castelloi*, quoted above.

I have one specimen, from Bolivia, which almost perfectly corresponds with Philippi's unlocalised species, except that the latter is stated to have " no trace of bands," whereas mine is vividly banded *on one growth stage only*. The umbilicus is large and obvious. In fact the whole shell is a compact object lesson on the instability of Ampullaria characters. Nevertheless it has much of the aspect of a distinct species, and I had actually prepared a drawing of it for reproduction in this work, but eventually came to the conclusion that its condition was not good enough for figuring. The specimen, however, along with several other irreconcilable forms in my possession, induces me to repeat that there is a need for special investigation of this group.

A. PERTUSA, Sowerby

Plate XI. figs. 9, 10

Ampullaria pertusa Sowerby, Proc. Mal. Soc., Lond., Vol. I., (1894), p. 48, pl. IV., f. 23, and Vol. VIII., p. 355.

This species was described by G. B. Sowerby iii. in 1894, from a shell labelled *A. Linnaei*, in the Cumingian collection at the British Museum. This unlocalised specimen was at the time the only one known to that author, but the species has since been received

in some numbers from Merida, Venezuela. It is here figured from specimens supplied by Messrs. Sowerby and Fulton.

The original description says, "This species very closely resembles *A. Castelloi*, but differs from it in the absence of the red colouring on the columellar lip, and in the presence of a fine sculpture, consisting of rows of minute punctures."

Neither of these characters is particularly distinctive, but as the author still retained the two species as separate in his revision of the genus published fifteen years later, it must be assumed that further acquaintance with *pertusa* did not induce him to modify his views. Nevertheless it will be seen from my figures that this shell is sometimes almost as brightly coloured in the columellar lip as *Castelloi*, and I may add that my specimens of the latter, including that figured at pl. XI., f. , have practically the same sculpture as *pertusa*.

As in the similar case of *A. puncticulata* it is difficult to describe this sculpture precisely. In some shells it appears as rows of minute granules, caused by the intersection of vertical and transverse striae ; in others the wearing away of the tops of these gives the effect of regular pitting. The type specimen of *pertusa* in the British Museum is an old shell, much larger than usual and rather worn. In fresher examples the sculpture is, so to speak, rather raised than excavated.

In general *A. pertusa* is a thinner and smoother shell than *Castelloi*. The latter is rough and solid, with a rather marked concavity at the top of the body whorl, which also slopes more rapidly downwards than in *pertusa*. In consequence the shape of the mouth is also more distinctly peaked below than in the latter. But this character cannot be regarded as constant; I have specimens which are here well rounded, and even slightly effused.

In colour *A. Castelloi* is generally darker and has a definite reddish tinge. This, however, may be no more than the rusty variation so common in Western *Ampullariae*. It also appears, as compared with *pertusa*, to be almost devoid of bands, but this is simply due to the darker and thicker epidermis. I have a partly uncoated specimen in which the bands are as definite as in my fig. 9. When we have noted that *pertusa* is generally the larger shell we have come almost to the end of the points which favour its specific distinction.

On the whole I am inclined to believe that these two species are but different forms of the same. The discrepancies between them are all such as may be due to local conditions, and our scanty knowledge of their habitats rather favours this hypothesis ; for the localities given are not more than three hundred miles apart. Many species of *Ampullaria* cover a wider range than this, and develop more pronounced changes of colour on the way.

PL. XI., f. 9. Olive yellow, inclining to orange near the lip. Upper whorls of spire dark lead-colour. Regularly and narrowly banded with dark brown inside and out. Interior of aperture slightly reddish. Peristome white, columellar margin edged with yellow, outer lip boldly blotched by the terminations of the bands.

PL. XI., f. . Smaller and darker in colour. Early whorls of spire reddish. Bands hardly visible on the front of the shell, very dark and definite on the back. Peristome bright yellow deepening into orange on the columellar margin and callus. Interior yellow, shaded with pinkish grey, and distinctly banded, the ends of the bands marked in brown on the outer side of the lip.

STUDIES IN AMPULLARIA 57 A. CASTELLOI, Sowerby Plate XI. fig.

Ampullaria Castelloi, Sowerby, Proc. Mal. Soc., Lond., Vol. 1. (1894), P. 48, Pl. IV., f. 22, and Vol. VIII., P. 346.

To what has been written in the last section I can only add that the specimen here figured has been chosen in order to exhibit fully the distinctions laid down by Sowerby between his two new species. *A. Castelloi* is here seen represented by a thoroughly typical individual, the most remote that I can find from our examples of *A. pertusa*. Its external colour is a deep reddish brown, the bands only showing in dark patches on the edge of the lip, which, as well as the columellar margin, is fulvous, sharply bordered

with a burnt red shade. Behind the lip the aperture is livid reddish.

It is perhaps worth noting that *A. Castelloi* is very rarely seen complete, the spire being almost always deeply eroded. In this respect it differs from *A. pertusa*, which usually presents a fairly sharp apex, even in the oldest and largest shells. But this distinction may imply no more than a difference of habitat. Indeed the whole shell is generally much battered in *A. Castelloi*, which is reported from the Meta River, S. E. Bogota-presumably a stream much troubled with boulders and rapids.

A. MARTINEZI, Hidalgo

Plate XI. fig. 12

Ampullaria Martinezi, Hidalgo, journal de Conchyliologie, 1866, Vol. XIV., p. 345, pl. XIV., f. 5; Sowerby, Proc. Mal. Soc., Lond., VIII., P. 354.

This species was named by Hidalgo in honour of J. Martinez Saez, who found it at Santa Rosa in Ecuador. According to Miller, quoted by Fischer and Crosse (Miss. Scient. Mex. Moll., Vol. II., P. 230), it is another of the highland species, occurring at elevations of between 500 and 1500 metres. Although it was first described nearly sixty years ago, it is still rare in collections.

Sowerby (l.c.) says : " I have some doubt as to whether this is distinct from *A. columellaris*; it has a much shorter spire and a more tapering form. "The relative height of the spire is not, perhaps, of any great importance, but Hidalgo's description takes note of other and more significant details; the distinctly margined suture, and the obtuse angulation behind the umbilicus. Each of these points may be plainly seen in our figure, and they are highly characteristic, as are also the simpler type of lip, and the rich yet delicate and sober colouring.

Apparently this is not a variable species, and the example figured may be taken as entirely typical of its general appearance.

PL. XI., f. 12. The shell has several extensive eroded patches, but for the most part it looks very smooth to the unassisted eye, though the lens reveals a slight transverse

striation. The closely-fitting epidermis is of a deep olive-yellow colour, and almost entirely hides the bands, faint traces of which are discernible on the back and near the lip. The eroded early whorls of the spire are blackish. The interior is clear orange yellow, with a brighter tract just behind the lip. The bands show clearly in pale purplish pink, some of the intervals being filled up with the same colour. The lip and columellar margin are orange, with a conspicuous red stain near the base of the latter. In one of my specimens this red stain is absent, and the whole lip is of a deeper shade of orange. The parietal callus is very thin and glossy, showing the underlying olive of the epidermis, but slightly tinged with red. The umbilicus is almost entirely closed. The operculum is dark brown, very thin and concave in its outer surface, and, like that of *columellaris*, can be inserted some little way into the mouth of the shell.

A. SINAMARINA, Bruguière

Plate XI. fig. 13

Bulimus sinamarinus, Bruguière, Journ. d'Hist. Nat., I., p. 342, pl. 18, ff. 2, 3 ; *Ampullaria sinamarina*, Deshayes in Lam. An. s. Vert., 2nd ed., VIII., p. 548; Schomburgk, Reisen in Brit. Guian., III., p. 546, and Troschel I.c., p. 548; Philippi, Mon. Amp., p. 27, no. 37, pl. 7, f. 5 ; v. Martens, Malak. Blätt., IV., p. 192; Hupé, Castelnau Exped., Vol. III., Moll., p. 70. pl. XIII, f. 4; Drouet, Moll. Guy. Fran., p. 83; Sowerby, Proc. Mal. Soc., Lond., VIII., p. 357.

This remarkable species was originally described as a *Bulimus* from specimens taken in the Sinamari, a river of French Guiana (usually spelt Sinnamary on modern maps). Schomburgk has recorded it from the Upper Corentyn River, famous for its cataracts, in British Guiana. Hupé simply gives "Cayenne" as habitat, and Drouet says that the species was found in July in the Oyapoc and Ouassa Rivers in French Guiana.

Schomburgk remarks that his brother found it in the Corentyn, but very rarely, and it appears, unlike most *Ampullariae*, to occur only in single examples. It has always been a rarity and is generally in bad condition, so that a fine specimen may be regarded as one of the greatest prizes that the seeker after "Apple snails" can hope to secure. This shell has no near allies in the genus, except the giant *A. megastoma*, Sowerby, with which von Martens associates it in his group of *Neritoideae* (=Gray's *Pomella*). It is even more roughly striated than its big relative, the curious granulated sculpture having been aptly compared to that of *Paludomus*. Certain species of the latter genus are said to prefer waters with a swift current, and it is perhaps noteworthy that this very similar *Ampullaria* should be found in such rivers as the Oyapoc and Corentyn, both of which seem to run a troubled course. The latter in particular, little-known at present, is credited with some of the most terrific rapids and cataracts in the world. It may be due to these hazards that *sinamarina*, as it appears in collections, is nearly always badly knocked about.

I think myself fortunate to have been able to draw my figure from an exceptionally well-preserved specimen of this very rare shell. The earlier whorls are, as usual, lost,

but the remainder is in beautifully fresh condition. The general colour is a dark olive green, lighter on the spire, the growth-stages strongly marked on the front of the shell by rusty red vertical lines, occasionally preceded by an orange-tinted tract. The lip and columellar margin are milky-white, the lip distinctly edged with dark brown, and the columella with orange. The inside of the aperture is beautifully coloured with a tender shade of blue, interrupted mid-way by the broad white lip of a former growthstage, with its dark outer edge showing distinctly, and suffusing the upper part of the final blue tract. The operculum is thin, dark, deeply concave on its outer side, and unusually small for the size of the aperture, up which it could evidently be withdrawn for a considerable distance.

This specimen is labelled " Guiana "-presumably the British territory.

I have seen other specimens in which the orange tint of the columellar extends all round the peristome, and the beautiful blue of the interior is replaced by livid reddish. Hupé's figure, quoted above, shows somewhat similar colouring.

Along with its other peculiarities, this species is remarkable for the absence of the parietal callus. The white columellar margin is cut off abruptly above and reappears as a white knob just under the insertion of the outer lip. The intervening space is left clear, and shows the criss-cross striation as plainly as the rest of the body whorl.

Genus AMPULLARIA, Lamarck

Eastern species with calcareous operculum

The term Eastern species includes all those found in the *Ampullaria* regions of Asia and Africa, and in the islands adjacent to those continents. All such have a thickened calcareous operculum instead of the horny form of that appendage possessed by the Western species. This hard and stiff attachment necessitates a straighter contour of the lip, as seen in profile, whereby Eastern specimens, even when incomplete, may generally be known. But the operculum is not always fitted to the mouth in quite the same way. Many of the species have a thickened and bevelled lip for its reception ; in others, notably in some African species, the lip is quite simple, and the operculum maybe pushed a long way into the shell. In these latter it is generally flatter and thinner than usual, and of more uniform thickness, though always perfectly rigid and opaque. The thickened and bevelled opercula which fit tightly in the mouth of the shell, are, as a rule, slightly concave on the outer surface like those of the Western species.

The general practice with conchologists is, apparently, to distinguish these Eastern forms by Bolten's generic name *Pila*. In some ways this usage may be convenient, but from the strictly systematic point of view there is little to commend it. Bolten's genus evidently included both Eastern and Western species, and his generic name should either be used for the whole assemblage or set aside. It has no sectional value. For reasons stated in the Preface, I have preferred to keep Lamarck's more familiar name throughout both on the plates and in the text.

Asiatic Species

AMPULLARIA AMPULLACEA, Linné Plate XII. (all figures) and Plate XIII. figs. and 2
Helix ampullacea, Linné, Syst. Nat. ed. X., p. 771, no. 592; *Ampullaria Linnaei*, Philippi, Mon. Amp., p. 62, no. 85, pl. 20, f. 6 (NOT the *A. Linnaei* of Reeve, Conch. Icon. Amp., f. 15, which is *A. lineata*, Spix) ; *Ampullaria Gruneri*, Philippi, I.c., p. 37, 110. 49, pl. 9, f. 8; *Ampullaria sumatrensis*, Philippi, I.c., p. 59, no. 8i, pl. 19, f. 2 (NOT f. , which is *A. turbinis*, Lea); *Ampullaria celebensis*, Quoy et Gaimard, Voy. Astrol., Vol. III., p. 167, pl. 57, ff. 1--4; Mousson, Land and Süsw. Moll. von p. 5n, pl. 1\., f. I ; Philippi I.c., p. 59, no. 82, pl. 19, h. 3, 4; *Ampullaria magnifica*, Dunker in Philippi, I.c., p. 64, no. 89, pl. 21, f. ; *Helix ampullacea*, L. Hanley, Ipsa Linnaei Conchylia, p. 368; *Ampullaria ampullacea*, Reeve, Conch. Icon. Amp., f. 48; v. Martens, Malak. Blätt., IV., p. 185; Sowerby, Proc. Mal. Soc., Lond., IX., p. 56 (exclusive of much of the synonymy).

NOT *Helix ampullacea*, Linné, Mus. Lud. Ulr., p. 666, 110. 368; nor *Helix ampullacea* of the Syst. Nat. ed. XII., p. 1244, no. 676; nor *Nerita ampullacea*, Müller, Hist. Verm., II., p. 172; nor *Helix ampullacea*, L. of Chemnitz, Conch. Cab., IX., p. 105, pl. 128, ff. 1133, 1134. According to Pfeiffer (Nov. Conch., Vol. I., pp. 49, 50) these references probably indicate *A. globosa*, Swains. (vide also Swainson, Zool. Ill. Ser. I., Vol. II., pl. 119). Philippi, I.c., p. 60, says he has no doubt that the *Helix ampullacea* of the Mus. Lud. Ulr. (he also quotes the Syst. Nat., 12th edition in the synonymy), refers to an uncoated specimen of the form described by Quoy and Gaimard as *A. celebensis*.

Apparently NOT the *Ampullaria fasciata* of Lamarck, Anim. sans. Vert., Vol. VI., p. 177 (vide Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II. P. 223) and of subsequent authors. Philippi (I.c., p. 39) while rejecting the name as useless, believes that Lamarck's shell, the "Cordon bleu" of D'Argenville, is represented by his own *A. Chemnitzii* (pl. , f. 5 in the Monograph, which is probably a figure of an uncoated *A. porphyrostoma*, Reeve).

It will be gathered from the above summary that the synonymy of this species has become almost hopelessly confused. The Continental authors were, of course, unable to check Linné's diagnosis by reference to his collection, which passed into the possession of our Linnean Society.

(JO)

Hanley, having the advantage of access to this historic collection, found therein a marked shell agreeing with Linné's original description, and gave a note upon the species in his "Ipsa Linnaei Conchyliæ" ⁰⁸⁵⁵. The chief points of this important pronouncement may be enumerated as follows :

- (1) The figures cited by Linné give no aid to identification.
- (2) The marked shell in the Linnean cabinet agrees precisely with the original description of *Helix ampullacea* in the *tenth* edition of the "Systema."
- (3) The species described under the same name in the "Museum L. Ulricæ" is quite different from this, and is too vaguely defined to be identified with certainty.

