MANUAL

OF

CONCHOLOGY;

STRUCTURAL AND SYSTEMATIC.

WITH ILLUSTRATIONS OF THE SPECIES.

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MURICINÆ, PURPURINÆ.

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In the preparation of the introductory portion of the present volume free use has been made of Keferstein's admirable work, forming part of "Bronn's Klassen und Ordnungen d. Thierreichs:" —the most comprehensive treatise on the anatomy of the mollusca which has yet appeared. Of course many additional facts and some corrections have been published since the issue of that work, and abstracts of the most important of these have been herein incorporated. I have endeavored to avoid the prolixity of Keferstein without sacrificing clearness of language, but occasionally quote his very words. The few statements for which I alone am responsible, are made in the first person. The body of literature consulted is too extensive for quotation in a work like this, where much must necessarily be sacrificed for the sake of brevity. Whilst I have freely used the admirable illustrations of Keiner, Reeve, Sowerby, Küster, and other monographs, I have added to these hundreds of figures, names and items of information gleaned from fugitive papers and scientific periodicals; so that I am enabled to present a carefully arranged, concise account of all that is known concerning the Murices and Purpuræ.

I may be thought by some, to have treated the species in a too conservative spirit; my object in the investigations of which this work is the result, has been solely to ascertain truth, not to establish, maintain or destroy scientific reputations.

January, 1880. G. W. T., Jr.

If there be nothing new, but that which is,
Hath been before, how are our brains beguil'd,
Which, laboring for invention, bear amiss,
The second burden of a former child!

SHAKSPERE.

PROSOBRANCHIATA.

ANATOMY.

External Features.

The body in prosobranchiates presents the following, more or less, differentiated portions:

1. *Head.* This is sometimes partially separated from the body by an intervening constriction or neck, but is very frequently only indicated by the possession of a mouth on its ventral and of a pair of tentacles on its dorsal surface. From the latter sometimes proceed pedicels bearing the eyes.
2. *Mantle.* This covers the posterior portion of the dorsal surface of the body.
3. *Foot.* Arising from the ventral anterior part of the body.

The mouth may be either simple, in the plane of the head, or it may be produced at the end of a contractile rostrum, or of a retractile proboscis. Behind the head and on the under side of what may be called the neck is attached the foot, and behind the neck begins the posterior portion of the body covered by the mantle: this part of the animal is very long, usually, and as the shell is moulded upon it, it assumes a similar form—generally spiral. However, in Patella and similar limpet-like shells, the body is short and straight. The mantle encircles the body like a collar below, but above it is much produced over the back of the animal, and the respiratory cavity forms a sinus of its margin. The foot consists of the attachment to the neck, which is usually narrow, and an expanded portion or sole, or creeping disk. Such is its typical form, but in Patella the foot embraces the entire ventral surface of the animal. It is a muscular process of the body, and the only locomotive organ possessed by prosobranchiates.

Viewed externally, the prosobranchiates, as well as the mollusca in general, must be regarded as bilaterally symmetrical; a view which is strengthened by the position of the nervous system; and the developmental history of the intestines, though its actual position, as well as that of the sexual organs, does not correspond with this symmetry. Thus we find that at first the anus is at the posterior end of the body, but gradually it approaches nearer and nearer to the anterior end until finally it opens on the back or right side near the mouth. In its early stages the shell and mantle only occupy the extreme posterior end of the body, but in their growth they cover more and more of the latter, gradually pushing the anus forward.

An external shell, usually sufficiently large to contain the entire animal, is common to all the prosobranchiates. It is a secretion of the mantle, and conforms to its shape; and the hardness which it assumes by the addition of carbonate of lime, renders it an efficient protection to the animal, whilst the faithfulness with which it reproduces the external features of the latter renders it extremely useful in classifying the mollusca. The spiral growth of shells is as nearly of true mathematical regularity as is possible in an organic body, forming the logarithmic spirals of Moseley, or conchospiral of Naumann. Corresponding to the shell, which is produced by the mantle, and borne by the posterior portion of the body, the posterior dorsal part of the foot bears an operculum, secreted by an expansion of its skin called the opercular mantle. Typically, the operculum is a spiral also, but in the same plane; yet in many cases its growth is annular. Usually horny, it is sometimes nearly, entirely or partially calcareous, and on the retirement of the animal within the shell it is brought into the aperture of the latter, which it more or less completely closes. Like the shell itself, it may be considered a protective organ, and when in apposition with the former suggests the two enclosing valves of the lamellibranchiate or bivalve mollusks.

Notwithstanding the large portion of the animal which is always within the shell, even when the head and foot are extruded, the latter is only attached to the former at one point, on the columella, and by means of a columellar muscle, which, passing through the foot, is attached at its other end to the operculum (when the latter is developed, which is not always the case . Although there is only this single actual bond of connection between shell and animal, the contact of the body serves to maintain the vitality of the shell, which soon bleaches, and finally decays when separated from its architect and inhabitant.

We will now describe, in a necessarily cursory manner, successively, the skin, the foot, the muscles, the shell and operculum, the digestive, nervous, vascular, respiratory, secretive and sexual organs of the prosobranchiates.

The Skin.

The body is completely enveloped by an external skin. Its epithelial layer is formed of quadrangular or prismatic cells, which have a distinct nucleus, and occasionally, when long-cylindrical in form, they have a tail-like end beneath, penetrating the cutis.* Externally the epithelium sometimes supports cilia upon the exposed portions of the body.

The cutis consists essentially of fine interlacing muscular fibres with interposed cells; often attaining a perceptible thickness. The subcutaneous muscular layers of the body are immediately continuous with those of the cutis: the fibres of which they are formed may be clearly distinguished as an outer longitudinal and inner circular layer. These fibres are (as in mollusks generally) compressed and band-like, with pointed ends and central oval nucleus.

The skin forms a fold above and surrounding the foot, and this portion is technically termed the mantle; it surrounds the body, behind the cephalic portion like a collar, and thence spreads dorsally over the posterior part of the animal. In the terminal, thickened border of the mantle, the cutis becomes of greater thickness; its upper stratum containing very numerous glands, furnishing the mucus and colors which are here mingled with the secreted shell-material. Similar glands, furnishing a copious supply of mucus are found also in the cephalic portion of the body as well as in the foot, and especially in the sole; but no cells are found in that part of the animal permanently covered

* It is possible that these last are epithelial terminations of nerves—hence sense organs.

by the shell. Frequently the external skin is colored by a granular pigment, which either is contained in cells, lying between or enveloping the glands, or else sometimes appears to lie free under the epithelium.

The mantle border is the principal agent in the secretion of the shell: it is thrown out by the epithelial layer as a sort of cuticular development. With the organic basis of this secretion is mingled carbonate of lime, originating in the epithelial cells, where it may be separated from the blood: in hardening, the exuded material becomes half crystalline or laminated. Usually the external layer of the shell is a transparent or translucent skin, the epidermis; having no lime in its composition. It is often colored by pigments lying in the outermost border of the mantle.

Whilst the growth of the shell is thus provided for by additions of the aperture margin from the mantle border, the whole mantle is equally capable of producing shelly substance; and not only are shells thus thickened from within by the mantle surface, but breaks are repaired with new material by a similar provision: only such repaired and interior portions are devoid of epidermis and of color, the pigments being found only in the free border of the mantle. Mollusks are even able to secrete shelly matter to provide against threatening dangers from the boring of other animals into their shell.* In certain genera, as Haliotis, Turbo, etc., the inner shelly layer is nacreous—that is, it forms mother-of-pearl.

The mantle border by means of its sphincter muscles embraces the body closely, thus closing the mantle cavity except at one point, where a small opening allows the ingress and egress of water for respiration. This respiratory opening is a semi-circular notch, formed by muscles, and is sometimes prolonged on its dorsal wall into a half-closed tube or respiratory siphon; which, when present, assists by the phases of its development in the classification of the mollusca. This siphon usually forms an anterior notch in the shell near the margin of the columella and the

* A curious example of shell secretion by the visceral mantle occurs in a cone belonging to the cabinet of the late Dr. Gray. A section of this shell has been made, showing holes bored into the spire end by lithodomi and the repeated walls erected by the animal across the ends of the whorls to protect itself against the ravages of its insidious enemies. (plate 2, fig. 1.)

existence of the latter thus predicates that of the former. The siphonal tube is sometimes greatly prolonged, and is then frequently covered for most or all its length by a prolongation of the aperture, which is technically known as the canal of the shell. The canal in Murex and Fusus is extremely long, at least in the typical species. Mollusks of which the shells are furnished with a canal or anterior notch are called siphonostomata, the first great division of the prosobranchiates. The siphon is principally confined to predatory or carnivorous mollusks. The second great division, termed holostomata, have rounded apertures; consequently no siphon but simply an opening for respiration. They are vegetable feeders usually (Natica is a remarkable exception), and close the aperture of the shell completely by their operculum.

At the posterior left border of the mantle, behind the branchiæ, is sometimes an opening from which a small siphon extends backwards, and when it is present, it forms a notch in the posterior part of the shell, as in Cypræa and Conus, or a canal as in Ovula, or frequently it only forms a callosity on the upper part of the columella, close to its junction with the posterior part of the aperture margin. Probably this siphonal opening is for the exit of the water that has entered by the branchial opening. In many of the siphonostomata it is not present.

The mantle border can be freely withdrawn within the whorl, as it is not united to the shell at any point. It is frequently prolonged into digitations, or exhibits prominences or invaginations, all of which develop similar features on the shell; thus giving rise to the fingers of Pteroceras, the spines of Murex, etc. Occasionally, however, processes of the mantle do not secrete shelly coverings: Cerithium and the oriental Melanians, for instance, have delicately digitated mantle margins, these digitations forming no secretion, and sometimes thrown back over the shell.

The mantle is occasionally largely developed into side lobes, which in Marginella and Cypræa are so extended as to be thrown up over the external surface of the shell, nearly or completely covering it. In such shells an epidermis is not present. The mantle lobes of Cypræa are beset with numerous papillæ, which seem to partake the function of tentacles as tactile organs. In other genera, as in Oliva, the mantle is prolonged into filiform processes before and behind.

The female Vermetus has the mantle cleft in the middle, according to Lacaze-Duthiers, although there is no corresponding cleft in the shell, and in Haliotis a similar mantle cleft impresses a groove in the shell, in which are situated the row of holes characteristic of the genus. The shell of Pleurotoma also has a sinus corresponding to a cleft mantle. The cause of the sutural sinus of the shell of the American fresh-water genus Schizostoma is as yet unknown; it may be due to a similar cause or it may be sexual. As the genus is restricted to the Coosa River and its neighborhood, I am inclined to think that it is a local disturbance of growth, especially as most of the species could not be distinguished from corresponding forms of Goniobasis except by the lip notch or slit.

Foot.

The foot is a fleshy, expanded mass, attached to the under side of the body, in front of the mantle by a peduncle. In the heteropods the foot is divisible into three portions, termed, respectively, propodium, mesopodium and metapodium; but in the typical gasteropods these three areas are blended in the sole, although the metapodium is indicated by the fact of its supporting on its dorsal side the operculum. In Strombus (pl. 3, fig. 14), a transverse furrow separates the mesopodium from the propodium, and the metapodium is covered downwards and in front by the operculum.

The peduncle of the foot is usually short and depressed, and covers the under side of the body between the mantle collar and mouth, the foot being expanded forward, but more extensively backwards; but in Strombus and its allies the operculum is long and narrow, whilst the foot is slim and cylindrical. Haliotis, Patella and Chiton have the foot, on the other hand, very much expanded. Rapidity of motion appears to be in inverse ratio to the size of the foot; those genera in which this organ is enormously developed, especially in those just cited, where it occupies the entire ventral surface of the body, being slow in movement.

Generally, the anterior border of the foot is variously lobed (plate 3), and these lobes are mostly of glandular structure, though Keferstein has found them in Buccinum to consist of interwoven meshes of muscular fibres, in which are lodged beautiful nucleated cells. These lobes or filiform processes, like those of the mantle, are tactile organs.

When the foot is greatly expanded, as in Cymba, Harpa, Dolium, etc., it is generally laterally recurved over the shell, somewhat like the mantle in Cypræa and Marginella. In Oliva (pl. 3, fig. 16) and in Ancillaria, the propodium, represented by triangular lobes, lies flat, while the distinctly separated mesopodium covers a portion of the sides of the shell. In Natica the propodium is greatly developed forwards, extending beyond the head and reflected backwards over the latter in such manner as to conceal it, with its tentacles, and the anterior part of the shell itself, from view. The mesopodium in Natica, being likewise largely reflected over the shell, the respiratory cavity is covered, but a canal is developed between the reflected propodium and the mesopodium, which conveys water to the branchiæ.

There is a rounded glandular opening in the sole of the foot of many prosobranchiates (Pyrula, pl. 3, fig. 18), which is the external opening of the pedal aqueous vascular system; to be more particularly noticed hereafter.

Nearly all of the prosobranchiates whilst in the larval state support an operculum on the dorsal side of the metapodium; with some, the operculum is fugatious, and is lost in the transformation of the animal, yet it continues present in most of the groups. Its secretion from the operculigerous mantle, and its morphological relation to the shell, will be explained further on. The opercular mantle sometimes extends beyond the borders of the operculum itself, and is divided into processes or filaments, which may, as in Ampullaria, be reflected over it.

The foot is the organ of locomotion of univalve mollusks: the anterior portion is protruded, and then by means of wavelike muscular contractions of the sole, the whole mass of body and shell is brought forward—when the former motion is repeated. In Phasianella, Quoy and Gaimard have observed that the foot is divided lengthwise by a furrow, and that when motion is rapid the muscles of the sole are alternately used on either side, so that the effect of the motion is that of a pair of feet. In attached shells, like Vermetus, the foot is only rudimentary and serves merely as a support to the operculum.

In retiring within the aperture of the shell the foot is generally doubled upon itself across the middle, so that its dorsal posterior side, bearing the operculum, comes outermost; but in Oliva and Voluta it folds longitudinally, whilst the quadrate foot of Conus is withdrawn obliquely, without folding, first the right and then the left side.

The Columellar Muscle and Operculum.

As already stated, there is but one attachment of the prosobranchiate to its shell; namely, by means of the columellar muscle, by which the inner face of the columella is directly united with the posterior portion of the body of the animal. It passes underneath the mantle, greatly thickening the body wall, and terminates upon the inner face of the operculum, so that by its contractions the operculum and shell are approximated. The form of this muscle depends on that of the shell, and in the conical, non-spiral shells especially, varies greatly from its normal development. Thus, it is horseshoe-shaped in Capulus; it is divided into two portions, one of which lies on either side of the anterior part of the animal, in Fissurella. In Haliotis the animal is coiled around it, and its insertion, instead of being on the columella, is on the middle of the inner wall of the shell itself.

At the ending of the columellar muscle in the dorsum of the foot, its fibres are nearly vertical to the plane of the operculum, which usually appears to be immediately superimposed upon them: in Buccinum, however, Keferstein finds interposed a layer of long cylindrical epithelial cells, with mostly distinct nuclei, and long divided processes entering between the muscular fibres.

The operculum, a cuticular development of these cells, is composed, as may be seen in the corneous opercula of Murex, Purpura, Triton, etc., of very thin superimposed layers. With the microscope one may perceive in a thin section, the cylindrical cells with their head attached to the lowermost layer; or, on the inner face, the small rounded pittings where they have been attached.

Dr. J. E. Gray was the first investigator who announced that the operculum is homologous with the second valve of the lamellibranchiates or bivalve mollusks. He has shown that the operculum is developed on the embryo long before it is hatched; that it is placed on and covers a particular part of the body called the *lobus operculigerus*, and which bears to it the same relation which the mantle does to the shell, and that its growth occurs in the same manner; that this growth is made by the addition of new matter to the inner surface and especially near the margin; that it is attached to the animal by means of one or more muscles, which, as in the bivalve shell, pass from the larger valve or shell to the smaller one or operculum; that the operculum, as it increases in size, is gradually moved on the end of its muscle—the many-whorled operculum of the Trochi revolves as many times on the end of the muscle as the many-whorled spiral shell turns on its imaginary axis; that the operculum is often lined internally with a shelly coat like a shell, and sometimes, like the Cowries, its outer surface is covered also with a shelly deposit by a special development of the opercular lobe.

The principal difference between the operculum and the valve or shell of the Gasteropods consists:—

1. In the operculum having no cavity, its cone being depressed, flat or even concave, or very much compressed, forming only a spiral riband, as in the spiral operculum. But this absence of a cavity is a difference only of degree, for the valves of some Gasteropods, as Umbrella, Patella, etc., are much flattened; the first resembling the annular operculum of Ampullaria and Paludina: but the greatest resemblance is to be observed in the small, flat valves of Gryphæa, Exogyra, Chama, and other genera of bivalve shells which are attached by one of their valves. These valves are often quite as flat and destitute of any cavity as the operculum of any Gasteropod; and it is to be remarked that these valves exactly resemble a spiral operculum in shape, the remains of the ligament forming a spiral mark on the outer surface, showing how the valve has rotated on the body of the animal as the operculum rotates on the foot of the Gasteropods.

2. The operculum is generally horny and formed of a substance similar to the epidermis of shells; but then some shells, like the Bulla, Aplysia, certain Uniones, etc., are entirely or almost destitute of calcareous matter, and some of the helices, when inhabiting granitic regions, are equally of epidermal substance: on the other hand many opercula are thickened internally with a calcareous deposit.

Dr. Gray proceeds to show that in bivalve shells like Chama, where one valve (the attached one) has a spiral apex, whilst the other valve, is a flattened spire, the position of the hinge with reference to the spire must rotate slowly with growth, as in the spiral operculum in its growth. The direction of the spire of a spiral operculum is opposite that of the shell, showing another analogy.

The conclusion arrived at by Dr. Gray is that the normal or typical form of mollusks is that protected by two valves or shells: indeed, some nudibranchiate gasteropod mollusks which have no shell in their adult state (Doridæ), have their newly hatched young covered with two shelly valves which afterwards fall off.*

Dr. Gray has always maintained that the opercula are of great value in the distinction of genera, and he does not fail to condemn severely the practice of preserving shells in museums, or of figuring and describing them in conchological works, without opercula. I have already alluded to the supposed opercular bodies found with the fossil Ammonites: † it may be added that they occur as well in some of the Heteropods and Pteropods.

In 1847, Lovén proposed to consider the operculum as analogous to the byssus; but Dr. Gray has pointed out that some genera of Gasteropods provided with an operculum, secrete a byssus also (Rissoa, Cerithium, Littorina, etc.). However, Prof. Huxley, one of the latest and best authorities, thus endorses Lovén's views:

"On the hæmal aspect of the posterior portion of the foot, a chitinous or shelly plate, termed the operculum, may be developed. This operculum appears to be the analogue, if not the

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* *Ann. Mag. Nat. Hist.*, 2 ser., v, 476, 1850.

† MAN. OF CONCH., vol. i, Cephalopoda, 267.

homologue, of the byssus of the lamellibranchs; and is certainly not homologous with either of the valves of the shell of the latter, which are pallial structures." *

The following interesting note by Dr. Gray, will throw some light on this very interesting subject:

"*On the reproduction of the lost part of an operculum, and its probable restoration when entirely destroyed.*

"It is to be expected that the operculum of a gasteropodous mollusk may be sometimes broken or injured, but I have never hitherto been able to find any very distinct example of the kind, so as to study how the repair of the lost part would be effected. That such an occurrence would most probably be rare, is easily explained from its situation, as the operculum is protected by the last whorl of the spire of the shell when the animal is expanded, and by the mouth when it is contracted into the cavity of the shell.

"I have lately met with a very distinct example in a specimen of Fusus in the British Museum collection. In this specimen the apical half of the operculum has been broken off (pl. 2, fig. 12 *a*), and the lost part has been renewed by an irregular roundish process, nearly of the size of the lost part, not quite as thick as the original portion, and formed of rather irregular horny plates; the smaller or first-formed portion being in the centre of the broken line, so that the restored part bears some similarity to the annular operculum of a Paludina. This restoration is exactly like that which would have taken place in a shell under similar circumstances, and is a further proof of the truth of the theory which I have long advocated, that the operculum is a rudimentary valve, and is homologous to the second valve of the bivalve mollusks.