Pfeiffer l.c. states that this latter diagnosis, with some additions, is repeated in the *twelfth* edition of the "Systema," and he considers that it applies to Swainson's *A. globosa*. In this opinion he is supported by Chemnitz's figures, purporting to represent *ampullacea*.

Hanley sent a sketch of Linné's marked shell to Philippi, and he appears to have believed, along with other writers on the subject, that it was used for the famous Monograph, and that the figure of *A. Linnaei* therein (pl. 20, f. 6) was made from it. But this figure—unless I have altogether misunderstood the accompanying description—was made from an actual shell which had come into Philippi's possession, and which agreed with Hanley's sketch. Von Martens (Mal. Blätt., IV., p. 186) states that this specimen was believed to have come from Macassar in Celebes. If this is a fact, it gives a certain point to a remark by Dautzenberg and Fischer (Journal de Conchyl. Vol. LI I I, 1905, p. 426), which is to this effect : "The true *A. ampullacea* of Linné (., appearing as *A. Linnaei*, Philippi (pl. 20, f. 6), is a species with very high pointed spire, much allied to, and possibly an actual synonym of *A. celebensis*, Quoy and Gaimard."

Von Martens (l.c.) mentions another specimen of *A. Linnaei* in the Berlin Museum, alleged to be from Manila, which he seems inclined to attribute to *A. ampullacea*. In the synonymy of this species he includes *A. celebensis* and also Philippi's *A. sumatrensis*.

Philippi recognised that the shell he had figured at his plate 20, fig. 6, did not agree with his idea of the Linnean *A. ampullacea*. Naturally enough, for he had gone to the wrong source for his information, the description which he quotes being that of the *pseudo-ampullacea* described in the "Museum L. Ulricæ," which Hanley, after comparison with the marked shell in Linné's cabinet, rejected as unauthentic. Elsewhere, under *A. celebensis* (Mon. Amp., p. 60), Philippi translates this misleading diagnosis *in extenso*, and its very first words mark its inapplicability to the true species. It begins "The shell is nearly globular," indicating that Pfeiffer was probably right in suspecting *A. globosa* to be the shell intended. The true *ampullacea* is not globular; von Martens rightly put it into his section *Ovatae*, having, doubtless, seen Reeve's then just-published figure—the first to appear under the shell's authentic name—with its accompanying description, which runs : "This appears to be the old Linnean type of the genus so far as it is possible to determine it. The shell is chiefly distinguished by a characteristic globosely pear-shaped form."

Philippi, of course, had not seen the Iconica figure, and noting that his shell, though conformable to Hanley's drawing, did not agree with the *ampullacea* of the "Museum L. Ulricæ," he gave it the unnecessary new name of *Linnaei*. This may now be dismissed, since, if his figure was near enough to Linné's marked shell to satisfy Hanley, who was

familiar with the latter, we may accept it as an authentic presentment of the true Linnean *ampullacea*. But it does not show the species in a very favourable light, being made from a small and uncoated specimen. The latter defect, however, is perhaps somewhat helpful towards identification, for the figure plainly shows the peculiar reddish grey ground-colour familiar to everyone who has seen a worn *ampullacea*.

Other objections, it is true, have been made to it, and more especially to the height of its spire. But this is not much more pronounced than in the *ampullacea* form represented at my pl. XII., f. 5. In any case, as I have tried to show by more than one example, the height of the spire is a very inconstant character in *Ampullaria* (cf. my figures of *A. polita* on pl. XVI.). And it should be recognised that *ampullacea* is a very variable species. Too much stress has been laid on some of the forms that have been separately described. Dautzenberg and Fischer, for instance, have (l.c.) assigned Reeve's excellent figure to Philippi's *sumatrensis*, quoting it as "*ampullacea*, Reeve (non Linné)." The species is too common, too widely distributed and too variable to bear such subtleties. It has many local forms, and may show a high or a low spire, a red, orange, yellow or white lip, but its individuality under all disguises is too strong

for it to be split up into separate items.

Indeed this is, to my mind, one of the most easily recognisable *Ampullariae*. There is a characteristic richness in its colouring, a kind of golden glow, due, apparently, to the presence of submerged tints, sometimes breaking out in full value on lip and columella, but more often merely suggested in the epidermis, which-if it be not too fanciful to use the language of a colourist-seems to have even its green tints made up with orange instead of yellow. The surface has generally a high polish and malleation is rare. In most specimens the banding is very regular, and its effect in the mouth of the shell is often particularly striking and beautiful.

This appears to be an insular species and to represent on the islands the very similar *A. turbinis*, Lea, of the mainland. The range of *ampullacea* is wide, as will be seen from the localities of the specimens figured. Reeve gave Borneo as habitat, and indeed the largest specimens seem to come from that island, but it is found all through the great Sunda group, and I am able to offer representations of one or two characteristic specimens from very remote places.

PL. XII., f. 1. Uniform dark olive chestnut externally, mouth pale orange yellow, flushed with pink and regularly banded. Lip pale orange. Sumatra.

PL. XII., f. 2. In shape a good deal like Philippi's figure (copied from Quoy and Gaimard) of the form *celebensis*, Mon. Amp., pl. 19, f. 4. Olive-chestnut, profusely and regularly banded. Aperture pale buff, banded and clouded with reddish. Lip and columellar margin yellowish white, the lip with a distinct black edging. Java. Mousson states that the natives eat the animal, and know it by the name of Tottan.

PL. XII. f. 3. One of the largest specimens I have seen, closely allied to the form which Philippi has figured as Dunker's *magnifica*. Dull, but rich orange-yellow, narrowly banded with bluish and reddish. Interior ashy pink, the banding, expressed in blue and chestnut, is of a rather ragged character, and the lip is irregularly blotched with brown, as is also the cream-coloured columellar margin. No label. Probably from N. Borneo, whence I have similar, but smaller specimens.

PL. XII. f. 4. This specimen, as will be seen, has suffered much injury, but it is so remarkable in itself, and its given habitat is so much out of the common, that I could

not refrain from giving a figure of it. The locality label was "Amboyna," and the shell has a strong general resemblance to Philippi's *A. Gruneri* (Mon. Amp. pl. 9, f. 8). If one makes allowance for some obviously faulty drawing in Philippi's figure, my specimen probably represents the form he had before him. It is of a rich olive yellow colour, with a few broad and rather widely separated bluish bands. The interior lip and columellar margin are cream colour, clouded and very blotchily banded with red-brown. The edge of the lip (much damaged) seems to have been originally white, as in Philippi's figure.

PL. XII., f. 5. A very beautiful and unusual form, of which I obtained a series from Mr. Hugh Fulton, who had then from the Xulla Islands, to the east of Celebes. They are mostly pretty uniform in size, which is below that of the average *ampullacea*. Spire high and sharp, the earlier whorls dark leaden grey, the last greenish with a dark red band, the rest of the shell rich olive with a strong suffusion of orange, and beautifully banded with regular, dark lines. Interior fulvous with a pink tinge. The edge of the lip and the columellar margin a little lighter. Bands very strong and dark in the mouth of the shell, most of them not quite reaching the outer edge.

PL. XIII., f. r. Another peculiar form, of which, through the kindness of Mr. Weeks, I received several specimens from the island of Samar in the Philippines. The shell here figured is the largest of the lot, which evidently represents a small race. It is dark green externally, with one thick band showing at the level of the upper lipinsertion, and several pairs of thinner bands above and below, none of these, however, are very conspicuous. Interior dark purplish, somewhat lighter on the lip and columellar margin, the banding in the mouth very distinct and regular.

PL. XI IL, f. 2. A much worn specimen, having lost all the upper part of the spire, the remains of which are almost devoid of epidermis. The body-whorl is olive-yellow, with the characteristic orange tinge, and banded with beautiful regularity. In the upper part a very fine line runs between each pair of the broader bands. Interior pale orange, much brighter on the edges of the lip and columellar margin. Banding almost exactly as on the external surface. The stripes mostly ending just behind the brighter colour of the edge. Penang.

We should finally remark of *A. ampullacea*, that, although it is often treated as the type of the genus *Ampullaria*, it can hardly be accepted as such. It is true that Lamarck in his "Prodrome" of 1799, specified Linné's *Helix ampullacea*, but his idea of this was evidently very vague, and seems to have been evolved from Linné's description in combination with the figure of a large "Apple snail," given by d'Argenville under the name of "Cordon bleu." The resulting mixture, which must have been largely imaginary -for at that time no one, on the Continent at any rate, seems to have known what Linné's species really was, and "cordon bleu" was a general term for American species afterwards called *Ampullaria fasciata*. This name, which was applied by conchological authors to Eastern and Western species indiscriminately, has now been properly abandoned, but in its day it was as great a refuge for puzzled collectors as the long-unrecognised *canaliculata*, also of Lamarck. When that writer confirmed his new genus in the "Système" of 80 r, he specified *A. rugosa*, known to us as the familiar *A. urceus* of Müller. This should probably be regarded as the true type, for Lamarck could not have known anything about Linné's *ampullacea*, even if he had not mixed it up with other vaguely defined shells.

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A. TURBINIS, Lea Plate XIII. figs. 3, 4.

Ampullaria turbinis, Lea, Proc. Acad. Nat. Sc. Philadelphia, Vol. VIII., p. (1856) and "Observations," etc., XI., p. 70, pl. 22, f. 2; *Ampullaria Celebensis*, v. Martens, Proc. Zoo. Soc. Lond, 1860, p. 12 (*vide* Morelet); *Ampullaria turbinis* Morelet, Sér. Conchyl. IV., p. 288; Nevill, Hand List Moll., pt. II., p. 6; Dautzenberg and Fischer, Journ. de Conchyl, Vol. LIII. (1905), p. 426; Sowerby, Proc. Alai. Soc. Lond. IX., p. 61. Probably also=Dautzenberg and Fischer's *A. sumatrensis* (*l.c.*) and certainly represented by Philippi's first figure of that form (Mon. Amp. pl. 19, f. , but not f. 2.)

It is rather amusing to notice the gravity with which Morelet takes exception to Lea's specific name as "un nom de fantaisie," on the ground that this genus always prefers "les eaux tranquilles" to "les tourbillons ou les gouffres." The American author probably intended *turbinis* to be taken in the secondary sense of the Latin word *turbo*, meaning a coil, and bestowed it to indicate the flattened spire, which is the most noticeable feature of the shell.

It is hard to say whether this is an independent species, or only a form of *ampullacea*. Sowerby remarks "There is little beyond the depression of the spire to distinguish *A. turbinis* from *A. ampullacea*, and it is with some doubt that I keep them separate. The difference, however, as far as my observation goes, seems to be fairly constant." The height of the spire, is, as we have already seen, a very inconstant character in this genus. In the case of *turbinis* a better claim to independence may perhaps be found in the general shape of the body-whorl, which slopes more rapidly below, and is much more flattened on the top, so that the line of greatest diameter comes higher up the shell than in *ampullacea*. The umbilicus is also, as a general rule, more obvious, and the colour lighter and brighter than in the latter.

I have not seen any really intermediate shells, and am inclined to believe that these forms, though coming originally from a common stock, have now become established in two very similar but independent species, and the fact that *turbinis* is found only on the mainland, whereas *ampullacea* seems to be restricted to the islands, supports this view, and indicates that *turbinis* is probably the nearer to the parent form. Morelet states that Lea's figure is that of an immature shell. It represents an undersized and imperfect specimen, and his original description points in the same direction, when it states that the aperture is very large—a frequent indication, in this genus, of immaturity.

Nevill's comments on Morelet's account of the species are interesting. He makes out two varieties, "one without bands, the other banded, with the bands (i.e. in the interior) ceasing abruptly a short distance before the peristome." The first he calls "*subglobosa*," and the second "*subampullacea*," names which speak for themselves as to the affinities of the different specimens.

Now I cannot help thinking that Nevill has gone too far in assuming that his named varieties correspond entirely with those described by Morelet. The latter author says *turbinis* is "greenish brown, sometimes uniform, but more usually ornamented with dark inconspicuous bands, which are reproduced more vividly in the inside of the aperture, without reaching the edge of the peristome." It will be noted that, in the case of the

first form, it is only the greenish brown exterior, which is specifically described as being devoid of bands. According to Lea's diagnosis, *turbinis* is "intus vittata," and a wholly unbanded shell would hardly be accepted even as a variety, nor do I think, that Morelet's description indicates such. Nevill's supposed representative of this is described as "A form with uniform green epidermis, not banded, with *white peristome* and remarkably depressed and flattened spire, unlike any figure I can find. *Possibly from Siam.*" (The italics are mine.)

Morelet says of the aperture—a remark apparently applicable to both banded and unbanded shells --that it is "livid white mixed with reddish and slightly tinged with orange at the edges."

Considering these discrepancies, together with the supposed locality, "Siam," and also the implication that "subglobosa" reminded Nevill of *globosa* in shape, I feel nearly certain that in his green, unbanded, white-lipped shell we have no variety of *turbinis*, but rather the first mention of the Siamese *A. Dalyi*, described much later by Blanford, which sometimes dispenses with its vertical striping, and appears as a large, plain "apple snail," green outside and livid whitish inside. The practical absence of transverse banding is one of the characteristics of this species, and in shape it is sometimes much more like *globosa* than *turbinis*. I have one specimen of it which answers well to Nevill's description of his "*subglobosa*."

Nevill's second variety, "*subampullacea*," is, according to his statement, fairly represented by Philippi's pl. 9, f. . This figure is not very refined in execution ; it is roughly drawn, and, in the copies I have seen, coloured with gross crudity; nevertheless it conveys an unmistakable impression of *turbinis* as it usually occurs. The slight orange tinge which Morelet noticed at the edges of the aperture is here developed into a very definite orange-red peristome.

The red-lipped form has been named by Dautzenberg and Fischer *erythrocheila*. It has a wider range of locality than typical *turbinis*, for these authors have reported it from Cochin China, and *also* specimens agreeing with Philippi's figure (which, though labelled *sumatrensis*, is probably the same thing) from Cambodia, while Nevill records similar *examples* from Perak. It is, in fact, the usual form in collections, quid bearing in mind that Lea's type specimen was not adult, and that the full-grown shells regarded by Morelet as typical *turbinis* had an orange-tinted lip, I am inclined to think that var. *erythrocheila* is superfluous. Of the specimens I have figured, the smaller evidently belongs to it, while the other is an exaggeration of the same type. It would seem that the comparatively infrequent white or yellow-lipped form attributed to Cambodia is more likely to be the variety. Lea's type specimen from Siam, being immature, was no safe guide as to the normal colour of the lip.

PL. XIII., f. 3. In this specimen the greater part of the upper whorls has been ground off, but I have figured it on account of the extraordinary vividness of its colour it is, in fact, the most gorgeous "apple snail" shell that I have ever seen. Externally rich olive-green, regularly banded with a darker shade. The whole of the aperture and peristome glowing orange-red, with dark bands showing in the interior. f. 4. Light yellowish green, profusely malleated, with rather broad darker bands. Aperture for the most part livid reddish, the upper portion and a wide tract just before the lip nearly white. Bands dark brown, coalescing into broad stripes here and there, most of them not quite reaching the outer lip. Peristome, rich orange outside, narrowly

yellow inside. This appears to be a typical specimen of Nevill's *subampullacea*. I have another labelled "Perak," which is somewhat smaller and generally lighter in colour, but the bands, which in the interior again fall short of the peristome, are externally a good deal darker.