"In examining two specimens of Pleurotoma babylonica, preserved in spirits, with the opercula attached, I was much surprised to observe that the opercula of the two specimens were exceedingly different in structure and belonged to two distinct modifications of that valve, one (pl. 2, fig. 12 *b*) being subannular, with the nucleus apical, like the other species of the genus, and the other (pl. 2, fig. 12 *c*) annular, with the nucleus

* Huxley, *Anat. of Invert.*, 487, 1877.

sub-central, somewhat like the operculum of Paludina. The examination of the restoration of the lost half of the operculum of the Fusus before referred to has solved the difficulty, and I have no doubt that one of these animals had by some accident lost its operculum, and that it had gradually restored it; commencing, as in the case of the restored part of the operculum of the Fusus, by a small nucleus in the centre of the opercular mantle, on the back of the foot, and gradually adding new layers around the edge of it, until it formed an annular operculum nearly of the size of the original, but differing from it in shape, being less acute in front and nearly similar in form at the two ends. A more minute examination has strengthened this theory, for the operculum of this specimen is less regularly developed than is usual in the annular operculum of the kind, and is much thinner than the normal operculum of the genus, as is the case in both these particulars with the restored part of the operculum of the Fusus.

"This change in the formation of the operculum when it is reproduced is just what might have been expected. The animal, when it has to form the operculum at its birth, begins its formation at the tip, and increases its size, as the animal requires a larger operculum for its protection, by the addition of new layers to the outer edge of its larger and last-formed end; but when it has to reproduce this organ, the opercular mantle having reached a certain size, it proceeds to cover its surface with a new protection in the most easy and rapid manner, and, commencing from a more or less central spot on the surface, enlarges the surface covered by adding new matter to the entire circumference of the first-formed part; it continues this process without waiting to making the operculum as thick and solid as the one which was lost, until it reaches the size of the original, moulding itself on the opercular mantle, and adapting its form to the form of the throat of the aperture of the shell which it has to close. The change of form in the front of the restored and mended operculum is caused by the parts being moulded on the existing opercular mantle—consequently they have not the narrow front part which is found in the normal form caused by that part having been formed when the animal had this part of a small size; and as it increases in size the whole opercular mantle moves forward, leaving the small tip of the operculum free, and useless to the animal, and, therefore, not necessary to be reproduced when the operculum is reformed in the adult age of the animal."*

The Shell.

All prosobranchiates (and nearly all mollusks) are provided with an external shell, a dwelling place and a citadel combined, the hardness and durability of which, as Keferstein remarks, "supplies us with the best means of knowing the animal; indeed, in many cases, it is the only part known, and was formally the only part valued and preserved in collections. Although the animal itself offers more weighty and striking characters for the separation of the higher groups, yet having learned the close relationship existing between shell and animal, we find therein ample justification for attaching especial importance to the shell in a systematic point of view."

We have already shown how the shell is produced by the mantle.

The form of the shell is throughout regular, and is normally a cone curved into a spiral, and descending in a screw-like manner from the apex or initial whorl to the aperture. Nothing can be more beautiful than the regular geometrical progression of the growth of a shell or the certainty with which each species and genus grows in its normal pattern, although these modes vary among themselves so widely: thus we have the simple depressed cone of the Patella, all aperture and no spire, and from it every gradation from the Haliotis, almost equally depressed and broad, the result, however, of a very rapidly enlarging spiral, to the long, many-whorled Turritella, or the Vermetus, which is a Turitella partially unrolled into a simple long tube:—the opposite of the Patella. The whorls of a spiral shell are, in most cases, closely wound around its axis, and, therefore, most part of their surface is in contact, each whorl partially covered and concealed by its successor; and where the axis does not lengthen by the obliquity of the spiral, we find, as in the cone and Cypræa that the shell only shows externally its last whorl, with, perhaps, a

* Dr. J. E. Gray, *Proc. Zool. Soc.*, 100, 1854.

very small portion of its predecessor visible on the spire. On the other hand there are genera in which the whorls are not at all in contact, and where the axis becomes itself an imaginative cone, widest at the base. Besides the almost numberless modifications of form resulting from the degree of obliquity and closeness of the spiral, the direction of the latter may be mentioned as another factor in producing modification. In most spiral shells the spire normally curves to the right, that is to say, placing the shell with its apex turned from the observer and its aperture in view, the latter will be found on the right hand. In others the volutions proceed in the opposite direction with such regularity as to be eminently characteristic of some species and genera. However, in certain genera, it is found that species normally dextral will exceptionally produce sinistrally coiled shells, and this abnormal growth probably is caused by disturbance of the relations of the embryo with its initial shell.

Whilst the bulk and weight of shells are composed principally of carbonate of lime, yet they have always an organic basis, which is first developed, and then gradually impregnated with the lime. If the latter be removed by the use of acids the organic residuum (conchyolin) still retains the shape of the shell, forming a sort of membranous framework. It is this organic basis which maintains the life of the shell, for, the animal removed, as in beach-worn or fossil species, the conchyolin soon disappears and the shell becomes pure carbonate of lime, growing at the same time more and more brittle. Many of the long spiral shells, such as Bulimus decollatus, some Pupas, Truncatella, Melania, etc., withdraw the body from the earlier whorls in the course of growth, and partition off the unoccupied space with a shelly plate: in such cases the unoccupied whorls become brittle and are soon broken off. We must, therefore, believe that the shell is vitalized, or rather, that its vitality is maintained by simple contact of its organic basis with the living animal.

There are two very distinct types of shell structure, the cellular or porcellanous and the membranous or nacreous. In bivalve mollusks the former is the outer and the latter the inner layer, in most cases, but in univalves the shell is usually porcellanous only; although a few of the holostomata, such as Turbo, Trochus, Stomatia, etc., have both layers, the inner one being pearly.

Nacreous shell substance consists of very thin, superimposed membranes, lying parallel with the surface and impregnated with aragonite. The iridescence of this substance proceeds from the waved or wrinkled close edges of these membranes. The aragonite is of crystalline structure, showing beautiful five or six angled tables. (Pl. 2, figs. 8, 9.)

As porcellanous shell structure is essentially the same in almost all Gasteropods, and the only kind of shell structure in most of them, a few sections of Strombus gigas will give a clear idea of the disposition of the material. (Pl. 2, figs. 4-6.)

There are, it will be perceived, three layers of deposition (of which the middle one is thickest in this case), each composed of a multitude of plates or prisms, but each differing in the direction of arrangement of these. It will be readily perceived how much this diversity of arrangement adds to the toughness of the shell structure, as no line of fracture can penetrate the entire shell wail, except by the violent breaking across of part of these layers of prisms.

As to the chemical composition of shells, the conchyolin or organic material is a small, varying percentage, carbonate of lime, existing in quantities varying, from Turritella, 88.70 per cent. to Strombus gigas, 99 per cent. There are traces of other constituents, of which carbonate of magnesia is perhaps one of the most important; it varies from 0.12 per cent. in Telescopium to 0.48 per cent. in Fusus antiquus. Silicic acid has also been detected. C. Schmidt has obtained almost 1 per cent. of phosphate of lime from the shell of Helix nemoralis. The calcareous operculum of Turbo (analyzed by Wicke) contains: Carbonate of lime, 98.72 per cent.; organic material 1.28 per cent.

Shells are perceptibly harder than, and will scratch calc-spar. Their specific gravity is somewhat higher than that of Carrara marble, being about 2.75 to 2.85 for the prosobranchiates, and varying but slightly in the pulmonates.

With reference to the coloring of shells (terrestrial as well as marine species) Fischer points out that as a rule, brilliancy of coloring increases towards the equator. He suggests three zones of coloration corresponding to the thermal zones, which may be designated as:

1. Monochromic or frigid zone.
2. Oligochromic or temperate zone.
3. Polychromic or tropical zone.

Of course exceptions are numerous—modifications based upon habits, ocean currents, adaptive coloration, etc.. M. Fischer particularly cites the melanism which characterizes so many shells of the West Coast of North and South America, giving, among other examples, the numerous species of sad colored and lugubriously named Trochi, which pervade those regions.*

On adaptive coloration.—A number of papers on mimicry or adaptive resemblance as a means of protection of animals against their enemies have been published, and the subject has awakened much interest and discussion. Coincidence of coloration of molluscous animals with their surroundings has been frequently remarked, but it is probably not so often for purposes of attack or security as the result of the food upon which they live or a dye obtained by contact with it. I have shown in my volume on the Cephalopoda that conscious adaptation of color has been noticed in the Octopus. Mr. Morse gives a number of instances of coincidence of color between American marine mollusks and their surroundings which he supposes to be evidences of protective adaptation.†

"The thickness, the roughness, and the smoothness of the surfaces of shells appear to depend, in a great measure, on the stillness or agitated state of the water in which they reside. Shells which have branching or expanded varices, like the Murices, are also much influenced by circumstances, and hence many mere varieties, arising from local causes, have been considered as distinct species. Thus Murex anguliferus is merely a Murex ramosus with simple varices; and Murex erinaceus, M. torosus, M. subcarinatus, M. cinguliferus, M. tarentinus, and M. polygonus are all varieties of one species. Murex magellanicus, when found

* Dr. P. Fischer, *Jour. de Conch.*, xxiii, 105, 1875.

† E. S. Morse, *Proc. Bost. Soc. Nat. Hist.*, xiv, 141, 1871.

in smooth water, is covered with large acute foliaceous expansions; but the same shell living in rough seas is without any such expansions, and only cancellately ribbed. In such situations it seldom grows to a large size; but when it does so, it becomes very solid, and loses almost all appearance of cancellation. Triton maculosus is very widely spread over the ocean in different temperatures and different kind of seas; it consequently offers a multitude of varieties both of size and surface, all gradually passing into each other, and most probably produced by the operation of the foregoing causes. Indeed, a vast number of merely nominal species have been formed from the habit, too prevalent among conchologists, of describing from single specimens, or even from several individuals brought from the same locality, which would never have been considered as distinct had collectors kept in their cabinets a series of specimens found under different circumstances, and studied, on the coasts where they are found, the variations which shells undergo."*

Shell.