A. DALYI, Blanford

Plate XIII. fig. 5

Ampullaria Dalyi (vel *A. turbinis*, Lea, subsp. *Dalyi*), Blanford, Proc. Mal. Soc. Lond. ¹⁹⁰³, Vol. V., p. 281. Pl. VIII., f. ; Sowerby, Proc. Mal. Soc. London, Vol. IX., p. 58.

This is perhaps the most important addition to the genus since the publication of *A. Nyanzae*, Smith in 1893. Blanford, as will be seen from the synonymy, considered that it might be a subspecies of *turbinis*, which is not impossible, although the supposed habitat, the Upper Menam Valley, is a good deal to the north of the precise localities recorded for the latter. The type specimen in the British Museum is simply labelled "Siam." It, and, in fact, the general run of specimens are considerably darker than that here figured, which was chosen because the characteristic vertical striping was unusually clear and definite. This, however, as Blanford points out, is by no means peculiar to *Dalyi*, a similar ornamentation being often seen on the South Indian form of *A. globosa*, to which our present species sometimes approaches in general contour. It may, however, always be instantly known by the simple lip, that of *globosa* being invariably thickened. From *turbinis* and from all forms of *ampullacea* it may be distinguished by the almost total disappearance of transverse banding within and without. The vertical stripes are sometimes absent, as noted under *turbinis*.

PL. XIII., f. 5. Rather light olive green, paler on the spire. Body-whorl with numerous darker vertical stripes, mostly very regular and continuous, but less distinct on the back of the shell. Interior pale livid reddish, peristome dirty white, edged at the lower extremity with brown.

A. MOESTA, Reeve Plate XIII. figs. 6, 7

Ampullaria moesta, Reeve, Conch. Icon. Amp. f. 92; Hanley and Theobald, Conch. Ind. p. 47, pl. 15, f. 6; Sowerby, Proc. Mal. Soc. Lond. IX., p. 60; *Pila moesta* (Reeve), Preston, Fauna of British India, Moll. p. .

Since this rather obscure and inadequately characterised species is not very well represented by the figures quoted above, and since, moreover, the type specimens in the

British Museum are not in the best state of preservation, I have thought it advisable to present drawings of two examples out of a small lot from Minery in Ceylon. Of these that represented at fig. 7 is the more typical.

Reeve's description, like several others in the Iconica monograph, is very vague, but the species has few outstanding characters, though its general appearance has a certain individuality. Very small specimens of *A. cinerea*, Reeve, the dwarf form of *A. globosa*, also found in Ceylon, are occasionally rather like my fig. 6, but *moesta* is much thinner, especially about the lip, which in all forms of *globosa* is perceptibly thickened; it has also a broader and more sharply pointed spire, and a more ovate shape. The shell is not really smooth, as Reeve has stated; it has a strong vertical striation, which can be made out in his figure, and, under the lens, is also finely ribbed transversely. The epidermis, which seems to be thin, is of a dull olive yellow colour, inclining to fawn in front, and a few slender belts show with fair distinctness. In fig. 6 these are more obvious the shell having been partly uncoated. The interior is ashy white, closely banded; the lip white. In one of my specimens the dots shown on the lip, in the figures of Reeve and Hanley, can be faintly made out; the others have this part unspotted. The vertical

striae are occasionally marked by slender brown lines.

A. WINKLEYI, Pilsbry

Plate XIV. fig.

Ampullaria winkleyi. Pilsbry, Proc. Acad. Nat. Sc. Philadelphia, LI I I. (90) p 189, pl. 5, figs. 2, 3 ; Sowerby, Proc. Mal. Soc. Lond. IX., p. 62; *Pila winkleyi* (Pilsbry), Preston, Fauna of Brit. India, Moll., p. 103.

I am once again indebted to the kindness of Mr. Weeks for a nice series of this *Ampullaria*, including one or two young shells, which are rather darker and more distinctly banded than the adult specimens. Of the latter the largest is here figured; the others are lighter in colour, and the bands are only definite on the lower part of the body-whorl.

PL. XIV., f. 1. Dark olive green pretty regularly and plainly banded. The upper part of the body-whorl and the suture of the spire show certain rusty stains. The interior is light tortoiseshell brown, banded heavily with a darker tint. Peristome, and a small tract inside the base of the columella ashy white; the lip and columellar margin distinctly edged with yellowish brown. The umbilicus shows rather too plainly, a small piece of the columellar margin having been broken away. The operculum has a pinkish tinge on the inside. Named after the discoverer, who took it at Henzada in Burma, on the Irawadi, north west of Rangoon.

68 STUDIES IN AMPULLARIA
A. CORRUGATA, Swainson
AND

A. GLOBOSA, Swainson
A. CORRUGATA, Swainson Plate XIV. figs. 2, 3

Ampullaria corrugata, Swainson, Zool. 111. 1st Ser. Vol. III., pl. 120; Philippi, Mon. Amp. P. 7, No. 7, pl. 7, f. (copy of Swainson's figure); as var. of *Ampullaria globosa*, Reeve, Conch. Icon. Amp. sp. 46; *Ampullarie corrugata*, Hanley and Theobald, Conch. Ind. P. 46, pl. CXIII., f. 2; *Ampullaria globosa* var. *corrugata*, Nevill, Hand List Moll., pt. II., p. z ; Sowerby, Proc. Mal. Soc. Lond. IX., p. 58; *Pila corrugata* (Swainson), Preston, Fauna of Brit. India, Moll., p. 98.

According to Swainson and Philippi *A. corrugata* -Sowerby's *A. rugosa* (Gen. of Shells, fasc. 4, ff. t, 2. Hanley and Theobald l.c. think that the latter is more like *A. globosa*.

A. GLOBOSA, Swainson
Plate XIV. fig. q.

Ampullaria globosa, Swainson, Zool. 111. 1st Ser., Vol. I I., p1. 19; Phillippi, Mon. Amp. p. 8, No. 3, pl. t, f. 3 ; Reeve, Conch. Icon. Amp. f. 46, ⁴⁷; v. Martens. Malak. Blätt. IV., p. 183; Hanley and Theobald, Conch. Ind. p. 46, pl. CXIII., f. 3, with varieties *sphaerica* (f. 4), and *fasciata* (f. 5); Morelet, Ser. Conchyl, IV., p. 289; varieties *sinistrorsa*, *minor* and *incrassatula*. Nevill, Cat. Moll. Fasc. E. July, 1877; var. *longispira*, etc., Nevill, Hand List Moll, pt. II., p. 2; Sowerby, Proc. Mal. Soc. Lond. IX., p. 58; *Pila globosa* (Swainson), Preston, Fauna of Brit. India, Moll., p. 97.

Also figured as var. of *ampullacea*, by Chemnitz IX., p1. 128, ff. 1133, 1134, and described at p. ¹⁰⁵ (*fide* Swainson) ; as *A. cinerea*, Reeve, Conch. Icon. Amp. f. 94, Hanley and Theobald, Conch. Ind., pl. CXIII. f. 1, and as *A. encaustica*, Reeve, Conch. Icon. Amp., f. 76, *fide* Sowerby, who considers these two forms as varieties of *globosa*.

It is perhaps best to discuss *A. corrugata* and *A. globosa* together, inasmuch as most conchologists, including, besides those indicated in the synonymy, Philippi, Hanley and Theobald, seem to think that the former is merely a variety of the latter.

A. globosa varies incessantly in size, colour, sculpture and general conformation, but only within certain limits, and these would hardly appear to exclude the rather slight characters on which Swainson relied for the discrimination of his *corrugata*.

In the original description this shell is stated (1) to be wrinkled, and (2) to have the umbilicus placed near the middle of the inner lip; its spire (3) is defined as elevated and ventricose, and (4) the body-whorl as widest in the middle and not near the top.

Swainson's figures—most beautifully executed, as usual—show all these characters with the greatest precision, but they do not amount to very much as specific distinctions. I have numbered them in order to tabulate the results of an examination of half a dozen *globosa* taken almost at random :

(1) Possessed by one specimen only, which also shows 2 and 4 very decidedly. Four of the others have a strong *transverse* striation.

(2) Shown, more or less definitely, by four out of the six. (3) Rather pronounced in two specimens. (4) Well marked and unmistakable in four specimens.

From this almost casual examination we may infer that the distinctive characters of *corrugata* occur in varying degrees of frequency among ordinary *globosa*, and that if we find a specimen which combines them all, we may call it *corrugata* or *globosa* as we please. Such specimens are, it must be admitted, not very common, but I have figured two, which, in different ways, seem to fulfil the requirements. These also illustrate what has often been remarked already, viz., that the *height* of the spire is of very little consequence in *Ampullaria*. By comparison with the small and depressed spire of the huge typical *globosa* at fig. 4, it will be easily seen how much wider and more ventricose are the whorls of this part in figs. 2 and 3.

PL. XIV., f. 2. Strongly wrinkled, vertically and transversely. Dull olive-green, with only very faint traces of bands. Eroded parts pinkish on the spire, bluish on the body-whorl (as in Swainson's figure and description). Umbilicus rather high up the side of the inner lip. Peristome pale yellow, inside of aperture light brown with very dark bands extending nearly to the outer edge of the lip. A thin, pale grey zone inside the latter. Labelled Goozerat.

Swainson's figure represents the operculum *in situ*, the whole of the aperture, save for the extreme edge of the peristome, being thus hidden, but the description states that in his specimen it was dark chestnut with blackish bands. The flattening of the sides of the shell, beautifully shown in his figure, is also very evident in my shell.

PL. XIV., f. 3. Very like Swainson's figure, but paler in colour, which is here of a light olive-yellow, the upper whorls of the spire pinkish. No external banding, but a good deal of transverse striation. The shell is also well wrinkled beyond a certain growth stage; at this point the colour becomes abruptly darker. Umbilicus not so high up as in the foregoing, but higher than in typical *globosa*, and nearly as high as in Swainson's figure. Peristome pale yellow outside, white inside, interior of aperture reddish white, with very faint traces of bands. Labelled "*pachystoma* var. *India*."

Hanley and Theobald's figure is also very like this shell, but has a somewhat redder colouring. They give Bengal and Pondicherry as localities.

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A. GLOBOSA, Swainson

This very well-known species appears to abound all over North-Central India, and extends as far eastward as Bangkok. It varies a good deal in colour, straw-yellow, olive, reddish or grey-green, and is occasionally seen almost black (probably "dead" specimens). The peristome may be white, yellow or orange-red. The largest examples seem to come from its eastern limits, and I suspect that the form here figured, of which I have two unlocalised specimens, is from Burma or Siam.

PL. XIV., f. 4. Dull olive, vertically striped somewhat after the manner of *A. Dalyi*, but instantly distinguished by its grooved and thickened lip. Umbilicus unusually wide (quite closed in the companion specimen, which is still larger). Interior dull reddish with very faint traces of bands, narrowly white at the base of the columella. Peristome orange-yellow, darker on the outside.

Swainson says that *globosa* is sometimes marked with narrow bands of purple brown. Such ornamentation is rather unusual in this species, but it does occur, and may be seen in the two named varieties figured by Hanley and Theobald. It is perhaps more frequent in the two small forms, *A. cinerea* Reeve from Ceylon, and *A. encaustica* Reeve (unlocalised). These are considered by Sowerby, doubtless correctly, to be mere varieties of *globosa*. Nevill records a reversed variety, almost unique in the history of *Ampullaria*.

A. THEOBALDI, Hanley

Plate XIV. figs. 5, 6, 7

Ampullaria Theobaldi, Hanley, Hanley and Theobald, Conchol. Ind., p. 47, pl. 115, f. z ; *Ampullaria maura*, Reeve, var. *Theobaldi*, Nevill, Hand List Moll., pt. II., p. 4 ; *Ampullaria Theobaldi*, Sowerby, Proc. Mal. Soc. Lond. IX., p. 6i ; *Pila theobaldi* (Hanley) Preston, Fauna of British India, Moll., p. 99.

Originally described and figured in the Conchologia Indica from a specimen, whereof the precise locality had been lost, but which was supposed to have come from Burma (?) Pegu. The latter habitat was given by Sowerby, but Hanley, in the P.Z.S. for 1875, the year of the original publication of his species, gave Bhamô in Upper Burma. Both localities, being on the Irawadi, may of course be correct. Nevill (l.c.) records a series of twelve from Bhamô. The specimens figured here are without precise locality.

Having examined the type in the British Museum collection and the specimens in my own cabinet, I have come to the conclusion that Nevill was right when he placed this large and imposing form as a variety of Reeve's *maura*. The latter, like *A. globosa*, appears to become larger as its range extends eastwards. I have a series from Silchar very uniform in size which is much below that of the two adult *theobaldi* figured here, but otherwise like them in every way. Silchar is, of course, to the westward, and northward of the localities given for Hanley's species.

Of the three *theobaldi* figured on pl. XIV., one-the smallest, and apparently the least mature-is much more heavily banded than the type of which the figure in the Conchologia Indict gives an excellent presentment. The shell shown at our figure 6 is still banded, but not very distinctly, on the outside, and in the largest specimen (fig. 5) the external bands have entirely disappeared from the body-whorl.

Characteristic of this form and of *A. maura* is the conspicuous dark edging of the columellar margin, often extending right up the parietal callus to the insertion of the lip. In some specimens the dark banding of the latter coalesces (as in our fig. 5), so that the whole of the peristome appears to be deeply bordered with brown or black.

PL. XIV., F. 5. An old shell, finely developed. Rich olive-green, vertically striped after the fashion of *A. dalyi*, but at once distinguished by its very wide umbilicus and by the dark-edged peristome. Interior reddish white, regularly banded. A broad and very distinct pale tract without spots or bands before the outer lip, as in Hanley's figure. (This character also appears to be common to all forms of *maura*.) Peristome dark brown, still showing distinct traces of the original blackish banding.

PL. XIV., F. 6. Nearer to Hanley's figure, but the banding, though fairly distinct, is not very conspicuous. General colour browner than in f. 5, and with less vertical striping. Interior of aperture reddish ash colour; bands very distinct, as is also the usual pale inner edge of the peristome. The latter cream-coloured, beautifully marked by the dark ends of the bands.

PL. XIV., F. 7. Apparently a young specimen. Fulvous olive, heavily banded with dark red. Interior dirty whitish, irregularly stained, and banded with reddish ash-colour. Outer lip rather bright green, vividly spotted by the ends of the bands, and with a light interior edge as usual.

A. MAURA, Reeve Plate XV. figs. r, 2, 8

Ampullaria maura, Reeve, Conch. Icon. Amp. f. 57; Hanley and Theobald, Conch. Ind. p. xvii; Nevill, Hand List Moll. pt. II., p. 4; *Ampullaria virens*, Lamarck var. *Maura*, Reeve, Sowerby Proc. Mal. Soc. Lond. IX., p. 62; *Pila maura* (Reeve), Preston, Fauna of British India, Moll., p. 99.

This, which appears to be specifically identical with the preceding, was reckoned by Sowerby among the many varieties of *A. virens*, Lamarck. I cannot discover that any other authority has supported this opinion, which is probably mistaken. As compared with *virens*, the shell, even in its present form, is larger and more widely umbilicated, and it has several peculiarities of colour. It appears, exclusive of *theobaldi*, to be confined to Assam. Most of my specimens come from Silchar. The dark edging of the peristome, mentioned under *theobaldi*, is very conspicuous in the three examples figured, although in the lightly banded form at f. 8 the circuit has not been completed by the fusion of the spots on the lip.

A. maura has an unusually distinct individuality, and the only really noticeable variation, apart from size and external banding, is in the ground colour, which is sometimes brown, and sometimes green of a rather characteristic tone, unlike that of any other *Ampullaria* known to me, and recalling in its gloss and uniformity the hue of a laurel leaf. Reeve's type, now in the British Museum, is of the brown form. In the brown shells the beautiful vinous colour seen in the aperture of the green variety is changed to reddish, but the light inner edge of the peristome is always present in either form. The differences of colour may possibly be sexual.

PL. XV., F. 1. Olive brown, regularly and closely banded up to a certain growthstage on the back of the shell; after that blank. Peristome with a deep brown edge, spotted on the outer lip by the dark ends of the internal bands. Aperture reddishwhite, faintly but distinctly banded.

PL. XV., F. 2. Deep laurel-green, with only one or two bands faintly indicated. Peristome with a heavy dark border, practically complete and uninterrupted excepting in the upper half of the outer lip, where the spots are not entirely fused. This part of the lip is greenish, heavily barred by the ends of the bands. Aperture, beyond the white outer tract, flushed with a beautiful vinous shade. Bands dark and distinct, mostly in close groups.

PL. XV., F. 8. An unusual and pretty form, of the same dark green colour as the last, sparingly but very decidedly banded within and without. The vinous tint of the interior lighter, and not extending much above the middle of the aperture. Outer lip greenish, sharply spotted with black. Black columellar edging very strongly developed. By comparison of the last two figures it will once more be seen how little value can be set on the height of the spire as a distinctive character in this genus.

The remaining shells on Plate XV. and those figured at Plate XVI., figs. 1 and 2, are probably all forms of one very common and variable species, *A. virens* of Lamarck. Several of them have received names at the hands of the older conchologists, who had not the opportunity of comparing large series. But the general opinion of modern authorities is that this one species has a range of habitat and variety wide enough to include them all.

Sowerby has placed them under *A. virens* alone. But Nevill's procedure is even more sweeping. He has put most of them down as varieties of Swainson's *carinata*, and made *carinata* itself a sub-species of *A. globosa*. This view does not seem to have been definitely adopted in its entirety by any other author, although Hanley and Theobald (*Conch. Ind.*, p. 46) regarded *malabarica* as a possible variety of *carinata*, and von Martens doubtfully suggested that *virens* might be the same as *globosa* (*Mal. Blätt.*, IV., p. 210).

We take Lamarck's *A. virens* as the typical form, since, in spite of some uncertainty, it appears to have been the first described of the series. Swainson (*Zool. Ill. Ser. II. Vol. I.*, pl. 38) claims that his *A. conica* is probably the same thing, but he gives no reference to the description, and the name *conica* is now definitely settled on another and very different species. Philippi, in his notice of *virens*, quotes Swainson's *conica* in (*Tilloch's?*) *Philosophical Magazine*, Vol. 62, for 1823. If this is correct-I have not been able to verify it-Lamarck's name has priority by one year.

A. VIRENS, Lamarck

Plate XV. figs. 3, 4, and Plate XVI. fig. 1

Ampullaria virens, Lamarck, Hist. Nat., etc., ed. I., Vol. VI., p. 179, ed. 2, Vol. VIII., p. 536; Delessert, Recueil, pl. 31, ff. 5 a, b, c (wrong operculum?); Philippi, Mon. Amp., p. 30, no. 41, pl. 8, f. a; sub-species *carinata*, sub-var. *virens*, Nevill, Hand List, Moll., pt. II., P. 3; *Ampullaria virens*, Sowerby, Proc. Mal. Soc. Lond. IX., p. 61; *Pila layardi* (Reeve), var. *virens* (Lamarck), Preston, Fauna of British India, Mull., p. 99.

Typical *virens* is also figured as *paludinoides* and variety thereof by Reeve, Conch. Icon. Amp., ff. 9 and 86, and a dark form as *Ampullaria Largillierti*, Philippi, at f. 109 of the same work.

The admirable figure of Delessert is, of course, our authority for the right application of Lamarck's diagnosis. Philippi, noticing that his specimens were flattened at the suture, accuses Delessert's artist of failure to express this character sufficiently. Nevill, who would only give *virens* the rank of a sub-variety, remarks but one distinguishing trait—"carination at suture obsolete." The fact is that in a long series of *virens* and its varieties one may find every degree of flatness or convexity at this part, though there is generally a little flattening.

In such a species as this, it is hardly worth while to specify a typical form, but I have chosen for Plate XV., fig. 3, a specimen exactly like Delessert's figure. The two darker forms represented under the same name are really just as much varieties as *layardi* or *malabarica*, but it so happens that no one has named them, and they therefore appear simply as *virens*.

Philippi, with his usual astuteness, noted one peculiarity which runs through the whole series of forms, and is included in the diagnosis of a couple, to which he has given specific names, viz., *A. Borneensis*, *A. malabarica*. It is also plainly expressed in his figure of another, *A. pallens*, although here it is passed over in the description. I refer to a strong black *external* edging of the outer lip, formed by the epidermis, and not due to the actual colouring of the shell.

It may appear that this character possesses no particular value, since it resides wholly in the epidermis, but it is constant, and, in its way, individual. Many Eastern *Ampullariae* show considerable and sometimes abrupt darkening of the epidermis as it approaches the lip, but in all those which are here reckoned as forms of *virens* the black or dark brown margin is definite, clear and sharp at the edges, and unannounced by any previous shading. In some it has almost the appearance of a thick ruled line, made with a broad-nibbed pen. It appears to be a sign of maturity, since it rarely leaves any variceal trace at former growth-stages. In a long series of *virens* forms, showing many variations of size and colour, I have only found it absent from specimens which were either immature or defective, through injury, at the lip. The want of this character in *maura* helps to exclude it from the varieties of *virens*, while, on the other hand, its very pronounced appearance in the *carinata* form militates against Nevill's opinion that the latter is a sub-species of *globosa*. I have not found it in any example of *globosa*, great or small.

The *virens* forms, apart from those which have received special names, make an exceedingly miscellaneous assemblage, with great var; ,our, shape and marking. Some are clear yellow, others green, others again dark brown. The lip may be white, yellow or orange, and is occasionally spotted, but more often plain. The internal banding is generally definite and dark; the outside of the shell is sometimes banded and even vertically striped, but, as a rule, is uniform in colour. I have chosen for figuring under the specific name three examples which seem to represent the extremes of the colour scheme.

PL. XV., F. 3. Typical *virens* almost exactly like Delessert's figure. Rather large; externally clear olive yellow, unbanded, interior white with pale reddish bands, lip white edged with pale yellow. Apparently from the neighbourhood of Madras.

PL. XV., F. 4. Dark olive green unbanded. Aperture reddish-brown, vaguely banded. A few spots on the lip, which is dirty reddish-white. Singapore.

PL. XVI., F. 1. A small dark form from Pondicherry. Uniform olive brown, the eroded whorls of the spire reddish. Lip and interior white, the latter with a partial blue flush, and strong reddish banding.

Var. PALLENS, Philippi Plate XV. fig. 5

Ampullaria pallens, Philippi, Mon. Amp., p. 32, no. 43, pl. 8, f. 4; von Martens, Malak. Blätt, IV., p. 184, also I.c. vol. XII., 1865, P. 53; *Ampullaria virens*, var. *pallens*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 62.

A rather remarkable form with the latter part of the suture channelled, resulting in a strong downward curve of the outer lip at its insertion. Von Martens rather oddly conjectured that it might be the same as Reeve's *cinerea* from Ceylon, but it is not at all like this, and is evidently a mere variety of *virens*.

The specimens in the Berlin Museum from which Philippi described his *pallens* were in the Deppe collection, and were marked M, which, in consideration of Deppe's record as a collector, was interpreted to mean Mexico. Von Martens afterwards found that they had been introduced from another source, and that the latter probably stood for Manila. This locality may be correct, but Sowerby leaves the form unlocalised, and my own specimen here figured is in the like case.

PL. XV., F. 5. Pale olive yellow, with a few thin and indistinct bands round the lower part of the body-whorl. Denuded whorls of spire reddish-grey. Interior dark fulvous chestnut, the bands showing irregularly near the lip. Lip pale yellow.

Var. LAYARDI, Reeve

Plate XV. fig. 6

Ampullaria Layardi, Reeve, Conch. Icon. Amp., f. 27 and f. 40; Hanley and Theobald, Conch. Ind., p. 46, pl. CXIV., f. 4; *sub-species carinata* var. *layardi*, Nevill, Hand List Moll., pt. 1¹, p. 3; *Ampullaria virens*, var. *Layardi*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 62; *Pila layardi* (Reeve), Preston, Fauna of British India, Moll., p. 99.

A dark form, often strongly corrugated, from Ceylon. There is a larger, smoother and paler variety which shows faint bands on the back. This is figured by Reeve, in the Conchologia Iconica monograph, at pl. VIII., f. 40. In my specimen the internal bands, which are very strongly developed on a reddish ground-colour, stop abruptly some distance before the lip, just as in Reeve's figure. The peristome is broadly cream-colour. I have smaller and more typical specimens, in which the lip is either livid yellow, as in Hanley's figure, or orange.

PL. XV., F. 6. Dark olive with a tinge of red, and lighter on the spire. Strongly corrugated. Interior livid reddish, peristome ashy white with a very faint reddish edge. Hardly any trace of bands within or without.

Var. PALUDINOIDES

(of Philippi, Reeve, and Hanley and Theobald, not of
Cristofori and Jan.)

Plate XV. fig. 7

Ampullaria paludinoides, Philippi, Mon. Amp., p. 27, no. 36, pl. 7, f. 4; Reeve, Conch. Icon. Amp., f. 9; Von Martens, Malak. Blätt, IV., p. 184; Hanley and Theobald, Conch. Ind., p. 47, pl. CXIV., f. 5 (not f. 6, which is *A. compacta*, Reeve) = *Pila conica*, Gray, var. *expansa*, Nevill, Cat. Moll. Fasc. E, 1877, *vide* Nevill, Hand List, pt. II., p. 5, and Preston, Fauna of British India, Moll., p. 100; *Ampullaria virens*, var. *paludinoides*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 62, but see also observation under *A. compacta*,

Reeve, *l.c.* p. 57, "I place *A. paludinoides* as a variety of *A. conica*."

None of the citations given above appear to indicate the original *paludinoides* of Cristofori and Jan's Catalogue. The species is lost, and our figure is only given as a typical illustration of the kind of shell that has served conchologists as a substitute.

The name is one of those elusive ghosts which haunt the nomenclature of the genus. The old Catalogue of the Berlin Museum in which it was published states that *paludinoides* was an umbilicated species from South America. These details, the former tentatively and the latter definitely, rule out *conica* from the list of "probables."

Philippi, who had access to the Berlin collections, might have solved the question, but unfortunately he seems to have mixed his descriptions of the Berlin *paludinooides* and *pallens* (*teste* von Martens l.c. on the latter species). At any rate there is nothing in his account of *paludinooides* that is really inconsistent with *virens*, and his figure, although too bad for certainty, seems to indicate the same. Reeve's *paludinooides* looks like a very ordinary *virens*, and the so-called variety represented at f. 86 of the Iconica monograph assuredly belongs to that species. The figure of Hanley and Theobald represents merely a larger specimen of the *virens* form figured at our plate XV., f. 7.

The joint authors just quoted sum up *paludinooides* as follows, " Jan's species should be ignored, for it is so inadequately defined that his description would fit half a score of Ampullariae; it is not likely to be the shell here figured, as it is called umbilicated and South American."

Before we dismiss Jan's species into limbo, I may, perhaps, be allowed to advance a theory of my own. When figures and descriptions fail us, the name given to a species is sometimes helpful. In this case it obviously implies an *Ampullaria* that was like a *Paludina*.

Now the only species of our genus which fulfils this requirement is the variety *nubila* of Philippi's *impervia*. It may be objected that this shell, as the name again implies, is imperforate, and therefore does not fit Jan's diagnosis. But Sowerby, whose practical experience was undeniably great, says "*Ampullaria impervia* (Philippi) is more often umbilicated than not" (Proc. Mil. Soc. Lond., VIII., P. 345). And it does come from South America. If Jan's locality was correct, why should not his type specimen-presumably lost-have been an example of the well-known var. *nubila*? which, indeed, with its thin, pellucid shell, high spire and rounded aperture, reminds one forcibly of our European *Paludinae*.

PL. XV., F. 7. The variety of *virens* here figured is a smooth shell of nearly uniform chestnut brown. The aperture is white, prettily barred with reddish, and the peristome is bright orange. This specimen is without locality. Hanley and Theo

bald for their very similar *paludinooides* give " Mangalore, near Moulmein, Pegu." Nevill, for the same form (his *conica* var. *expansa*), gives also, with query, Tenasserim and Mandalay.

Var. CARINATA, Swainson

Plate XV. fig. 9

Ampullaria carinata, Swainson, Zool. Ill., 2nd ser., Vol. I., pl. 9; Philippi, Mon. Amp., p. 8, no. 2, pl. 1, f. 2 (copy of Swainson's figure); Reeve, Conch. Icon. Amp., f. 58; Hanley and Theobald, Conch. Ind., p. 46, pl. CXIV., f. ; *Ampullaria globosa* sub-species *carinata*, Nevill, Hand List Moll., pt. H., P. 3 ; = *Ampullaria virens* (Lamarck), Sowerby, Proc. Mal. Soc. Lond., IX., p. 61 ; *Pila carinata* (Swainson), Preston, Fauna of British India, Moll., p. 98.

Swainson's figures are, as usual, exquisite, but his description is very meagre. He noticed little beyond the "carination" caused by the depressed suture, and the absence of external bands. Neither of these characters is of any great value in this group of *Ampullariae*, and in fact there is little to distinguish *carinata* from *virens* except its size-often larger than that of the specimen figured-and the rather intensified colour. The olive epidermis inclines to chestnut brown, and the peristome is orange, often very brilliant. Nevill gives Madras and Calcutta as localities, and I have specimens marked "Bombay."

PL. XV., F. g. Smooth, reddish olive, without external markings. Interior redbrown, closely banded with a darker shade. Peristome orange.

It should be noted that this is not the *Ampullaria carinata* of Lamarck, which is the sinistral fresh-water shell now known as *Lanistes carinatus*.

Var. TISCHBEINI, Dohrn

Plate XV. fig. o

Ampullaria tischbeini, Dohrn, P.Z.S., 1858, p. 134; Hanley and Theobald. Conch. Ind., p. 46, pl. CXIV., f. 3; *Ampullaria virens*, var. *Fischbeini* (*sic*), Sowerby, Proc. Mal. Soc. Lond., IX., p. 62; *Pila tischbeini* (Dohrn), Preston, Fauna of British India, Moll., p. 102.

This is perhaps the most individual form of *virens*, and differs constantly from the others. Its most characteristic features are the regular and well marked external banding, and the simpler type of lip, which though slightly thickened-as may be distinctly felt, by inserting a finger in the aperture-is not nearly so much incrassated, as, for instance, in *carinata*. The slight interior elevation is also masked to the eye by the continuation of some of the dark bands over the lip-if the latter were unspotted its projection would be more obvious.

It is curious to note that in several old collections-not all of them private property -I have found the African *A. adusta*, Reeve = *pilula* Reeve, doing duty for *tischbeini* from Ceylon.

The figure in the Conchologia Indica is rather badly drawn, but I have one specimen, less conspicuously banded than usual, which is very like it. The shell, however, as one generally sees it, shows its characteristic bands far more plainly. The specimen figured may be taken as a fair, average example.