Rest periods in the growth of mollusks are sometimes, as in the Murices, marked by a thickening of the edge of the shell, caused by continuous depositions of shell material, forming a ridge or varix; and the rate of growth may be thus traced readily, in numerous mollusks. Thus in Murex one group shows three varices upon each whorl, indicating that a period of three years, or at least three seasons of activity is required for the completion of a single whorl of growth. In another group of Murices the varices are more numerous, as many as four to ten being counted on a whorl. In Triton, the varices are two on each whorl, but nearly alternately situated, so that the varices of each whorl occupy an intermediate position to those on the preceding whorl: in Ranella there are also two varices but they form a continuous fringe or wing-like expansion on each side of the spire, showing a very regular growth by periods of half-whorls.

The accretion of surface during growth is not continuous but is made by minute layers, around the margin of the aperture, each extending a little beyond its predecessor, and the edges of

* Dr. J. E. Gray. *Philos. Trans.*, 771, 1833.

these layers as exposed on the external surface are called growth-lines. Those shells which have a simple, or sharp-lipped aperture and which do not develop varices, nevertheless distinctly show the rest-periods by the greater impression of the growth-lines. Many shells retain the sharp aperture for a variable period, which may be called their juvenescence, but finally acquire adult characters, consisting of a thickened, reflected, inflected or lipped aperture—which is sometimes more or less contracted by inflected calcareous projections called *teeth*. Growth, however, frequently continues after adult characters have been acquired, and then these are absorbed away when accretion recommences, leaving the mark of their former position in a more prominent growth-scar or line.

The power of dissolving their shells is possessed by certainly a large portion of the mollusca and is habitually exercised by many of them: thus the cone, which we have seen partitioning off its whorls against an enemy and thus seriously incommoding itself for room, would under normal circumstances acquire for itself additional accommodation by absorbing away most of the thickness of the enclosed whorls or partitions, and Cypræa, Nerita and Auricula assist themselves in the same manner so as to become eventually an external shell only, with a single cavity. In species with lengthened spire, this method is not so practicable, because only a small portion of the whorls are enclosed within succeeding ones. The growth of many of these animals is such that they cease after awhile to occupy some of the earlier whorls, and they then partition them off as a regular habit, in the same manner that the cone has worked under the pressure of exceptional necessity. These partitions made, the portion thus cut off from contact with the animal loses vitality, becomes brittle and breaks off, forming the truncated shells which are characteristic of numerous groups—especially of land shells.

From what has been said of the mode of formation of shells it will be readily seen that details of sculpture as striæ, sulcations, ribs, nodes, spines, etc., result from similar ornamentation of the applied mantle: thus the spine of a Murex, if closely examined, will be found to have a longitudinal seam upon its front face, showing that it has formed by a corresponding digitation of the mantle. It is scarcely necessary to pursue this subject further at this time: reference to the plates of this and succeeding volumes will demonstrate this relationship of shell and animal.

Neither shall we investigate further the forms of shells or their opercula, monstrosities, etc. All these matters, where general in scope, may well be relegated to an introductory treatise on Conchology; or we may at some future time include them with other particulars of more general than special application in a volume of appendix to this series.*

Digestive Organs.

The digestive organs in the Prosobranchiates are well developed. The mouth, which is sometimes in the lower plane of the head, and sometimes at the end of a proboscis capable of protrusion and retraction, is frequently encircled by an extensible lip; within, it is often armed with a jaw on either side, and the tongue is usually armed on its upper surface with numerous transverse rows of teeth, constituting the lingual ribbon. The œsophagus is often beset with appendages and salivary glands, and leads to the stomach; whence the intestine turns forward, passing close to the kidney and heart and into the respiratory cavity, the right side of which it traverses and finally empties into the anus. The intestine and often a portion of the stomach is embraced by an

* Such a volume might embrace the facts of geological and geographical distribution, in addition to the outlines of molluscan structure and a history of classification. One can readily conceive that such a volume would be a natural outgrowth and completion of a monographic series, a collation of the information contained in its predecessors, and an application of the same to the various important generalities which occupy modern scientific thought. It is a reproach to natural science, and to no department thereof more than to conchology, that most of its votaries consider the determination of species and genera its legitimate end; that they are more actuated by the selfish ambition of acquiring reputation than by the love of knowledge. Thus it happens that in most treatises very few structural details are given, whilst the technical descriptions of external features occupy the bulk of the work—such descriptions being the necessary justification for the imposition of generic or specific names and the consequent glorification of the namer. I propose, as far as practicable, to reverse this procedure, to consider the necessarily arbitrary and artificial nomenclature simply preliminary; as a facility towards the acquisition of knowledge of nature and its laws—not as the end of knowledge. As the builder finds it convenient to express the kinds of instruments used in his labor, by technical names, so do naturalists find necessary a succinct designation of the subjects of their studies; and the

enormous liver, filling nearly the whole of the first whorl of the shell, and pouring its secretions into the former (and often into the latter also) by several openings. We will successively examine these various organs more in detail.

The proboscis is a production of the skin of the anterior or head portion of the body, bearing the mouth at its end. When it remains permanently protracted it receives the name of rostrum, that of proboscis being more properly limited to this organ when provided with muscles by which it can be retracted within the body. The typical proboscis is quite characteristic of the siphonostomated Prosobranchiates, or those carnivorous mollusks of which the shell is canaliculate or notched at its lower extremity; whilst those animals provided with a rostrum or snout, or with a simple mouth are members of the usually phytophagous holostomata In Dolium, a remarkable exception, the exceedingly long proboscis accompanies phytophagous habits.

The invagination of the proboscis is effected by means of powerful retractor muscles supplied along its entire length and especially numerous at its base, where the retraction begins. The protrusion of the proboscis, on the contrary, is effected by pressing forward the blood towards the head, an operation assisted by the contraction of the annular muscles of the fore-part of the body. In Natica, according to Troschel, the invagination of the

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naming and technical description of species, in the same manner distinguishes for us the implements which we should use in our investigation of nature—implements by which the Great Builder has worked, in which He has expressed His thought. The proper acquisition of a language requires the preliminary knowledge of its grammar, the knowledge of letters precedes reading : even so, the simple name of a species, then of a genus, and its recognition when met with or referred to forms the mere alphabet of science, from which we proceed gradually to the consideration of individual properties, then to intimate and to wider relationships, until we are fortified with sufficient knowledge to generalize. In these latter days generalizations are numerous enough also, but unfortunately they are usually the product of minds not furnished with the requisite intimate knowledge of the factors with which they build their theories. The details of anatomy and physiology of the mollusca will be given for each group as it occurs in the course of this work, and I shall thus necessarily repeat myself frequently; and I hope that by the time that my reader and I have finished the volumes containing the technical descriptions, we will both be better prepared than we are at present to understand the subject as a whole. This course has also the important *personal* advantage, that if at any time I shall be attacked for sins of commission or omission, I may make the obvious defense—wait and see.

proboscis commences at its extremity (like that of the tentacles of snails) by means of two retractor muscles attached to the oral mass. The same observer describes a muscular disk on the under side of the proboscis, behind the mouth, in Natica and Sigaretus. This disk possesses suctorial action and probably enables the mollusk to attach itself firmly to the shells of other species when drilling them for the purpose of devouring the soft parts.

The oral mass is usually an oval body formed by invagination of the external skin through the mouth, from the upper posterior end of which proceeds the œsophagus, whilst at the lower posterior end is situated the lingual sheath, enclosing the odontophore. The wall of the oral cavity is filled mostly with flesh-colored muscles and clothed with an epithelium, which is often covered by a thick cuticula, and furnished with cilia on the roof of the mouth.

The lips form a short hollow cylinder at the commencement of the mouth, made up of longitudinal and annular muscles, the latter preponderating; and sometimes forming a ring-like thickening, which is greatly developed and cleft into lobes in the genus Conus, and forms another kind of sucking disk, by the use of which the animal assists its locomotion—necessarily laborious on account of the weight of its shell. In the terrestrial branchiferous genus Cyclostoma the snout possesses a similar disk.

Jaws. The inner surface of the lips is sometimes covered by hard plates, which are evidently of much service in grasping and comminuting food. The jaws are attached by their hinder portions to the labial skin or membrane, from the epithelium of which they are secreted. They are hyaline, without structure, and yellowish. Their front face is detached from the membrane and frequently elevated like a scale, bearing sometimes, as in Dolium galea, a rounded free hook. In the Prosobranchiates the jaws are a pair, situated on either side, but in some of the Pulmonates this pair become united above, forming a single, arched, superior jaw. These cheek plates or immovable mandibles are found in nearly all the Tænioglossata, as well in those provided with a rostrum (Cyclostoma, Valvata, Rissoa, Jeffreysia, Crepidula, Vermetus, Trichotropis, etc.) as in those with a haustellum (Marsenia, Natica, Cypræa, Cassis, Triton, Strombus, etc.).

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These plates are apparently wanting in all the Rachiglossata (Murex, Fusus, Nassa, etc.). The linear horny plates described in Buccinum undatum by Cuvier and Valenciennes, are probably appendages of the tongue, and used as a handle in perforating the shells on which they prey.

Tongue. The odontophore or tongue (pl. 4, fig. 40) is attached to the floor of the mouth. It contains two parallel cartilages, which may be more or less confluent, and which are united towards the middle by fibrous and muscular tissue. "The intrinsic muscles of the odontophore are attached at one end to the posterior and under faces of the subradular membrane, some being inserted into its posterior and lateral portions, and others into its anterior extremity, after it has turned over the anterior extremities of the principal cartilages. Certain of the muscular bundles are also attached to the forepart of the odontophoral cartilages themselves. The contraction of these muscles must tend to cause the subradular membrane, and with it the radula, to travel backwards and forwards over the ends of the cartilages in the fashion of a chain-saw, and thus to rasp any body against which the teeth may be applied. When undisturbed, the radula is concave from side to side, and the teeth of the lateral series, being perpendicular to the surface to which they are attached, are inclined inwards to one another. But when the intrinsic muscles come into action, the radula, as it passes over the ends of the cartilages, becomes flattened, and the lateral teeth are consequently erected or divaricated. The extrinsic muscles pass from the odontophore to the lateral walls of the head, and protract or retract the whole apparatus. They may give the protruded extremity of the radula a licking motion, which is quite independent of the chain-saw action due to the intrinsic muscles."—HUXLEY, *Anat. Invert.*, 490.*

The subradular membrane does not terminate behind with the muscular mass of the tongue, but is continued and invaginated into a pouch called the tongue-sheath. The under wall of the

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* Geddes has recently carefully investigated the mechanism of the odontophore in Loligo. Buccinum and Patella. He does not altogether agree with Huxley as to the mode of action of this organ, but thinks its movements depend on those of the cartilages, whilst Huxley regards the cartilages as passive.—*Trans. Zool. Soc., London*, x, 485, 1879, *with three plates.*

oral cavity forms a muscular elevation, which is frequently semicircular, and above which the œsophagus opens. Troschel has regarded this as an organ of taste, and from its position it may well have that function.