PL. XV., F. 10. Light olive, the bands, and one or two variceal streaks rather darker. Interior whitish flushed with pale, dull red, and conspicuously banded. Peristome white, outer lip spotted by the ends of some of the bands.

One of my specimens is marked "Bintenne." The form seems to be peculiar to Ceylon.

78 STUDIES IN AMPULLARIA

Var. MALABARICA, Philippi Plate XVI. fig. 2

Ampullaria malabarica, Philippi, Mon. Amp., p. 29, no. 39, pl. 7, f. 8; Hanley and Theobald, Conch. Ind., p. 46, pl. CXIV, f. 2 ; subsp. *carinata* var. *malabarica*, Nevill, Hand List Moll., Pt. II., p. 3 ; *Ampullaria virens*, var. *Malabarica*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 62; *Pila malabarica* (Philippi), Preston, Fauna of British India, Moll., p. 98.

NOT the *Ampullaria. Malabarica* 'of Reeve, Conch. Icon. Amp., f. 67, which appears to be a form of *A. conica* found in the Philippines.

A variety of uniformly small size and light colour, and almost devoid of bands within and without. It has been received from various localities in the southern coast districts of India. Philippi's specimens were from Mangalore on the Malabar coast, to which Hanley and Theobald add Cochin, in Travancore, and Bombay. Nevill gives Madras and, further to the south, Cuddalore. The specimen here figured came from Travancore.

PL. XVI., F. 2. Uniform olive yellow, with only a very faint trace of banding visible, in a good light, near the umbilicus. Interior pale greenish-white, with slight reddish banding in the lower part of the aperture. Peristome white with a central yellow stripe. The external black edging of the lip seems to overlap slightly, and is very conspicuous, giving a peculiarly neat finish to the outline of the mouth.

A. CONICA, Gray

Plate XVI. figs. 3, 4, 6, 9

Helix conica, Woods' Index Test. Suppl., pl. 7, f. 22; *Ampullaria conica*, Gray, in Suppl. l.c., p. 29 (1828); Hanley, Conch. Misc., *Ampullaria*, pl. III., f. 13 (from type), and pl. II., f. 8 (var.); Reeve, Conch. Icon. Amp., f. 10 (as of Wood); von Martens, Malak. Blätt, IV., p. 186; Morelet, Ser. Conch. IV., p. 290; Nevill, Hand List Moll., Pt. II., p. 5 ; Sowerby, Proc. Mal. Soc. Lond., IX., p. 57; Preston, Fauna of British India, Moll., p. 100.

Sundry varieties and local forms have also been described and figured under specific names, as follows :-*Ampullaria orientalis*, Philippi, Zeitschr. Malak., 1848, p. 192 ("*China*") =*A. scutata* of Philippi (not of Mousson), Mon. Amp., p. 9, no. 4, pl. I., ff. 4, 5 (*fide* Nevill); *A. scutata*, Mousson, Die Land and Süßw. Moll. von Java, p. 60, pl. VIII., f. 2, 1849; *A. turbinoides*, Reeve, Conch. Icon. Amp., f. 37; *A. lubrica*, Reeve, l.c., fig. 61 ; *A. compacta*, Reeve, l.c., f. 62 (also figured as *A. paludinoïdes* var. *by* Hanley and Theobald, Conch. Ind., pl. CXIV., ff. 6, 7 and described at p. 47); *A. complicata*, Reeve, l.c., fig. 89; *A. Javanica*, Reeve, l.c., fig. 96; *A. Stoliczkana*, Nevill, Cat. Moll. Ind. Mus., 1877, Fasc. E (*fide* Sowerby).

NOT the *A. conica* of Swainson, which =*A. virens*, Lamarck, nor of Pfeiffer, Nov. Conch., Vol. I., p. 51, pl. XIV., ff. 1-5.

Swainson's figures are, as usual, exquisite, but his description is very meagre. He noticed little beyond the "carination" caused by the depressed suture, and the absence of external bands. Neither of these characters is of any great value in this group of *Ampullariae*, and in fact there is little to distinguish *carinata* from *virens* except its size-often larger than that of the specimen figured-and the rather intensified colour. The olive epidermis inclines to chestnut brown, and the peristome is orange, often very brilliant. Nevill gives Madras and Calcutta as localities, and I have specimens marked "Bombay."

PL. XV., F. 9. Smooth, reddish olive, without external markings. Interior red brown, closely banded with a darker shade. Peristome orange.

It should be noted that this is not the *Ampullaria carinata* of Lamarck, which is the sinistral fresh-water shell now known as *Lanistes carinatus*.

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One of my specimens is marked "Bintenne." The form seems to be peculiar to Ceylon.

78 STUDIES IN AMPULLARIA

Var. MALABARICA, Philippi Plate XVI. fig. 2

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NOT the *Ampullaria Malabarica* 'of Reeve, Conch. Icon. Amp., f. 67, which appears to be a form of *A. conica* found in the Philippines.

A variety of uniformly small size and light colour, and almost devoid of bands within and without. It has been received from various localities in the southern coast districts of India. Philippi's specimens were from Mangalore on the Malabar coast, to which Hanley and Theobald add Cochin, in Travancore, and Bombay. Nevill gives Madras and, further to the south, Cuddalore. The specimen here figured came from Travancore.

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A. CONICA, Gray

Plate XVI. figs. ^{3,+}6, 9

Helix conica, Woods' Index Test. Suppl., pl. 7, f. 22; *Ampullaria conica*, Gray, in *Suppl. I.c.*, p. 29 (1828); Hanley, Conch. Misc., *Ampullaria*, pl. III., f. 13 (from type), and pl. II., f. 8 (*var.*); Reeve, Conch. Icon. Amp., f. (as of Wood); von Martens, Malak. Blätt, IV., p. 186; Morelet, Ser. Conch. IV., p. 290; Nevill, Hand List Moll., pt. II., p. 5; Sowerby, Proc. Mal. Soc. Lond., IX., p. 57; Preston, Fauna of British India, Moll., p. 100.

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NOT the *A. conica* of Swainson, which =*A. virens*, Lamarck, nor of Pfeiffer, Nov. Conch., Vol. I., p. 51, pl. XIV., ff. 1-5.

NOT the *A. Borneensis* of Philippi, Mon. Amp., p. 31, no. 42, pl. 8, f. 3 (perhaps also of Morelet, Sér. Conch., IV., p. 290). Nevill and Sowerby have placed *Borneensis* as a variety of *conica*, but it was almost certainly a variety of *virens*, to which Philippi himself compares it, and is only able to distinguish it by the higher spire.

When one attempts to illustrate this widely distributed and very variable species, the same difficulty arises as with *A. virens*. Some of its many varieties have received names from the older conchologists; others just as far divergent from the typical form have to be figured along with it under the specific designation, because one cannot call them anything else. Hence the four figures entitled *conica* on the plate appear to have very little in common, though they all belong to one species.

Of all the Asiatic *Ampullariae* this has perhaps given the most trouble to conchologists; partly because it is exceedingly variable, and partly through the insufficiency of the original figure in the supplement to Wood's Index Testaceologicus. This, as

remarked under *A. teres*, is reduced in size, and also thoroughly uncharacteristic—it might represent almost any "Apple snail" in one stage of growth or another. This figure stood alone, as sole testimony to the species, for more than twenty years, and being given without any statement of locality, it utterly misled Pfeiffer, who took it to represent an *Ampullaria* that he had collected in Cuba (*vide* the remarks of Fischer and Crosse, Miss. Scient. Mex. Moll., Vol. II., p. 238). Pfeiffer, however, had doubts as to whether his supposed *conica* might not in reality be the young of *A. reflexa*. As to this latter species he was again in error; the Cuban shells which he attributed to it were almost certainly *A. paludosa*.

At length in 1854 Hanley settled the identity of our species by hunting up Gray's type, of which he gave an excellent figure at Pl. III., f. 13, of the *Ampullariae* in the Conchological Miscellany. At Pl. II., f. 8, he also represented a variety.

We may take this figure of the type as our first real authority for Gray's species. Except that the body-whorl is a little broader, and the spire (eroded) a little higher, it is remarkably like my figure 3 in shape, and the colours are almost precisely similar.

Hanley did not discover the locality of the type, but he gave Malacca for the variety. The species in various forms seems to be found all over the Malay Archipelago, and as far north as the Philippines, while Reeve has given "Australia" as locality for the var. *turbinoides*, but this is, perhaps, a mistake. It is also found all over further India from Mandalay to Singapore, and Morelet extends its range through Siam and Cambodia to China. The same author avers that the typical form comes from Malacca. Since he evidently knew Hanley's figure of the type, which he quotes and accurately describes, this statement may be accepted implicitly.

Few species have a wider range, and, moreover, *conica* apparently possesses the faculty of producing totally different forms in fairly close proximity. I have, for instance, a series of small, light-coloured specimens from Manila. One of these is figured at Pl. XVI., f. 6. From the interior of the island (Luzon) I possess a quantity of still smaller, but apparently adult shells, all very much alike, and extremely dark, within and without.

The shell, which is generally thin, may be known by its very high polish and by the almost total disappearance of the umbilicus. It might almost be regarded as a small edition of the much larger *A. polita*, to which it is closely allied. Indeed, von

Martens (Malak. Blätt, IV., p. 185) considered that the var. *lubrica* might be identical with *polita*. But no form of *conica* exceeds medium size, whereas *polita* is often truly gigantic.

PL. XVI., F. 3. Pale olive yellow, with a few faint indications of narrow bands on the back of the shell and near the umbilicus. Interior mostly reddish-brown, profusely banded; a white belt extending from the foot of the columella inside the lip; lip beyond this yellowish, barred by the ends of the bands.

PL. XVI., F. 4. A thin olive green shell, obscurely banded. Aperture stained with reddish-brown, bands only a trifle more conspicuous than on the outside. Lip and upper portion of the mouth greenish-white. Celebes.

PL. XVI., F. 6. A miniature copy of the shell represented at f. 3, which it almost exactly resembles, but the colour of the body-whorl is somewhat browner in tone. Manila.

PL. XVI., F. 9. This much-battered specimen is figured on account of its unusual depth of colour. Dark, rich olive, with several black variceal streaks. Aperture umber brown, with the usual light belt inside the lip. Peristome edged with reddish orange. A few faint traces of bands in the interior. Rangoon (?).

Var. TURBINOIDES, Reeve Plate XVI. fig. 5

Ampullaria turbinoides, Reeve, Conch. Icon. Amp., f. 37; *Ampullaria conica* var. *turbinoides*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 58.

A small specimen of a form remarkable for its high, acutely pointed spire. Dark olive green, very glossy, and obscurely banded on the back. Aperture umber brown in the depths, a broad paler tract before the lip. Both light and dark portions crossed by the banding, which is close and well marked. The usual pale inner stripe is prettily indicated in blue. Beyond this, on the very narrow dark edge, the bands reappear as spots. Habitat, Australia (*fide* Reeve).

Var. LUBRICA, Reeve

Plate XVI. fig. o

Ampullaria lubrica, Reeve, Conch. Icon. Amp., f. 61; *Ampullaria conica* var. *lubrica*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 58.

Reeve's figure is marred by the presence of the operculum *in situ*, the markings of the aperture being thus entirely concealed, nor are *they* described in the letterpress. The author, however, has well noted a peculiarity of this form—the presence of sundry,

irregular blackish smears ; these are conspicuous in the specimen I have figured. Otherwise the shell is uniformly dark green on the outside, and exceedingly glossy-in fact it looks as if it had been oiled. In one or two lighter coloured specimens that I possess the gloss is even more remarkable, and to it, of course, this variety owes the very appropriate name given by Reeve. The interior of the aperture is bright burnt-sienna colour, with thin but decided dark bands. The peristome, rather broad and not preceded by the usual light streak, is yellowish, the ends of the bands faintly marked upon it. Labelled " Luzon."

Var. COMPLICATA, Reeve

Plate XVI. figs. 11, 12

Ampullaria complicata, Reeve, Conch. Icon. Amp., f. 89; Sowerby, Proc. Mal. Soc. Lond., IX., p. 57.

Sowerby prefers to give this the rank of a separate species. Reeve says it is "well distinguished by its oblong turbinated form, and contracted aperture. The irregular linear painting is also a characteristic feature." His figure hardly bears out this description in respect of the contracted aperture.

I have seen but few specimens of this shell, and should certainly have hesitated to refer my fig. 11, at least, to *complicata*, had not both the specimens represented been in the same lot, which was labelled with that name, and with the locality "Singapore." Each has points in common with Reeve's figure, notably the shape of the body-whorl, which is quite unlike that of our other forms of *conica*. My fig. 12 also shows the brown colour and, to some extent, the irregular linear painting ascribed to *complicata*. The lip of this specimen, I should remark, is unfortunately incomplete.

I have reason to believe that these specimens may have been examined by Reeve himself, and he possibly suggested the labelling. At any rate they may each be said to possess some of the characters of his species, for if fig. 12 looks most like this in general facies, its associate at f. c presents us with an internal coloration very much nearer to that of the *Conchologia Iconica*. The banding is also as shown there-characteristically open and evenly spaced, the lines not running in irregular groups as in the other forms. On the other hand, fig. 12 comes nearer to Reeve's description in the narrow mouth, though the colouring of that part is quite different. Nevertheless, I believe this figure to be a representation of genuine *complicata*; its companion is perhaps no more than an aberrant *conica*, if we are to recognise such a distinction.

PL. XVI., r. 11. Dark olive green, the bands showing distinctly but faintly on the back of the shell. Interior umber brown, very definitely and regularly banded. The usual light stripe before the lip white inside, bluish outside. Lower lip and columellar margin pale umber brown, distinctly barred by the ends of the bands.

PL. XVI., r. 12. Yellow-brown, the body-whorl rather heavily and distinctly banded in the lower part, and near the lip. Interior also yellow-brown, with closely-set dark bands. The broad light area abruptly cut off above the middle of the lip; bluishwhite. Lower lip and columellar margin light yellowish-brown, the ends of the bands distinctly marked on the lip.

A. POLITA, Deshayes

Plate XVI. figs. 7, 8

Ampullaria polita, Deshayes, Encycl. méth. I I., p. 31, no. 8 (18 30) ; also in Lamarck, Hist. Nat., etc., ed. 2, vol. VIII., p. 544; *Ampullaria virescens*, Deshayes, Dict. class d'hist. nat., pl. 87, f. 2 ; *Ampullaria polita*, Philippi, Mon. Amp., p. 29, no. 40, pl. 8, f. 1 ; Reeve, Conch. Icon. Amp., f. 35; von Martens, Malak. Blätt., IV., p. 184; Morelet, Ser. Conch., IV., p. 291; Nevill, Hand List Moll., pt. II., p. 7; Mabile, Moll. du Tonkin, Bull. Soc. Mal. Fr., IV., p. 15 S ; Blanford, Proc. Mal. Soc. Lond., V., p. 281 ; Dautzenberg and Fischer, Journ. de Conchyl., LIII., p. 161, and also p. 426; Sowerby, Proc. Mal. Soc. Lond., XII., p. 69. Varieties and aberrations-*Ampullaria pagoda*, Morelet, Journ. de Conch., XIII., p. 227; *A. compressa*, Nevill, Hand List Moll., pt. II., p. 7; *A. Brohardi*, Granger, Le Naturaliste, 1892, p. 97, and E. A. Smith, Proc. Mal. Soc. Lond., IV., p. 40; *A. polita* var. *major*, Dautzenberg and Fischer, Journ. de Conch., LIII., p. 426.

This very well-known and quite unmistakable species is only illustrated here in order to show the occurrence of two forms with high and low spire respectively. That with a low spire is generally much the larger and often exceeds the size of our fig. 7. The difference may possibly be sexual, in which case the larger form would most likely be the shell of the female. *A. polita* does not vary much in colour, though von Martens describes brown and numerous banded forms which I have not met with. One of my specimens has a single very faint band, but as a rule there is nothing to interrupt the glossy uniformity of the outer surface. After inspection of the specimen in the British Museum, and a careful study of Morelet's figure and description, I am convinced that his *A. calliostoma* (Sér. Conch. IV., p. 202, pl., XIII., f. 7) is nothing but a small, brightly coloured specimen of the present species.

For a long time after its publication *A. polita* continued to be a very rare species, but it is now abundant in collections. Reeve gave Port Jackson in New South Wales as its habitat, but this was probably a mistake. Philippi localised it in Java, which may be correct, but its headquarters are certainly in Further India. It has been reported from Siam, Cambodia, Cochin China, Tonquin, etc., and seems to be found commonly in the rice fields.

PL. XVI., F. 7. Uniform olive green, slightly tinged with orange near the umbilicus. Interior deep purple-brown with faint traces of hands. A narrow light belt before the outer lip, as in *A. conica*, but fulvous in this species. Peristome deep orange chestnut, the outer lip heavily barred by the black ends of the bands.

PL. XVI., F. 8. Rather darker in colour than the preceding and Much less smooth, the vertical wrinkles being marked by stripes of more intense colour. Upper whorls of spire denuded and leaden grey. Interior rich purple-brown, with a pale-coloured upper tract; ante-marginal belt lilac; outer margin chestnut, heavily barred with black.

African Species

The *Ampullariae* of the African continent and of the adjacent islands are still very little understood, and it is difficult to resist the conclusion that only a small proportion of the species has been described hitherto. The region is eminently suited to this genus. The climate of the tropical parts, the huge rivers, lakes and swamps all provide ideal conditions, yet the known forms of African *Ampullariae* bear no comparison, in point of numbers, with those of South America. Billotte's list published in 1885 contained only nineteen, and of these not a few are doubtful or varietal forms. Bourguignat in 1889 made out twenty-two, but his enumeration is liable to the same objection. Both authors, for instance, have included, besides several species of their own creation, Reeves' *A. erythrostoma*, now recognised as Lamarck's *guyanensis* from South America. Sowerby's list, published in 1910, admitted twenty-one African species-not counting *palustris*, a sinistral shell belonging to *Lanistes*, which had slipped in by mistake. No additions of any importance appear to have been made to this total, possibly owing to the intervention of the Great War, and I have yet to see a muster of African *Ampullariae* which mounts up to thirty species. It is almost inconceivable that this meagre assemblage represent the whole wealth of so vast an area, and indeed I have often examined single specimens from Africa which would not accord with any recognised form. But, in the absence of regularly localised series, it would be rash to regard such as new and undescribed, and as a collector I have unfortunately found the supply of "Apple Snails" from Africa very short.

To some extent Africa atones for numerical poverty by presenting us with several of the finest forms, and indeed such a quartet of species as *A. Wernei*, *A. Nyanzae*, *A. Charmesiana* and *A. speciosa* can hardly be matched in any other part of the world for size and splendour. It is to be regretted that one or two of them are hardly known in English collections, and of Sowerby's twenty-one species I have only been able to figure thirteen for the reasons given above.

A. MADAGASCARIENSIS, Smith

Plate XVII. figs. z, 2, 3

Ampullaria madagascariensis, E. A. Smith, P.Z.S., 1882, pl. xxii., ff. 8, 9; Sowerby, Proc. Mal. Soc. Lond., IX., p. 60.

I have found this species in an old collection, correctly localised, but under the curiously inappropriate name of *A. reflexa*! It was evidently known to collectors long before its first publication by the late Edgar Smith, who described it from specimens taken in a marsh to the north of Antananarivo (Johnson) and in the Imarina province (Cowan).

When adult it does not vary much in size or colour, but, like so many *Ampullariae*, it seems to occur in two forms, which I take to be sexual, that assumed to belong to the male having a higher spire, a redder colour and less banding than the more globose and distinctly ornamented shell which is *possibly* that of the female.

I have a couple of very young specimens, which are small and dark-coloured, almost blackish. These agree almost precisely in general appearance and in sculpture with the indeterminate *A. dira*, Reeve, ridiculed by von Martens (Malak. Blätt., IV., p. 183). I believe that they represent this lost species, for the *Ampullariae* of Madagascar seem to have come pretty freely to Europe, long before their real affinities began to be understood. They were in fact more familiar, under rather casual names (see above, for instance) than many from more accessible regions.

This species has the flat and thin operculum characteristic of the Madagascar species, and it resembles the *ovata* group in that this appendage is rather small, and may be inserted far up the shell.

PL. XVII., F. t. I take this form to be the shell of the male animal. It is highspired, bright reddish olive in colour, with the bands only evident just before the final lip, though traces are discernible at the black variceal streak on the front of the shell. Aperture reddish, very regularly banded, the bands crossing the broad ash-coloured belt which runs up inside the lip from the base of the columella. Columellar margin pale sulphur yellow, flecked with light red in its lower part; parietal callus bluish.

PL. XVII., F. 2. This and the next are possibly female forms, being considerably more globose and richly banded. The present shell is light greenish olive, with the upper whorls of the spire reddish. There are several dark variceal streaks at the growthstages, and the banding is very regular and beautiful, the bands running mostly in pairs. The same arrangement is also evident in the aperture, the ground-colour of which is light sulphur yellow, flushed with reddish brown in the lower part. Columellar margin yellowish; parietal callus very thin.

PL. XVII., F. 3. A very similar specimen, but the general colouring is darker, and the bands are not so conspicuous. The whole shell is somewhat redder in tone than the preceding, especially in the interior. The peristome and the upper part of the aperture are rather broadly yellow; the lip and columellar margin splashed and spotted with reddish brown.

A. LARGILLIERTI, Philippi

Plate XVII. fig. 4

Ampullaria Largillierti, Philippi, Zeitschr. f. Malakoz., 1848, P. 192; Mon. Amp., p. 46, no. 64, 1)1. '3, f. 5 ; *Ampullaria filosa*, Reeve, Conch. Icon. Atop., f. S8 ; *Ampullaria Largillierti* (Philippi), Billotte. Bull. Soc. Mal. de Fr., Vol. II., p. to; *Bourguignat*, Moll. de l'Afr. Équat., p. 167; Sowerby, Proc. Mal. Soc. Lond., IX., p. 59.

Nor the *Ampullaria Largillierti* (Phil.) of Reeve, Conch. Icon. Amp., f. 109, which is a variety of *A. virens*, Lam., *fide* Sowerby. Reeve himself states that his shell " is the nearest allied to *A. Layardi* from Ceylon "-a form of *A. virens*.

This very peculiar little species, rarely seen in good condition, is here represented

from a characteristic specimen. It is generally of small size, but I have seen it considerably larger than the figure. The shell is remarkable for its strong criss-cross striation and for its noticeably peaked shape at the lower end of the aperture. It was not recognised from Philippi's description by Reeve, who gave it the name of *filosa* =the "threaded" *Ampullaria*, from the raised transverse striae which are often so strongly marked as to be visible even to the unassisted eye. The colour-bands are not always as distinct as in my figure, and the general hue of the epidermis varies from olive to rusty reddish, but it has generally a decided inclination to red. The locality given by Philippi is Nossi-bé, whence he received it from Largilliert. This is presumably the lake on the east coast of Madagascar, to the south of Tamatave, but there is a small island of the same name north-west of Madagascar, and from this Morelet reports Philippi's other Nossi-bé species *A. Cecillei*. Philippi himself, however, gives the locality as "in Madagaskar."

Von Martens (*vide* Billotte, l.c.) also gives as locality for *.1. Largillierli* the Querimba Islands, off the coast of Mozambique.

PL. XVII, F. 4. Rusty olive, distinctly but narrowly landed. Columellar margin and lower extremity of aperture white; the interior, for the rest, reddish ash-colour; one or two bands distinctly marked in the upper part.

A. OCCIDENTALIS, Mousson

Plate XVII. figs. 5, 6, 7

Ampullaria occidentalis, Mousson, *Journ. de Conchyl.*, 1887, Vol. XXXV., p. 299, pl. XII., f. 9; Bourguignat, *Moll. de l'Afr. Squat.*, p. 167; Sowerby, *Proc. Mal. Soc. Lond.*, IX., p. 60.

Originally described from specimens collected by Dr. H. Schinz at Kunene, a coast settlement in the extreme south of Portuguese West Africa; but long before known to Mousson by a specimen (taken in the same district) which served for the figure in the *Journal de Conchyliologie*, and had been sent to him by Geale.

Mousson compares it with the preceding species, but the resemblance is not particularly striking. It has not the dark and solid aspect of *Largillierli*, being generally larger, thinner and much paler in colour. The epidermis appears to be extremely thin, and the whole shell, especially when old, looks almost semi-transparent.

This is a fairly constant species, and is always readily recognised. The only noticeable variation is in the external banding, which is sometimes copious, as in our figure 6, sometimes sparse, as in f. 5, and not infrequently almost obsolete, as in f. 7. In the aperture the bands, or the remnants of them, are always much darker, and stand out with startling vividness against the lustrous, satiny sheen of the white interior.

The species has also been recorded from Benguela (Bourguignat), and from a shallow swamp at Dongwenna (Sowerby); both localities being also in Portuguese West Africa.

PL. XVII., F. 5. The darkest specimen I have seen. Livid yellowish green, with three very decided red-brown bands of varying width. Aperture shining white, reddish below, the bands and variceal streak strongly marked.

PL. XVII., F. 6. Externally almost the colour of beeswax; the red-brown banding pronounced on the back of the shell, less conspicuous in front. Interior white, the bands here and there rather abruptly developed into dark blotches.

PL. XVII., F. 7. Bands almost obsolete; dull olive yellow and very smooth externally. Aperture flushed with reddish below. The lip marked with red-brown dashes, vestiges of the obsolete bands.

These three specimens are labelled " Dongwenna."

A. PILULA, Reeve

Plate XVII. fig. 8

AND

A. ADUSTA, Reeve Plate XVII. figs. 9, o

Ampullaria pilula, Reeve, Conch. Icon. Amp., ff. 12, 36, also pl. XXV., f. 11b and 121; as synonym of *Ampullaria adusta* (Reeve), Sowerby, Proc. Mal. Soc. Lond., IX., p. 56.

Ampullaria adusta, Reeve, Conch. Icon. Amp., f. ii; von Martens, Moll. Deck., p. 60, 1869; Bourguignat, Moll. de l'Afr. Équat., p. 166; *Ampullaria ovata*, var. *deckeni*, von Martens, Beschalte Weichthiere Deutsch-Ost-Afrikas, p. 159; *Ampullaria adusta* (Reeve), Sowerby, Proc. Mal. Soc. Lond., IX., p. 56.

NOT the *A. adusta* of Tristram, P.Z.S., 1863, nor of Nevill, Hand List Moll., pt. II., p. 1 o (locality given, "South America !").

Sowerby considers, doubtless correctly, that these two are identical. In that case, as they were both published in the Conchologia Iconica, *adusta* has precedence of one figure, and the name should be retained for the species. Accordingly Sowerby has put *pitula* down as a synonym only, and *adusta* should have been first dealt with here, but the make-up of our plate had to be considered, and it will be most convenient to follow the order of its arrangement in the text also.

Reeve undoubtedly noticed the likeness between his two types, figured on the same plate in the Iconica, for while he gave " Borneo " (wrongly) as habitat for *pilula*, he also remarked of his unlocalised *adusta* that it was " probably from Borneo." These, apparently, are two forms of a shell now known to be from Africa. The larger, more richly banded form called *adusta*, has been localised at Zanzibar, according to von Martens, Bourguignat and Sowerby. The smaller shells, in which the external banding is reduced or obsolete, may be considered to represent *pilula*; these, according to the labels on my specimens, seem to be most prevalent on the West Coast of Africa.

Under either form the species is highly individual, and a fine one withal, having a certain graceful strength of outline and a sober richness of colouring which make it very conspicuous and pleasing. I have not found it common in collections, but African *Ampullariae*, as already remarked, are not generally in strong supply.

PL. XVII., F. 8. Olive-green, regularly banded, with narrow lines. Peristome rather broadly whitish, interior of aperture olive-brown, with dark brown bands, most of which extend to the outer lip. Labelled "Acera (Accra?), W. Coast of Africa.

A. ADUSTA, Reeve

PL. XVII., F. 9. Much larger and darker than the preceding; the external banding less definite. The umbilicus wider and more open. Peristome yellowish horn-colour, very thin; interior of the aperture clouded and banded with umber-brown, the bands ceasing before the peristome. Labelled "W. Africa."

PL. XVII., F. . A still darker, but smaller specimen, broadly banded outside. Interior yellowish brown, with strongly marked groups of dark brown bands, which extend to the lip, but are interrupted just before it by a narrow light-coloured belt, running from the base of the columella almost to the upper insertion. Columellar margin yellowish white.

It will be seen that points of difference between *pilula* and *adusta* are merely the superior size of the latter, its broader banding and wider umbilicus. Judging from the localities of my shells, which I have every reason to believe genuine, and from the statements of von Martens, Bourguignat and Sowerby, it would appear that the species, in either form, belongs to the coast, and is found in both East and West tropical Africa.

A. LEOPOLDVILLENIS, Putzeys Plate XVIII. fig.

Ampullaria Leopoldvillensis, Putzeys, Proc. Mal. Soc. Belg., Vol. XXVII., p. 98; Sowerby, Proc. Mal. Soc. Lond., IX., p. 59.

I have not been able to consult the original description of this species, which appears never to have been figured before. As its name implies, it comes from the Congo.

It is a well-marked species, unlike any other African form, and apparently but little subject to variation in colour or size. The latter is somewhat above the medium. The rather flat and thin operculum, characteristically African, fits tightly just inside the lip, and has a blunt edge, almost of the same thickness as the middle.

The specimen figured is rather light in colour; dull olive-green externally, and very regularly banded inside and out. The peristome is pale orange-yellow with a few dark streaks at the base; the rest of the aperture is light umber-brown, the bands interrupted near the lip by two yellowish belts, marking former growth stages. My other specimens are darker in colour, and the orange of the peristome has a more decided tint.

88 STUDIES IN AMPULLARIA

A. GRADATA, Smith Plate XVIII. figs. 3, 4

Ampullaria gradata, Smith, P.Z.S., 1881, p. 289, pl. XXXIII., f. 22; Billotte, Bulletin Soc. Mal. de Fr., Vol. II., p. 110; Bourguignat, Moll. de 'Afr. quat., p. 167; von Martens, Beschalte Weichthiere Deutsch-Ost-Afrikas, p. 158; Sowerby, Proc. Mal. Soc. Lond., IX., p. 59.