For convenience of description the odontophore may be divided into five longitudinal areas, which are crossed by the numerous transverse rows of teeth: these teeth are distinguishable in character in each area. The central tooth is termed median or rachidian, the adjoining area on each side bears the laterals, and these again are flanked by the uncini. Sometimes, however, only three areas are found, when the laterals are suppressed, and a cross series includes only rachidian and uncinial teeth. In Bullidæ again, the rachidian teeth are suppressed and there are simply two bands of uncini. A numerical formula has been devised which represents these teeth thus:

In Trochus (∞. 5. 1. 5. ∞.), meaning 1 rachidian, 5 laterals and numerous (∞ being the sign of infinity) uncini. The mollusks with which we are at present occupied (the Muricidæ), have but three longitudinal areas and the formula for Murex, for example, is 1. 1. 1., signifying one rachidian tooth, with a single uncini on either side. The tongue areas bearing the uncini are sometimes designated as pleuræ.

Rev. G. Rowe, from whose lucid description the above is extracted,* truly observes that "this subject has been investigated by several naturalists, with a view to obtaining criteria for a systematic arrangement of Gasteropodous Mollusca. Up to the present time, however, their labors have only partially succeeded. The union under one formula of so many creatures widely differing in shells, anatomy and habits, clearly indicates that if the lingual ribbon contains generic characters, they have not yet been ascertained. At the same time it does present differences which may offer collateral evidence in cases difficult of discrimination. It does not help us to discriminate carnivorous from phytophagous animals; but it seems possible to make use of it as a mark between species."

The teeth, according to the investigations of Leuckart, Bergh and Troschel are composed of ninety-four per cent. organic or

* *Intellectual Observer*, v, 67, 1864.

chitinous material and six per cent. of bone-earth, agreeing nearly with horn in composition. They are readily extracted and prepared as microscopic objects, the easiest method of procedure being that given by Mr. A. M. Edwards, which I subjoin.

On extracting and preserving Odontophores.—If the specimens are large enough, they may be first roughly cut away from the surrounding tissues; otherwise the entire animal, even with the shell may be placed in a test tube, immersed in Liquor Potassæ, and allowed to soak from a day to several weeks until everything is dissolved except the shell, the odontophore and a few shreds of muscular fibre. The contents of the tube being poured into a large vessel of clean water, the odontophore will settle to the bottom, whence it must be carefully taken out by means of a dip tube and thoroughly washed until all alkali is removed. Alcoholic specimens require boiling in the alkaline solution, but fresh material had better be treated cold, unless time presses, when boiling will facilitate the extraction of the odontophore. In this case care must be taken as delicate specimens are likely to be injured by boiling. When the specimens are very delicate, a solution of less than officinal strength is substituted with advantage: this is a matter in which experience is the best teacher.

The odontophore can be preserved (in either alcohol or glycerine), but in mounting as a microscopic object Canada balsam or still better, glycerine-gelatine should be used.*

Through Troschel, in 1836, attention was first directed to the various forms of tongue sculpture as being available in classification, and Lovén and Troschel himself by means of the most exhaustive investigations discovered the extraordinary multiplicity of form, etc., of the radula. In their systematic labors Troschel and Gray raised the radula to the rank of a character of the first importance, in the molluscan, especially the gasteropod system, and they accordingly made many changes, rearrangements, and improvements.

To be sure, the tongue and its delicate teeth have been long since known, but they occupied only a subordinate place in the minds of systematists. With Lebert we might agree that Aristotle meant the teeth upon the radula (*Hist. Anim.* vi, 4.)

* A. M. Edwards, *Proc. N. Y. Lyc.*, 160.

"habent quædam os et dentes, ut Limax, acutos et minutos," and not as Lovén held, the jaws, but we meet with a better account of them for the first time in Swammerdam upon Paludina, Littorina and Neritina.

With many other striking observations upon mollusks we meet with the first description of the radula in Adanson, which with the underlying tongue he regards as a lower jaw. "La mâchoire inférieure," writes Adanson (*Hist. Nat. du Seneg.* p. 17) in a Bulimus, his B. Kambeul, "ne consiste que dans le palais inférieur de la bouche, qu'est tapisé d'une membrane coriace, mais extrêmement mince, blanche et transparente, sur laquelle sont distribués longitudinalement sur deux cens rangs environ vingt mille dents semblables à autant de crochets courbés en arrière. Ces crochets sont si petits qu'on a peine à les sentir au toucher, ou ne les distingue parfaitement qu'au microscope."

Poli was one of the first to figure the radulæ of Cephalopods, Gasteropods and Chiton, then Savigny in his Zoology of the Description de l'Egypte. Cuvier in his Memoires correctly describes the radulæ of a number of mollusks, but attached little systematic value to the part. On the other hand Quoy and Gaimard, and Souleyet in the works describing the collection of their voyages, figure many radulæ, but they were not brought forward with sufficient prominence. In Osler's work on the mode of feeding of mollusks, attention was again more especially directed to the radulæ, and Lebert studied the same more particularly with reference to their microscopic characters. As already observed, the extensive observations of Lovén and Troschel are the most comprehensive in their treatment of the subject of this discussion, though the great work of the latter approaches completion very slowly. We shall hereafter sketch an outline of the classifications which have been wholly or partially based upon modifications of the odontophore.

The tongue, beset with such teeth, is well adapted as an apparatus for filing off or rasping food and drawing it into the mouth. In mollusks which creep up on the glass sides of a vessel in which they are confined, one can easily observe the mechanism of eating. The tongue with the whole oral mass is pushed forward a little beyond the lips, so that one can see the little teeth spreading out. The tongue rubs off particles of nourishment only in the process of retraction, or tears larger pieces from leaves for example, and draws them into the oral cavity. In seizing and holding the nourishment, the strong annular lip and the jaws are useful accessories.

As already stated, certain corresponding peculiarities of animals and shells enable us to separate the carnivorous from the phytophagous mollusks; curiously enough, the arrangement of the lingual ribbon does not indicate this separation, and we accordingly find, in systems of classification based upon this organ, the animal and vegetable feeders rather incongruously mixed.

Besides the mastication of food, the teeth are probably used in boring through the shells of other mollusks in order to obtain the flesh. It is still a matter of discussion whether this operation is effected by mechanical or chemical action or by a combination of both; but it is generally supposed that the teeth are the tools by which an excavation through the hard shell of the victim is perforated. Most of the large siphonostomate Prosobranchiates obtain food in this manner, as well as the Naticas among the holostomates; and I shall have occasion frequently to refer to the subject hereafter when treating of the individual species. The shells attacked are usually bivalves, which are bored near the beaks where they are thinnest. That instinct is sometimes at fault in these creatures is evidenced by the solid spine of a sea urchin, which P. P. Carpenter relates, has been bored through by a mollusk.

On every coast the evidence of this work of destruction is abundant, a large portion of the bivalves washed ashore, being perforated near the umbones.

Müller has seen Cerithia on the Brazilian coast bored by Murex Senegalensis, in consequence of which the animal dies and opens its operculum, when a Turbinella comes to share the feast. He has seen a dozen specimens of Cerithium at one time with the Murex extracting the meat through a boring in the spire and the Turbinella at work within the aperture of the shell. When both these are done, a Pagurus occupies the empty shell, or shares it with a Crepidula.*

* *Jena Zeit.*, 57, 1871.

Möbius has seen Venus mercenaria, and Cypræa Europæa bored through the shell by Murex erinaceus, and the soft parts eaten.*

Mr. C. Spence Bate has proposed the following theory of the means by which mollusks make these perforations.†

"His observations upon the boring of the Buccinum into the shells of other mollusca attributed their power of perforation to a current of sea-water passing through the buccal apparatus, the lingual ribbon having no part in the operation. The animal takes two days to perforate the shell of Mytilus edulis, and performs the work without the least motion of its shell, as must be the case whenever a circular hole is bored by mechanical action.

The sea-water itself is probably the solvent used in boring by the mollusca, being charged with free carbonic acid; and is directed by them against the object to be bored through the process of respiration, and ciliary currents.

The action of sea-water upon limestone coasts in driving tunnels and excavating caverns in the rock is evidence of this solvent power; and the same theory will probably account for the absorption of the columella in the Purpuridæ as well as other instances of absorption by the animal of portions of its shell."

I think that the above theory, ingenious as it is, will not account for the perfectly round hole, with clean-cut vertical walls made by boring mollusks in the shells of their prey; indeed it is difficult to imagine any solvent as the unassisted agent in making such a perforation; yet, on examining a shell not entirely bored through, the bottom of the hole is perfectly smooth, showing no marks of mechanical rasping.

The œsophagus, as already stated, opens into the upper posterior end of the mouth. In those mollusks furnished with a proboscis that portion of the œsophagus which traverses it is much narrowed, and when the proboscis is retracted it is bent into a sigmoid or coil. In its entire length it is provided with interior longitudinal folds. Its middle is dilated into a sort of crop in Voluta, Dolium and some other prosobranchiates. Keferstein has found in Triton variegatum, and in Dolium galea that

* *Zool., Garten*, 371 1866.

† *Rept. Brit. Assoc.*, 73, 1849.

the œsophagus, just behind the lingual wall (pl. 4, fig. 27), is dilated below into a longitudinal pouch which is filled up with a gelatinous tough mass, projecting into the interior like a ridge: it consists of a hyaline material, with many spindle-shaped or stellate cells with round nuclei. A similar organ has been detected in species of Murex, Voluta (pl. 4, fig. 33), Ancillaria, etc.