The late E. A. Smith (l.c.) wrote of this species that its affinities, "if it be distinct, are rather with those forms found in Nilotic regions than with *A. speciosa* of Philippi from Zanzibar. The four species, *A. Wernei*, Philippi, *A. Kordafana*, Parreyss, *A. lucida*, Parreyss, and *A. ovata*, Olivier, are very closely related, and it is a matter of impossibility to define the limiting character of any of them. The present species also may only be another form of the same shell." The last three names here quoted are now admitted by most authorities to belong to forms of one species, but *A. Wernei* has not, to my knowledge, been regarded by any other conchological writer as allied to these, though *gradata* may perhaps be considered as intermediate between it and them. It varies a good deal in size, and small specimens are sometimes not unlike *ovata* in general appearance; its operculum, judging by the specimens I have examined, decidedly reminds one of that species, being thin, flat, sharp-edged and rather small, so that it can be pushed some way up the mouth, while that of *Wernei* fits tightly to the lip and is very thick and somewhat concave on the outside. There is, however, a certain amount of external likeness between *gradata* and *Wernei*. The latter is generally much the larger, but specimens of it are often less in size than my fig. 4, which may be taken to represent the limits of *gradata* in this respect. Smith says that his species " may be distinguished by its broader and shorter aperture, and the considerably greater arcuation of the columella : or the form may be described as more pyriform, being narrower above and broader below." It will be seen from my figures that the lower part of the aperture in *gradata* is more evenly rounded off than in *Wernei*, and the projection of the lip at the periphery is less strongly marked, so that the slope of the outline between these points is more gradual and rounded, and the whole shell has a less " peaked " appearance. Smith does not mention a distinction which is very obvious in my figures, and is even more striking if larger specimens of *Wernei* be brought to the comparison-viz. that in this species the lip is produced downwards to a considerable extent, whereas in *gradata* the lower end of the aperture hardly seems to break away from the outline of the bodywhorl.

Fine examples of both these species are somewhat rare in collections, and I have not seen enough to venture a positive opinion on the following point, but it may be just worth mentioning that whereas in *gradata* the internal bands, especially those in the lower part of the aperture, often extend to the outer edge, in *Wernei* the lip is not traversed. There may be a few dots on the margin, as in f. 6; these, however, seem to originate from outside, and to mark the ends of external rather than of internal bands. This distinction, if it be real, I am inclined to attribute to the fit of the different opercula. In *Ampullariae* the markings of the lip appear to be formed during the rest-periods in the growth of the shell, when the animal is in retreat, and the operculum remains *in situ*

for an unbroken period. It may often be noticed how at the growth stages the colouring matter of the bands accumulate in dark blotches. Perhaps the thick, tightly-fitted operculum of *Wernei* protects the lip from contact with the pigment, whereas in *gradata* the animal, not being so closely shut up, this substance is free to reach the very limits of the shell.

The locality originally given by Smith was " Lake Nyassa and between it and the East Coast (Thomson)." Billotte and Bourguignat cite rivers in the Usagara district of East-Central Africa, and von Martens states that the Berlin Museum had specimens possibly belonging to this species from Tabora.

Pr. XVIII., F. 3. Olive-green, darker at the growth stages and vertically striped. A black variceal streak in front; the uncoated parts of the shell near this light violetgrey. The earlier whorls of the spire reddish. Numerous faint bands on the bodywhorl. Upper and lower extremities of the aperture pale sulphur yellow, as are also

the upper lip and columellar margin. Rest of the aperture reddish grey, the upper part more or less distinctly banded. Bands strongly marked on the lip, especially below.

PL. XVIII., F. 4. Rich olive-green with a few rather pronounced darker bands. Upper part of aperture, with the edges of the lip and columellar margin greenish yellow, beyond this the lip is broadly grey-pink shaded with olive, and heavily barred by the reddish ends of the internal bands. Rest of aperture coffee-brown, most of the bands marked with fair distinctness.

A. WERNEI, Philippi
Plate XVIII. figs. 2, 5, 6

Ampullaria Wernei, Philippi, Mon. Amp., p. 19, no. 22, pl. 17, f. 2 (not Pl. 5, f. 4, which is *A. Charmesiana*, Billotte, var. *minor*, fide Billotte, Bull. Soc. Malac. de Fr., Vol. II., p. 107); von Martens, Malak. Blätt., IV., p. 187; Bourguignat, Moll. Nouv. litig., etc., pt. III., p. 78; von Martens in Pfeiffer's Novit. Conch., New Series, p. 22, pl. VI., ff. 1-5; Billotte, Bull. Soc. Mal. de Fr., II., p. 112 ; Bourguignat, Moll. de l'Afr. Équat., p. 168; von. Martens, Beschalte Weichthiere Deutsch-Ost-Afrikas, p. 154.

Since I wished to figure *A. gradata* and *A. Wernei* on the same plate, it was necessary to choose rather small examples of the latter, which is normally next to *A. Nyanzae*, Smith, and *A. Charmesiana*, Billotte, the largest *Ampullaria* discovered in Africa up to the present time.

This species was originally described from specimens sent by Parreyss under the name of *A. rugosa* (Lamarck's name for *A. urceus*, Müller). They were taken on the White Nile, and were named by Philippi after the German traveller Werne, who in 1840-1 made an expedition into that region. Von Martens subsequently described what he considered to be a smaller banded form from the Querimba Islands off the

coast of Mozambique. Later still (1870) he figured, in the second series of Pfeiffer's "Novitates Conchologicae," a very large specimen from the Bahr al Ghazal. Bourguignat recorded it from the Albert Nyanza, and it would seem that it probably occurs all over the lake and river system of tropical Africa. Through the kindness of Mr. J. R. le B. Tomlin I have specimens of a small form from Darfur in the Sudan, and one of the examples figured on our plate (f. 6) was taken on the Niger. The British Museum has an almost exactly similar specimen labelled "N. Nigeria."

It varies a great deal in size, probably through local conditions. The Darfur specimens are much like my figure 2; a dwarf form probably stunted and otherwise mis-shapen owing to scarcity of water in an arid district. Those sent to me by Mr. Tomlin were actually as he has recorded in the journal of Conchology, Vol. XVII., p. 154, being exhumed by jackals from the mud in which they were aestivating. The fishing cat of India and Ceylon, a large wild species, is known to have a similar predilection for the marsh-snails.

I have already dwelt upon the points of difference between *Wernei* and *gradata*. It is, perhaps, a matter of greater difficulty to find permanent distinctions between *Wernei* and *speciosa*. Von Martens, in several of the passages cited above, notes the similarity of these two species, and the distinguished French conchologist, Dr. L. Germain, predicts that they will have to be united, as soon as adequate materials for comparison are available. ("Etude sur les mollusques-Mission de délimitation du Niger-Chad," p. 43.) Here, however, and at p. 72, in the appendix, he notices *speciosa* from the Bahr al Ghazal, and since *Wernei* is undoubtedly found in that district, it would seem to be unlikely that these are mere forms of the same species.

Yet it must be admitted that when *speciosa* reaches an abnormal size, as it sometimes does, and when the characteristic orange-red of its peristome has been replaced by yellow or white-variations which are not altogether unknown-it does begin to look very much like *Wernei*. The latter, however, has certain individualities of its own-small and subtle, but apparently constant. It is generally malleated (*vide* figs. 5 and 6), and this, for some reason, is hardly ever the case with *speciosa*. The spire is generally higher, its component whorls being deeper, but a better distinction is found at the suture, where they are flattened but not channelled. This difference will be very obvious to anyone who will compare my figures of *Wernei* and *speciosa*, and note the upper insertion of the lip in each. Finally the umbilicus is narrower in *Wernei* and much more oblique-the latter a necessary consequence of the greater downward slope of the body-whorl.

For the rest, *Wernei* is much the rarer shell; generally larger, and proportionately thinner, especially at the lip. It sometimes attains gigantic proportions. Mrs. Longstaff mentions the capture of a splendid specimen in a muddy creek at Hillet Abbas on the White Nile (G. B. Longstaff, "Butterfly-hunting in Many Lands," p. 424).

PL. XVIII., F. 2. A small and perhaps rather stunted shell, almost imperforate. Bright olive-green externally with a few reddish bands; that at the periphery wider than the others. Interior light reddish with the bands better developed; peristome broadly edged with orange-yellow.

PL. XVIII., F. 5. Light grey-green, spire tinged with reddish. Lower half of the shell distinctly banded on the back. Body-whorl much malleated. Aperture light above, then violet-brown, rather indistinctly and thinly banded. Peristome broadly

bordered with vivid yellow, deepening to orange oil the parietal callus. Locality "Sudan."

PL. XVIII., F. 6. A small example of what may be called typical *Wernei*. Dark olive, much malleated in front; faint traces of external bands on the lower part of the shell. Interior reddish ash-colour, rather fitfully banded. Peristome yellowish white with a few dark spots and splashes at the lower edge.

This specimen was given to me by the late Mr. E. Collier, then President of the Conchological Society. He kindly sent with it the collector's note, which stated that it had been picked up in June, 1880, from some marshy ground that was being cleared for building operations, 160 miles from the mouth of the Niger. The shell was sent uncleaned to Mr. Collier, who managed to resuscitate the animal in water, and kept it alive for a time until it died a natural death.

A. SUBSCUTATA, Mousson

Plate XVIII. fig. 7

Ampullaria subscutata, Mousson, Journ. de Conchyl., 1882, Vol. XXX., p. 46, pl. III., f. 6 ; Sowerby, Proc. Mal. Soc. Lond., IX., p. 61.

This little species appears to have formed part of a collection made in 1880 at Maravare in eastern Madagascar by Audebert the French traveller. It was described as new by Mousson, who considering that it bore a great resemblance to his *A. scutata* from Java, gave it a name which suggested the likeness. This, however, unlike *scutata*, which is a form of the highly-polished *contra* group, is a dull and rather rough shell, it is also flatter at the suture than any of these, and as a rule smaller, though it should be said that the specimen here figured is below the size of Mousson's type. It is considerably pitted, probably by parasites, and has a strong transverse striation. The operculum, as usual with species from Madagascar, is thin and flat; it can be inserted some way up the interior.

General colour a dark, uniform olive-green, with no perceptible trace of external bands. Interior reddish, darker in the depths of the shell, and thinly banded, especially near the base. Peristome white; outer lip faintly marked by the ends of the bands.

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A. CECILLEI, Philippi Plate XVIII. figs. 8, 9

Ampullaria Cecillei, Philippi, Zeitschr. f. Malak, 1848, p. 191; Mon. Amp., p. 47, n0. 65, pl. 13, f. 6; *Ampullaria inops*, Morelet, Rev. Zool., 1851, p. 220; *Ampullaria Cecillei* (Phil.), Morelet, Sér. Conchyl., I L., p. 108; Sowerby, Proc. Mal. Soc. Lond., IX., P. 57.

Morelet, who could hardly have seen any figure of this shell, for it remained unfigured until the very year in which he published it as *Ampullaria inops*, either overlooked or failed to recognise it under the name given three years previously by Philippi. The moral is that in this difficult genus new species should not be introduced by unaided descriptions. In his "Séries Conchylioliques," I.c., the French author charges Philippi and Küster with superficial examination of the species, apparently on the ground that it was described in the famous *Ampullaria* monograph as "red-brown, smooth and shining." Morelet states that it is "habitually covered with blackish clinging mud," and that, when this is removed, "Its colour is not at all deep, but of a rather clear yellowish green, at the same time the surface loses its polish and reveals itself as ridged with irregular striae, criss-crossed by other very delicate, slightly undulating, granular striae, forming small and not very prominent wrinklins at the base of the last whorl."

I am inclined to think that this description applies to an insular form, such as that of which I have specimens from the Natuna Islands. My Nossi-Bé examples agree perfectly, even when cleaned, with Philippi's account. It would seem that Morelet must have mistaken the original locality on the main island of Madagascar, where Philippi undoubtedly locates it. Morelet, in the preface to pt. II. of the "Séries Conchylioliques," clearly indicates *his* Nossi-Bé as the little island of that name off the north-west coast of Madagascar, which, like the distant Natuna Islands, is doubtless inhabited by a race of *A. Cecillei*. But Philippi's description holds good for specimens from what we may, perhaps, call the mainland. (See observation under *A. Largillierti*.)

PL. XVIII., F. 8. Dark olive, a good deal blackened, and strongly striated. A few traces of bands on the back. Interior reddish, closely banded with a darker tint. Peristome greenish white, very thin.

PL. XVIII., F. 9. Dark olive green, densely striated with very fine vertical lines. The lower half of the body-whorl closely and plainly banded. Aperture reddish fawn colour, the bands well marked, especially near the edge. Natuna Islands (Everett).

The occurrence of this species on the Natuna Islands westward of Celebes is interesting, in view of the resemblance of the Celebesian fauna to that of Madagascar. This resemblance, most strikingly exemplified in the curious animals known as Lemurs, at one time greatly impressed scientific men, being supposed to indicate the former existence of a large continent, extending from Madagascar on the west to Celebes on the east. It was even proposed to name this partly submerged continent Lemuria. Dr. Russell Wallace has some interesting remarks on the subject in his "Malay Archipelago," 1st edition, Vol. I., p. 445 (chapter XVIII.), but he eventually relinquished the Lemurian theory.

My other Natuna specimens are somewhat redder in colour than that figured, and more like those from Madagascar.

A. OVATA, Olivier

Plate XIX., fig. 9

AND

A. KORDOFANA, Parreyss

Plate XIX. figs. 1, 3, 7

Ampullaria ovata, Olivier, " Voyage dans l'Empire ottoman," II., p. 39, pl. XXXI., f. (1804); Cailliaud, " Voyage a Méroë," Atlas, pl. LX., f. 10; Audouin in Savigny, Descript. Coq. Egypte, p. 165, pl. II., ff. 25', 25²; Philippi, Mon. Amp., p. 49, no. 67, pl. 14, f. 5; Reeve, Conch. Icon. Amp., f. 64; von Martens, Malak. Butt., IV., p. 187; Bourguignat, Moll. nouv. litig., etc., p. 79, pl. X., f. ; Morelet, Moll. terr. fluv. voyage Welwitsch, p. 39, etc., pl. IX., f. 10 Jickeli, Land- und-Süsswasser Moll. N. O. Afrik., p. 230; Bourguignat, Mollusques Egypte, Abyss., etc., p. 32; Billotte, Bull. Soc. Mal. Fr., II., p. r ; Bourguignat, Moll. de l'Afr. Squat., p. 168; Iconogr. Malacol. lac Tanganika, pl. VI., f. ; and Hist. Malacolog. lac Tanganika, p. 74, pl. VI., f. 1 ; von Martens, Beschalte Weichthiere, Deut.-Ost-Afrik., p. 158; Germain, Moll. terr. fluv. Afr. centr. franç., p. 527; Sowerby, Proc. Mal. Soc. Lond., IX., p. 60.

Ampullaria Kordofana, Parreyss in Philippi, Mon. Amp., P. 44, no. 60, pl. 13, t. I ; Bourguignat, Moll. nouv. litig., etc., p. 76, pl. XI., ff. 12, 13.

Other varieties figured and described, *Ampullaria lucida*, Parreyss, in Philippi, Mon. Amp., p. 45, no. 61, pl. 13, f. 2, pl. 14, f. 4; Bourguignat, Moll. nouv. litig., etc., p. 80; Billotte, Bull. Soc. Mal. Fr., II., p. 110; *Ampullaria ovata*, var. *lucida*, Sowerby, Proc. Mal. Soc. Lond., IX., p. 60; *Ampullaria Raymondi*, Bourguignat, Moll. nouv. litig., etc., p. 76, pl. IX., f. 4; Billotte, Bull. Soc. Mal. Fr., II., p. ; Bourguignat, Moll. de l'Afr. quat., p. 168; as var. of *ovata*, Sowerby, I.c.; *Ampullaria Boiurguignati*, Billotte, Bull. Soc. Mal. Fr., II., p. 107, pl. VI., f. 3; Bourguignat, Moll. de l'Afr. Squat., p. 166; von Martens, Beschalt. Weich., etc., p. 160; as var. of *ovata*, Sowerby, I.c.; *Ampullaria Dumesniliana*, Billotte, I.c., p. 105; Bourguignat, Moll. de l'Afr. quat., p. 167; as var. of *ovata*, Sowerby, I.c.; *Ampullaria Bridouxi*, Bourguignat, Hist. Mal. du Lac Tanganika, Vol. I., p. 72, pl. V., f. 22; Bourguignat, Moll. de l'Afr. quat., p. 166; as var. of *ovata*, Sowerby, I.c.