The stomach, in its simplest form (pl. 4, fig. 38), is a dilatation of the digestive tract into which the hepatic ducts open. In Murex and Buccinum it is rounded and curved so that the origins of the œsophagus and intestine approximate. In many of the species a blind sack has been detected in connection with the stomach. In some there are internal lobes or filaments (as in Mitra episcopalis), and in others actual tooth-like bodies for compressing the food (Telescopium). In Bythinia, Strombus and Pteroceras the blind sack has been found to contain a firm body, somewhat like the hyaline rod of muscles; it extends some distance into the cavity of the stomach.

The intestine in spiral shells may enter the stomach opposite the entrance of the œsophagus, or, in consequence of the bending of the stomach, it most usually enters not far from the œsophagus; it then bends forwards, terminating in an anus situated not far from the mouth. In the carnivorous species, Murex, Triton, etc., the intestine is direct or nearly so, but in the phytophaga it usually forms one or more convolutions (pl. 4, fig. 32). The intestine may be distinguished into two portions, the small intestine and the rectum, the latter being usually enlarged in diameter, confined to the anal end and straight portion of the tube, and having longitudinal folds of its inner wall. In the female, the vagina is placed alongside the rectum, and in some univalves there are anal glands opening by the anus.

The anus is simply a round opening closing by sphincter muscles; situated in the anterior part of the respiratory cavity, lying on the right side of the animal.

Salivary glands. Usually a pair of these lie along the œsophagus (behind the œsophageal ring), and open into it close to its entrance into the oral mass. These glands may be tubular and long, dilated behind as in Strombus, or the posterior extremity cork-screwed as in Voluta (pl. 4, fig. 33), or they may be short or cylindrical or clavate as in Pleurotoma, Littorina, Trochus, etc. Sometimes, as in Dolium, Cassis and Triton, the elongated glands are in two subdivisions, divided by a deep fissure into a small anterior and a larger posterior portion (pl. 4, fig. 27). The two glands may also unite over the dorsal side of the œsophagus, into a single mass, from which, however, separate ducts proceed on either side.

Souleyet was not able to discover distinct salivary glands in Turbo, but its œsophagus is enlarged just behind the mouth, and this enlarged space is furnished with a number of folds which may be regarded as substitutes (pl. 4, fig. 34).

In Conus there is only a single gland (pl. 4, fig. 36), and it is very doubtful whether this is salivary in function; Troschel considers it a poison-gland.

In addition to the salivary glands there is found in Murex (not observed in other genera), a gland lying above the œsophagus; it is thick, granular in structure, of liver-brown color, divided into several large lobes and opens into the œsophagus by two ducts. Its purpose is unknown. In Dolium the secretion of the salivary glands is distinctly acid, a property first detected by Troschel, and afterwards observed in this and in several other mollusks by a number of investigators.* Troschel states that if the Dolium galea is irritated, it will protract its proboscis as much as a foot, and eject from it a quantity of clear fluid, with a very acid smell, and producing effervescence upon calcareous soil. The liquid has been ascertained to contain several per cent. of free sulphuric acid, and about 4 per cent. of hydrochloric acid.† How the mollusk secretes this acid, and how it protects its own tissues and the epithelial cells of the glands themselves against its action is not at all understood. The acid secretion does not appear to be taken into the stomach, for Troschel found in the stomach of Dolium seaweed and calcareous remains, which, when artificially brought into contact with the acid, immediately commenced to dissolve. He thinks the secretion is

* *Researches upon the organs which, in the gasteropods, secrete sulphuric acid.* By Prof. Paolo Panceri, *Jour. de Conch.*, 3d ser., ix, 308, 1869.

† De Luca and Panceri have ascertained the existance of free sulphuric acid in the salivary product of Murex trunculus and M. brandaris. *Ann. Sc. Nat.*, 87, 1867.

for defensive purposes, and it has been suggested by others that it assists carnivorous mollusks like the Murex in boring into the shells of their victims—usually bivalve mollusca.

The liver in all prosobranchiates is a brownish or greenish gland of extraordinary size, which forms almost the whole of the usually spirally coiled hinder portion of the animal from the stomach back, giving up to the sex-glands but a small space. The form of the liver is, therefore, very much the same as that of the posterior portion of the body itself. It is lobulate, and when removed to water is found to be acinose. The acini at their ends are cleft into many digitiform processes; the ducts from the acini unite, then those of the lobes, with frequently sinus-like dilatations, but ending as two bile ducts, placed one before the other, and which correspond to the largest subdivisions of the liver, and approach and, finally, enter the digestive tract at the stomach; if a blind sack is present they enter in front of it. One may accordingly regard the liver as a much subdivided gland, since it is only at a few places, in respect to minute structure, that its ducts and sinuses may be distinguished from the terminal lobes. The liver consists here, as in all univalve mollusks, of an outer structureless membrane and an internal epithelium of roundish secretive cells, which have a distinct nucleus and yellow concretions, and also contain fat. H. Meckel would distinguish fat and bile cells: according to Leydig, however there is no such distinction possible. The hepatic lobules are united together by thin membrane, plexuses of finely subdivided blood-vessels surround them, and externally the whole liver is surrounded by a blood sinus.

Nervous System.

The typical arrangement of the nervous system throughout the mollusca is the same, the differences of which we have occasion to speak being simple modifications of a single fundamental type. The œsophageal ring consists essentially of three pairs of ganglia and a double commissure on each side, and in the more highly organized prosobranchiates these ganglia are approximated and the commissures shortened until the cerebral mass resembles that of the cephalopods, where the ganglia can be distinguished only by the origin of some of the nerves. In species having a simple mouth, the œsophageal ring surrounds the œsophagus immediately behind the oral mass, but in those having a proboscis or snout, it is situated so far back as to remain at rest whilst the proboscis is protruded or retracted.

The cerebral ganglia are placed above or at the sides of the œsophagus, and from them proceed the nerves of the eyes, tentacles, lips and mouth ; the pedal ganglia are under the œsophagus, and from them the acoustic and pedal nerves arise ; the visceral ganglia are mostly at the underside, somewhat above the pedal ganglia, and here the nerves supplying the mantle, branchiæ, viscera, heart and columellar muscle take their origin. Almost all of the nerve-cords arising from these three ganglionic pairs may also develop ganglionic enlargements whence numerous nerves in their turn originate. Such is the general plan of the nervous system in prosobranchiates, differing but little from that of the lamellibranchiates or bivalve mollusca. A sufficiently clear idea of the modifications of the ganglia, and of the origin, course and function of the various nerves, may be obtained from my figures on plate 6, with the accompanying explanations, so that it will not be necessary to particularize here.

Organs of Touch.

The principal tactile organs are the tentacles, but there are in addition, in certain prosobranchiates lobular productions of the head near the tentacles, which appear to have a similar function (plate 3), whilst the whole exposed surface of all mollusca is delicately sensitive.

The tentacles, always two in number in the prosobranchiates, are solid structures, not invaginate and capable of retraction within the head as are those of the pulmonates : they arise from the front dorsal part of the head and in the proboscidiferous species are situated at the base of it.

The tentacles usually bear the eyes upon stalks which are connate with or branch out from them. The position of the eyes varies in different genera ; thus they are found near the bases of the tentacles in Littorina, Dolium, or near the middle, as in Murex, Fusus, Cassis, Mitra, etc., or even at the end, as in Terebra. In Strombus the robust eye-stalk originates about the middle of the filiform tentacle. In many holostomates, as Trochus, Nerita, Ampullaria, Paludina, etc., the ommatophores are entirely separate from the tentacles.

The tentacles are sometimes delicately hairy, and these hairs are evidently tactile also. In the same category of tactile organs must be included the lobes, filiform processes, etc., of the mantle margin, as well as the processes which beset the mantle lobes of Cypræa, which lobes are thrown over the back of the shell so as nearly to cover it. The anterior lobes of the foot existing in many mollusks, as in Buccinum and Harpa for example, may also be regarded as tactile organs.

Sight.

We have already seen that the eyes are variously situated upon or branching from the tentacles in most cases; in others they are sessile or nearly so, upon the head, and situated behind and outside of the tentacular bases. Tentacles and eyes are both wanting in Chiton.

The eyes are spherical, oval, or conical structures, embedded in the skin of the eye-stalk in such a way that the epithelium of the stalk covers them. Externally they are enveloped by a firm laminated membrane (sclerotica) which becomes thinned out anteriorly to a cornea. Internally the sclerotica is covered by a pigment contained in polygonal cells, the Choroidea, which extends forwards to the cornea, and since the cornea does not cover the whole of the external side of the eyeball but only its middle, a dark pigment ring is seen at its border, which might be described as an iris, but cannot be considered equivalent to the same structure in higher animals. In Strombus this iris-like ring exhibits strikingly brilliant colors, yellow, red, and green; often several colors appear in separate rings behind each other, numerous instances of which are figured by Quoy and Gaimard in the Voyage de L'Astrolabe, and used by them as specific characters. In this eyeball, just behind the cornea, the lens is placed, which is nearly spherical and consists of concentric layers. The posterior part of the eyeball is occupied by the so-called vitreous or glassy body which Keferstein regards as a retina.

Hearing.

Souleyet first detected auditory organs in univalves, and Siebold, Krohn, Kölliker, Schmidt, Lucaze-Duthiers and Jhering have so multiplied observations upon this point, that their existance in all prosobranchiates may be considered highly probable.

Two auditory vesicles usually exist, and very generally appear to be sessile upon the pedal ganglia, where they appear as small white points. In the heteropoda, in many nudibranchiata, as shown by Hancock, and in numerous genera of branchio- and pulmo-gasteropoda, which have been carefully examined by Lacaze-Duthiers, however, there seems to be no doubt that the auditory nerves arise from the cerebral ganglia, even though the vesicles may be situated close to the pedal ganglia.*

Within the vesicles are found, in many univalves a single large otolith, whilst in others numerous smaller ones exist, or even, as in the oriental Melania and Melanopsis, a large laminated otolith together with small crystalline ones.† The auditory nerve divides upon the vesicle into a number of branches; and the vesicles are probably connected with the external world by means of an auditory canal; at least such a canal exists (according to Ad. Schmidt) in Helix, and K lliker discovered it in the cephalopods.

Vascular System.

The circulation in mollusca varies greatly as to complexity, according to the higher or lower organization of the animals. In the prosobranchiates (plate 6) the circulation is the most complicated, and yet comparatively to vertebrates, simple. Arteries proceed from the heart to the various organs, where they subdivide and terminate in fine capillary vessels. There are no venous capillaries, and the blood flows freely around the organs in the body. There are valves in the aorta and auricles of the heart which permit the flow of blood only from the auricle to the aorta. From the body cavity the blood flows into veins, some of which conduct to the branchiæ whilst others pass directly to the ventricle of the heart. In some genera the arteries do not all end in capillary vessels, but in a portion of them, and especially in the anterior part of the body these are replaced by

* Huxley, *Anat. Invert.*, 494.

† Hermann von Jhering records the existence of otoliths in Cassis, Cassidaria, Conus, Buccinum, Nassa, Murex brandaris, Fusus Syracusanus, Columbella rustica and Mitra ebenus.—*Sitzungsb. Phys. Med. Soc. Erlangen*, ix, 63, 1877.

lacunæ, as in heteropods and pulmonates, equivalent to both venous and arterial capillaries.

The ventricle is short, conical, with the aorta at its apex with two valves at its origin; and at its opposite blunt end, the rounded auricle, separated by a constriction and like the aorta with two valves at its origin. Sometimes the auricle is divided, a division lying on either side of the heart and receiving each the blood of one branchia. When there are two auricles they surround the rectum, resembling the lamellibranchs in this arrangement.

The auricle always lies in front of the ventricle in the prosobranchiates (as in the pulmonates and heteropods), and therefore the blood flows from before backwards to the heart, whilst in the opisthobranchiates the reverse is the case; and this difference was deemed of sufficient importance by Milne-Edwards to give names to these two orders of branchiferous gasteropods.

In prosobranchiates with spiral shells the heart lies behind and below the apex of the respiratory cavity on the left side of the animal, between the anterior portion of the liver and right border of the kidney. The aorta, which arises from the apex of the ventricle, soon divides into two branches, the aorta visceralis which supplies the posterior and coiled portion of the animal, its liver and sexual organs, and the aorta cephalica which gives off many branches forming a plexus over the stomach, œsophagus, mantle, etc.

Venous capillaries are wanting, as already observed, and the arteries discharge into the body spaces surrounding the œsophagus, the stomach, the hepatic lobes, the intestine. The blood in the mollusca is typically bluish and transparent in color, but red in exceptional cases (not in the prosobranchiata), which will be noted hereafter. By breaking away the shell of a Helix, the circulation of the blood is faintly visible through the thin skin of the body.

Usually there are two large venous sinuses, anterior and posterior, from which venous branches collect the blood into two veins, which finally unite in the branchial artery. The aqueous vascular system of the foot forms an important connection between the venous sinus and the external world. This pedal aqueous system includes a pore on the pedal disc, with direct communication with the body cavity, and ramifies through the pedal mass (pl. 3, fig. 18). It has been observed in Murex, Dolium, Triton, Strombus, Buccinum, and many other genera. In Nerita canrena Delle Chiaje saw the water spirted from a number of holes in the foot.

The statement of the existence of the remarkable communication of the abdominal sinus with the surrounding water was received with little faith, and the subject attracted as little attention, though immediately after Delle Chiaje's discovery, R. E. Von Bär had fully demonstrated its existence in the lamellibranchs, until finally Agassiz made known his weighty confirmatory and thorough observations. In Pyrula carica and P. canaliculata, Agassiz observed a large pore in the pedal disc, which is so large that it will admit a goose-quill, and which is divided into many branches throughout the foot, which open, by means of numerous finer branches, into the abdominal cavity. Agassiz injected carmine or indigo solution through this pedal pore, and it filled not only the pedal canal system, but also the body cavity and, finally, the whole vascular system. Quite similar relations were found by him to exist in Mactra. The water actually mixing with the blood in this manner, Agassiz also showed thereby that the blood was exhaled from the body cavity, salt crystals also being observed, which were derived from the sea-water which had been taken up. It has been known for a long time that univalves when removed from the water allow considerable water to escape from them, which runs out of the foot. Agassiz found numerous blood corpuscles in this water, and there can, therefore, no longer be any doubt that water passes through the pedal pore into the abdominal or body cavity, where it is mixed with the blood.*

* On the other hand, the researches of Mr. Wedl have led him to announce the existence in the mollusca of a completely closed vascular system, with capillary networks in the greater part of the organs. The type of distribution of these is extremely variable, and intimately connected with the structure. It is thus that in the Murices the skin of the trunk and of the back is formed of several superposed layers of muscular fibres, crossed in different directions, and that several networks of blood vessels are likewise superposed in these parts. The vascular networks are superposed in the same manner in the foot of these Ctenobranchs. In no part of the skin is there any communication between the veins and the exterior ; nor do the veins appear to communicate with the aquiferous vessels. M. Wedl, however, has not been able to determine whether these

Many univalves have such an extraordinarily large foot (Cymba neptunis, Buccinum lævissimum, Harpa, Natica, Sigaretus, etc.) that it often exceeds the volume of the shell many times when fully expanded; and it has long been cause for conjecture how this mass was retracted into the shell. By the discovery of the water-vascular system and its connection with the body cavity the mode in which the foot is retracted becomes clear, since the foot is filled with water in the same way as a sponge, which escapes again when it is retracted so that the increase of the mass of the foot is due to the water it has sucked up. Delle Chiaje already understood the relation of the water-vascular system to this process, though upon the whole he ascribed a respiratory function to the water which entered the body cavity. Osler also attributes the enlargement of the foot in Buccinum to the water absorbed by the water-vascular system, well known to him. Agassiz introduced quite decisive experiments upon this point. He placed a large Natica heros with the foot retracted, in a glass vessel of water full to the level of the brim, and when the animal gradually produced its enormous foot not a drop of water was spilled from the vessel. He performed similar experiments upon many univalves and lamellibranchs in graduated glass tubes and in all movements and variations in the size of the foot there never was the slightest difference to be detected in the water-level.

Respiration.

The branchiæ in prosobranchiates are small, leaf-like, hollow prolongations of the mantle, placed in rows behind each other, and are usually contained in a pouch on the dorsal side of the animal, forming the respiratory cavity. In some opisthobranchiates the gills are lodged at the sides of the body between the narrow, collar-like mantle and the broad foot: such is the position of the filamentous branchiæ of Patella and the laminated gills of Chiton. In the spiral species the right branchia only is well developed, that on the left side being small and rudimentary; sometimes, however, as in Turbo and Phasianella, the two gills

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last open directly into the previsceral cavity, or whether they are distributed only in the foot.—*Sitzungsb. Akad. Wiss. Wien*, ii, 1868. *Ann. Mag. Nat. Hist.*, 4 ser., IV, 365.

are brought close together, so as to appear almost as one. In the non-spiral shells, Fissurella, Parmophorus, and in Haliotis the gills are symmetrical and both well developed.

The form of the depressed respiratory cavity is triangular, in the hinder angles of which the heart and kidney are placed. At the same place also the rectum enters and passes forwards on its right side. At the left side of the same, but attached to its angles, the gills are placed, with the laminæ free and extending into the cavity simple or double, with their basal position in relation with the heart.

On the floor of the cavity, at the right side, by the rectum, lies the vagina or the ciliated furrow of the seminal passage and between these sexual organs and the rectum there is frequently pushed the tubular, inflated, excretory duct of the kidney; above on the rectum sometimes lies the prolonged anal gland with its opening in front of the anus, so that the openings of the anus, anal glands, kidney and sexual organs are arranged close together in the above order from without inwards at the right anterior side of the cavity. The covering of the respiratory cavity between the intestine and branchiæ is embraced by the frequently large mucus gland, and between it and the intestine there is frequently a special color gland. (Purpura, Murex.)

The respiratory cavity has its external opening on the left side of the body, under the mantle border, which is here contracted to form a rounded hole. Sometimes the walls of this opening are produced into a canal or siphon, and this difference is one of much importance, being co-extensive, with important modifications of the shell, and (excepting Natica) with difference of food. Thus the Siphonostomata, as already stated, have the shell terminating in a notch or canal below, and are carnivorous, whilst the animals with a sessile respiratory opening belong to the Holostomata, the shells with rounded apertures, and (with the exception of Natica) vegetable feeders. In some of the Murices the canal of the shell is very long, but where the canal is short or the aperture simply notched below, it by no means follows that the siphon is short; on the contrary, in Cassis and Dolium it attains an extraordinary length, and is reflected over the back of the shell, so that the borders of its wall become dorsal.

6

Organs of Secretion.

We may consider under this head the kidney, mucus gland, purple gland and anal gland :—all special organs situated in the respiratory cavity or opening into it.

The kidney is a large, hollow, glandular mass at the base of the respiratory cavity, close to or sometimes perforated (Triton) by the rectum. It contains a fluid having a whitish or brownish appearance, filled with hard granules, and in which Jacobson first detected the presence of uric acid, ammoniac and salts of lime.

If the kidney is cut open the internal cavity is observed, which is, however, much narrowed by numerous thick, spongy, crimped annular folds or meshes, which clothe it internally. The spongy walls, the surface of which, because of the folds is much increased, are covered with round cells, which excrete the urinary products. At the wall of the cells, at least in the youngest ones, there is always a distinct nucleus and its contents consist sometimes of a yellowish or greenish fluid, and within are concentrically laminated urinary concretions. By bursting, these secretory cells allow the urinary concretions to escape into the water in the kidney.

Externally, the kidney is spun over by a very thick and strong vascular network of the venous system. This vascular network has several openings into the kidney, through which the urinary products are mingled with the blood ; and, consequently, when these are examined microscopically, they are found to contain, besides renal cells and free concretions, a considerable number of blood corpuscles.