Ampullaria ovata, var. *emini*, von Martens, Beschalt. Weich., etc., p. 160; NOT *A. ovata*, var. *deckeni*, von Martens, I.c., p. 159, which is *A. adusta*, Reeve.

A. OVATA, Olivier

Plate XIX. fig. 9

It is only possible to cite selections from the enormous literature of *A. ovata* and its varieties. I have endeavoured to quote all notices that are accompanied by figures.

It is rather curious that the typical form of a species so common and so variable should remain almost unknown and in fact not a little uncertain. Olivier's original figure, given in a work not strictly conchological, was copied in outline by Philippi, and represents a rather slim, elongated shell with sloping suture, but, as von Martens observed, this figure, being turned too much to the left, must appear out of proportion in respect of the width of the aperture and that of the body-whorl.

Most of the other figures quoted for *ovata*, e.g. those of Reeve, Savigny, Cailliaud, etc., have been declared by Billotte or Bourguignat to belong in reality to *Kordofana*, and in fact the only figure, apart from Olivier's original, that appears to pass muster as a genuine representation of *ovata*, is that given by Bourguignat himself in pt. III. of the "Mollusques nouveaux litigieux ou peu connus," at pl. X., f. I t. This figure was made from a shell found by Olivier in Lake Mareotis, and it should therefore be authentic. But the accompanying description gives no really distinctive character, Bourguignat noting only the sharp apex of the spire, its rounded whorls, etc., and when we come to examine the figure itself, we find that, making allowance for smaller size, it is in no essential point different from f. 13 of pl. XI. in the same work, which represents *Kordofana*. At the same time it differs widely from Olivier's original figure copied by Philippi.

This figure, judging by Philippi's tracing, is manifestly out of drawing-, and would seem to represent a somewhat abnormal form. I have never found anything quite like it, but the shell represented at fig. 9 of my plate XIX. has the long, narrow aperture, the sloping suture and rather high spire of Olivier's type, and may be considered as a fairly near approach thereto. It is the only one of its kind that I have seen, and I do not know its locality, but its operculum agrees in every way with that of *ovata*, and it is, no doubt, a form of that species. Bourguignat restricts the habitat to Lake Mareotis.

PL. XIX., F. 9. Reddish olive, with hardly a trace of bands. The neighbourhood of the suture not abruptly flattened as in figs. 3 and 7. Aperture yellowish white with a few thin ruddy bands in the lower part.

Var. KORDOFANA, Parreys

Plate XIX. figs. , 3, 7

To this form belong, apparently, most of the figures and descriptions given of *ovata*. The principal distinction appears to reside in the neighbourhood of the suture, which is here flattened, or even slightly channelled. The shell is broader and stouter, with a wide mouth and considerable variety of colour. It appears to be very

common in upper and lower Egypt, Nubia, Abyssinia, and the great lakes of Central Africa.

There can hardly be any doubt that but a single species of *Ampullaria* exists in Egypt, and that this is the normal form of it. It would appear that by the accident of priority in publication, a rather insignificant variety has obtained the specific name of *ovata*. This small variety, or local form from Lake Mareotis, only differs from the common aspect of the species in the more slender shape, the less flattened suture and the acutely pointed spire. All these characters may be seen in the case of another variable Eastern species, *A. virens*, to be of no permanent value. Of the four Egyptian forms which depend upon them for their claim to specific rank, two, *A. ovata* and *A. lucida*, are almost unknown by specimens, and are certainly very rare ; the others, *A. Bourguignati* and *A. Raymondi*, only exist in single specimens, which are in bad condition, and are almost certainly monstrosities.

We may just notice two extra-Egyptian forms recorded above; *A. Dumesniliana*, Billotte, from Somaliland, which Sowerby pronounced to be merely a young specimen of *ovata*, and *ovata*, var. *emini*, von Martens, a very large manifestation of the *Kordofana* form recorded from Victoria Nyanza and from the Albert Edward Lake.

Kordofana, which is really the normal form of the species, though it has to rank as a variety, is sometimes very brilliantly coloured in the interior. The British Museum possesses several such specimens, but they are not common, and the general appearance of the species is rather sombre. I have chosen three examples to illustrate the range of coloration.

PL. XIX., F. . A large, ovate shell, with the flattening at the suture much reduced; spire almost entirely eroded. Dark olive-green, narrowly banded. Upper part of aperture and lip yellow, the rest brown, with distinct, narrow bands extending to the outer edge. Columellar margin and lower lip brilliant orange-yellow, the lip spotted by the ends of the bands. Kigoma on Lake Tanganyika.

This is somewhat different from ordinary *Kordofana*. Von Martens states that more than one form of *ovata* occurs in Tanganyika ; he mentions " a more globose variety, with dark olive-green colouring." This may perhaps be a specimen thereof. Another specimen that I have from Tanganyika is much more globose and dark brown in external colour, but has a similarly orange-yellow lip.

PL. XIX., F. 3. A representative specimen of *Kordofana*, but not localised. Olivechestnut, the denuded parts of the shell showing a pinkish colour. Mouth orangeyellow, flushed with red towards the base and exhibiting faint traces of bands.

PL. XIX., F• . 7. Very strongly flattened at the suture. Yellowish brown, irregularly streaked and splashed with black. Interior brown in the depths and banded, then cream colour, with a wide, irregular stain of vivid orange ; lower lip spotted with brown, columellar margin cream-colour tinged with orange. Kordofan.

A. GORDONI, Smith Plate XIX. figs. 2, 8

Ampullaria Gordoni, E. A. Smith, Annals and Magazine of Natural History, Vol. X., p. 382 (1892); von Martens, Beschalte Weichthiere Deutsch-Ost-Afrikas, p. 156; with varieties *bukobae* (Pl. I., f. 22-figure of animal) and *volkensi*; Sowerby, Proc. Mal. Soc. Lond., IX., p. 59.

This species was named after the Rev. E. Cyril Gordon, who discovered it at the south end of the Victoria Nyanza.

It was described from a single shell, but has since been taken in some numbers. The British Museum has a fine series in the Students' Collection. Two varieties have been described by von Martens, var. *bukobae*, from Victoria Nyanza, and var. *volkensi*, from Yipe Lake, south west of Kilima-Njaro. My own specimens came from the Albert Nyanza, and appear to incline to var. *bukobae*. The animal of this variety has been described and figured by von Martens, after a sketch by Dr. Stuhlmann. It is brilliantly coloured; orange marbled with purple-black.

It would seem that this species never exceeds medium size. The shell has but little polish, the epidermis being of a rather coarse, fibrous character, and von Martens observes that it is generally overgrown with green algae.

The leading characters of the species are the very large and wide aperture, always more or less dark in colour, and the peculiar shape of the shell, which is nearly as broad as it is long. Von Martens notes a peculiarity which is not mentioned in Smith's original description, and which may indeed be characteristic of var. *bukobae*. He describes the penultimate and last whorls as "declining outwards with an abrupt bend, but without a real carination, the appearance of such nevertheless ensues from the erosion of the surface proceeding just up to this point." The British Museum specimens and my own bear out this observation. The upper surface of the whorls is strongly flattened, but this flattening leaves no distinct edge at the bend, where it is regularly rounded off.

Var. *volkensi*, which I have not seen, appears to be somewhat paler in colour, and to have the outer margin of the lip slightly thickened.

PL. XIX., F. 2. Yellowish brown with a green tinge, marked with thin, very regular bands. Interior yellowish in the upper part, dark purple-brown below, and beautifully banded, the bands mostly running in pairs, and being twisted fantastically at their termination on the outer lip. Columellar margin olive brown; parietal callus very stout, purplish yellow, with a large and conspicuous black projection at the insertion of the upper lip.

This specimen, which is the largest of my series, and alone among them possesses the yellow patch in the upper part of the aperture and the yellow callus, I take to be the shell of a female. The other example figured, which is of more ovate shape, with higher spire, and entirely dark aperture, is probably the male form.

PL. XIX., r. 8. Smoother than the preceding; the vertical striation being less coarse. Dark olive green regularly banded with thin reddish lines. Interior dark tortoiseshell brown, a good deal brighter towards the lip, where the bands begin to show. Columellar margin and parietal callus livid brown.

A. NIGRICANS, Sowerby

Plate XIX. fig. 4.

Ampullaria nigricans, Sowerby, Proc. Mal. Soc. Lond., IX., p. 60 and p. 63 (figure in the text on p. 63).

This remarkable species is here figured from the only specimen available to the author. It is of small size, the type now in the British Museum being considerably larger, in fact, exceeding by a quarter of an inch the specimen of *Kordofana* represented at fig. 7 of our plate.

The example of *A. nigricans* here shown is, however, in excellent condition, and displays the colour and markings more favourably than the type, which is somewhat blackened, an appearance generally due to long sojourn in the water after the death of the animal, but which may perhaps in this case be ascribed simply to age, seeing that the shell possesses its operculum. The locality given by Sowerby is Buddu in southern Uganda, at the rather unusual elevation, for an *Ampullaria*, of 4000 feet above sea level. My specimen, supplied by Messrs. Sowerby and Fulton, is labelled simply "Uganda."

PL. XIX., F. 4. Shell thin and very glossy; whorls rather flattened at the top. Dark-olive brown, with thin and regular banding, distinctly evident in a good light. Interior uniform brown, with a shade of violet, the bands less distinctly marked than on the outside. Operculum thin and, for an African species, remarkably concave on the external surface; the inner side ashy pink in colour.

A. SPECIOSA, Philippi

AND

A. RUCHETIANA, Billotte

Ampullaria speciosa, Philippi, Zeitschrift f. Malak., 1849, p. 18; Mon. Amp., p. 40, no. 54, pl. I I, f. 2; Reeve, Conch. Icon. Amp., f. 33; von Martens, Malak. Blätt., IV., p. 184; Dohrn, P.Z.S. Lond., 1864, p. I 17; Morelet, Séries Conchyl., pt. 1 1., p. 107; Bourguignat, Moll. Egypte, Zanz., etc., p. 32; Billotte, Bull. Soc. Malac. Fr., 1 1., p. I I I; Bourguignat, Moll. de l'Afr. quat., p. 168; von Martens, Ann. Mus. civ. Genova, XV., p. 65; Beschalte weichthiere Deutsch-Ost-Afrik., p. 153; Germain, Moll. terr. fluv. Afrique centrale française, pp. 524 and 531; Sowerby, Proc. Mal. Soc. Lond., IX., p. 61; Germain, Etude sur les Mollusques-Mission, Niger Chad., pp. 42 and 72, pl. II., ff. 38, 39, pl. III., f. 3, and pl. IV., ff. 1, 2.

A small form is figured by Reeve, Conch. Icon. Amp., f. 79, as *A. canaliculata*, Lamarck.

Ampullaria Ruchetiana, Billotte, Bull. Mal. Soc. Fr. II., p. 105, pl. VI., f. ; Bourguignat, Moll. de 'Afr. quat., p. 168; von Martens, Beschalte Weichthiere DeutschOst-Afrik., p. 154.

There can hardly be any doubt that Billotte's *A. Ruchetiana* is a form of *speciosa*; not, perhaps, a young shell, as von Martens conjectures, but a variety of small size and pale colour. The two are therefore discussed together in this work.

A. SPECIOSA, Philippi (Var.) Plate XIX. fig. 5

This species was first recorded from Zanzibar, afterwards from Cape Guardafui, and is now known to inhabit practically the whole of eastern tropical Africa. Von Martens reported it from the German territory, and E. A. Smith as taken by Dr. Gregory in British East Africa. Dr. Germain described specimens from the Bahr al Ghazal, and Billotte records exceptionally large examples brought by Revoil from Somaliland. A still larger form is stated by Dr. Germain to have been taken by Foureau in the Congo.

When in fine state *speciosa* is perhaps the most beautiful of all *Ampullariae*. Its large size, bold contours and light, brilliant colouring make it exceedingly attractive. The colour of the lip, generally vivid orange-red, is sometimes reduced to salmon colour, orange, yellow or even yellowish white, and I have noticed that in the very largest specimens, which are sometimes truly gigantic, it has a tendency towards carmine. The epidermis varies but little, being almost always of a clear yellow-brown, with a decided shading of chestnut towards the lip. In the dark interior remains of the orange peristome at the growth-stages have a charming effect. The absence of this characteristic decoration induces me to regard a small grey-green form with numerous bands, of which I have several specimens, as in reality the young shell in its first period of development. A shell similar to these was figured by Reeve as *A. canaliculata*, Lamarck, and stated to have come from Cashmir. Hanley and "Theobald (Conchologia Indica, p. 46) noticed this mistake, but their own ascription of an *Ampullaria*, supposed to be

Philippi's *pallens*, to Cashmir, seems questionable.

Apart from size and the colour of the lip, *speciosa* does not vary greatly, and I have not met with another adult specimen so abnormal as that here figured. It is, however, in effect a singularly pretty shell.

PL. XIX., F. 5. Much elongated, with very wide umbilicus. Epidermis pale olive, and thin, allowing one or two bands to appear on the back. Front of the shell almost entirely uncoated, showing a pale pinkish-ash ground colour crossed by violet bands. Aperture yellow above and just before the lip; otherwise pink-brown. Peristome pale orange-red.

Billotte's figure, quoted above in the synonymy, is drawn in an unfavourable position, the shell being turned too much to the right. In consequence its whole contour is altered, and the aperture looks much too narrow. The original of this figure was a shell from the Webi River in Somaliland. It was doubtless a specimen similar to that here figured, which agrees perfectly with Billotte's, save only that the white lip has a narrow yellow-brown edging.

It would seem that Billotte has described yet another variety of *speciosa* under the name of *Revoili*. This I have not seen, and no figure accompanies the description, but from the latter it would hardly appear to be deserving of even a varietal name. *As to Ruchetiana*, we may accord it that qualified rank, though, like several of Billotte's novelties, it has been ignored by most conchological authorities.

This is apparently not a young shell. Its peculiarities, such as they are can hardly be ascribed to immaturity. It might be described as a stunted, pale-coloured variety of *speciosa*, with a contracted umbilicus and a white lip. These variations from the normal are perhaps due to unfavourable conditions, such as scanty or brackish water; the impoverishment of the shell and its inhabitant resulting in a cramped growth and a deficiency of colouring matter.

PL. XIX., f. 6. Pale ashy olive, with numerous closely-set narrow bands. Interior chocolate brown, the bands showing faintly. Lip and columellar margin white with a narrow fulvous edge.

One or two of my small *speciosa* mentioned above, likewise have the lip white with an extremely narrow fulvous edging. A simple white lip is not unknown, even in full-sized examples. This, of course, might, in an old specimen, be the result of fading, from exposure to light; one may often see such an effect in the shells of *Placostylus*, whose brilliant orange red mouths, when in fresh condition, have just the normal lip-colour of *speciosa*. But I have seen well-preserved specimens of the latter, in which the lip had only a faint tinge of yellow.

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