Usually the kidney opens into the base of the respiratory cavity by means of a transverse, slit-like opening, encircled by a strong sphincter muscle (Triton, Dolium, Cassis, Murex, Littorina, Natica, etc.) ; sometimes, however, it has a gut-like, efferent duct, a ureter, which passes forward between the rectum and sexual canal, opening outwards not far behind the anus (Paludina, Turbo, Voluta, Conus). There are accordingly three efferent canals alongside of each other at the right side of the respiratory cavity, viz., the rectum, ureter, vagina or vas deferens. The ureter is usually a somewhat dilated canal and is not simply a prolongation of the kidney, but is often separated from the latter by a diaphragm perforated by a number of holes which are encircled by muscular fibres. Within, a number of longitudinal folds are to be observed, and it is covered throughout with ciliated epithelium. The ureter is usually filled with water and it is possible that it may have some other significance than a mere efferent duct.

The mucus gland lies in the middle portion of the cover of the respiratory cavity in most prosobranchiates; its tough secretion is discharged through the respiratory opening in extraordinary quantity, especially when the animal is handled.

The purple gland accompanies or is a modification of the mucus gland. It is only found in a portion of the prosobranchiates; among them, both the typical Muricidæ and the Purpuridæ. The peculiarity of the fluid secreted by this gland is, that originally colorless or yellowish, a short exposure to sunlight changes it to a brilliant violet or reddish color, at the same time giving off a very penetrating fetid odor. The cause of this photographic change of color is unknown, but the knowledge of it came to mankind in very early ages, and Tyrian purple was the most highly prized and most beautiful dye known to the ancients.*

Pliny states that in his time the purple dye was obtained from the Buccinum and the Purpura. The mollusk now known as Murex trunculus is generally supposed to have been that principally used by the ancients in obtaining the Tyrian purple. It is related that the discovery of the dye is due to the dog of a Tyrian nymph, which crushing some of these shells in its teeth, its mouth became stained with purple. It is possible that the fragile Ianthina may have been thus crushed, but the shells of the Muricidæ would resist the dog's teeth. To be exact, this event occurred 1500 B. C. The color was so beautiful that the fair nymph expressed to her lover, Hercules, her desire to have a robe of similar hue. Hercules, of course, gratified her. It is evident that

* See Lucaze-Duthiers' (*Ann. Sc. Nat.*, xii, 5, 1859) exhaustive "Mémoire sur la Pourpre," an exceedingly interesting paper, illustrated by specimens of the color resulting from various applications of the dyes obtained from Murices, Purpuras, etc. See also *Smithsonian Report*, 1863; *Lovell's Edible Mollusks*, p. 124; *Grimaud de Caux, Rev. et Mag. Zool.*, 34, 1856.

the product of two different species was mixed in order to produce the finest color, as Pliny gives the proportion of 200 pounds of juice of "Buccinum," and 111 pounds of that of "Pelagia" as suitable for obtaining a beautiful amethyst color, sufficient for 50 pounds of wool. The extent of the Tyrian industry is visible in numerous holes in the rocks, two to three feet deep, containing the breccia of shells anciently crushed in them for the extraction of the dye. The arms of the city as preserved on its medals was the purpura shell, and in the time of Strabo the multiplicity of dye-works unpleasantly affected the air of the vicinity. The Romans used various species in great quantity for dyeing purposes, and the remains of Murices form vast heaps; indeed, in one case, at Tarento, the mass is so large as to have received the name of "Monte Testaceo."

The color was prepared by pounding up small specimens, or by breaking the shells of larger ones and extracting the purple gland. This fluid was mixed with five or six times its weight of water, with twenty ounces of soda to every hundred pounds. Placed in lead or tin vessels the mixture was exposed to the sun for several days, until the hue desired was obtained, when the wool was simply plunged into it and allowed to remain for a few hours. Under Augustus the dyed wool brought as much as $200 per pound.

The Indians of the new world also understood the art of purple dyeing from shell-fish, and it is probable that all ancient peoples inhabiting seashores have become accidentally acquainted with this property, common to so many mollusks, at a very early date. The Roman law prohibiting the use of purple garments to any but the imperial family, was a deathblow to this industry, which thenceforth rapidly declined. During the middle ages the very existence of such a dye was considered fabulous; but with the revival of the arts and civilization its properties were rediscovered, and for awhile successfully utilized. Chemistry has now supplied us with even more brilliant colors, whilst saving much of the cost of procuring material.

The anal gland accompanies the purple gland in Murex and Purpura and has not been discovered in other mollusks. It lies on the left side of the rectum and consists of a central canal with lateral branches having a dendritic appearance. It opens on the edge of the anus, and by pressure its brownish contents may be made to issue. The function of this, as well as of the purple gland is unknown.

Sexual Organs.

The sexes are distinct in the prosobranchiates: the organs are, however, very simple and so alike in structure, that frequently the sex of the gland can only be determined by microscopical examination. Usually a germ-secreting gland is imbedded in the liver, from which an efferent duct opens at the right side into the mantle cavity. In most cases the males may be readily distinguished by the large penis, which is placed at the right side of the head behind the eyes. The shell in the female is generally more inflated than in the male.

Female Organs. (pl. 3, fig. 19.) The ovary discharges into a much looped oviduct and the latter dilates into a gut-like uterus—the last portion of which, on account of its muscular wall may be regarded as a vagina. There is sometimes at the commencement of the uterus, or at its connection with the vagina, a seminal pouch, but other appendicular organs are seldom present.

The last portion of the uterus or even the whole of it, and the vagina lie in the respiratory cavity, to the left by the side of the rectum and nearest to the abdominal wall. The sexual opening is accordingly found to the left of the anus, but usually far behind it. Sometimes the uterus is split throughout its entire length and its folds formed by the longitudinal and transverse plaits, consequently lie freely exposed in the respiratory cavity. Lacaze-Duthiers has so described it in Vermetus.

There is scarcely anything to be said in regard to the eggs of the prosobranchiates, generally. Where their development can be seen, a distinct germinal vesicle and germinative dot are present; but when they leave the ovarium the yolk granules are present in such numbers as to conceal the before-mentioned structure. In the oviduct, or quite above the uterus, the eggs come into contact with the zoösperms, which are occasionally retained at this point in a spermatheca. Further down in the uterus fertilization could no longer be effected as it here becomes enclosed in a tough albumen, and finally is covered, usually many together with a firm capsule. These egg-capsules, in their various shapes, will be described in the discussion of the development of the animals.

Male Organs. These are simpler than those of the female (pl. 3, fig. 18, 20): the efferent canal is not divided into so many succeeding portions, but instead a copulatory organ (penis) is placed anteriorly, the structural peculiarities of which present much that is noteworthy.

The sperm gland or testicle lies embedded in the liver in the same way as the ovarium usually, only on the right side, as a flocky mass which has a greater tendency to embrace the liver than to crowd it away. Sometimes however, it is a compact mass, and in Paludina it is divided into but two lobes, a larger anterior and a smaller posterior one. But in most cases the testicle is a much expanded and divided, flocky looking, whitish mass, which like the ovarium presents an acinose structure. The efferent ducts of the simple lobes and lobules then collect together on the right side of the body into the vas deferens.

The single testicular lobules consist of a structureless tunica propria and an internal epithelium of rounded cells, in which the zoösperms are developed. In all cases where the mode of development can be followed, the contents of the epithelial cells divide into daughter-cells, in which, after the development and growth of a nucleus and the disappearance of the cell-wall, the spermatozoa are developed. The zoösperms are filiform and pointed at both ends in the spiral prosobranchs, but in Patella, Chiton and Haliotis the anterior end is a rounded head.

The vas deferens passes from the testicle along the columellar side of the animal into the mantle cavity, and through the latter into the penis on the right side of the body, behind the eyes. This duct is formed externally by a strong muscular layer, and clothed within with a ciliated epithelium: it is usually dilated and coiled at its commencement.

A penis is wanting in the Trochoidea and Scutibranchiates of Cuvier, and the male sexual opening is here placed just as in the female, immediately behind and to the left of the anus. The penis is an outgrowth from the body wall, and is not evertible and retractile in the prosobranchiates as in the pulmonates, though having at times a cavity within. It is a fleshy, often very long and thick appendage usually bent in a sigmoid form, and can be bent back under the mantle and thus be hidden.

The penis is either hollow, in which case the vas deferens proceeds to it as a closed canal passing through it to its extremity, where it opens upon a small papilla as in Buccinum, or it opens simply as in Littorina, Oliva, Onchidiopsis; or, in other cases it is a solid body upon which the vas deferens passes along in the form of a ciliated furrow continued upon it as a deep groove to its extremity, as in Triton, Dolium, Cassis, Harpa, Voluta, Terebra, Strombus, Cypræa, etc. This last and most common form of penis presents many varieties; in Cassis, for example, it is pointed anteriorly, in Dolium it is enlarged anteriorly, in certain species of Strombus it has a small appendage upon the posterior side, and in Natica it presents at the end a whip-like (flagelliform), in Dolium a claw-like appendage. Usually there are large sack-like glands, which are placed on large pointed papillæ near the base of the penis; they appear therefore as a row of tubercles or processes, as in Littorina, Cassis, and Terebra, these glands are placed upon special finger-like outgrowths of the penis.

Development.

The eggs come in contact with the spermatozoa and are fertilized in the oviduct or at the commencement of the uterus. The eggs consist of a dark granular yolk; a germinal vesicle and one or more germinative dots, enveloped by a thin vitelline membrane. How the zoösperms penetrate this membrane is unknown; but they are introduced into the female tract by an act of copulation in the bulk of the spiral prosobranchs, which possess a penis: in the Trochoidea, Scutibranchs and Cyclobranchs, however, the copulatory organ is wanting, and probably the spermatozoa discharged into the surrounding water by the male, are thence taken into the uterus. Of course the *attached* genera like Vermetus and Siliquaria, and including also Magilus and Rhizochilus in the Purpurinæ cannot possibly fertilize in any other way.

Very few prosobranchiates are viviparous. The eggs are usually enclosed, a number together, in tough leathery capsules, within which they undergo their larval stage of development. These capsules are variously aggregated, according to the genera.

Littorina deposits its eggs in gelatinous masses, and the outer portion of the albumen of each egg hardens into a sort of shell; but ordinarily an egg capsule is formed, and then the separate ova do not possess shells, but the capsule encloses a mass of albumen which is common to all the ova within it—sometimes several hundred. In this albumen the larvæ move about before leaving the capsule for the outer world.

The capsules are variously shaped and aggregated, and were formerly mistaken for and described and figured as zoophytes. It will assist us in our survey of their forms to present the classification of these bodies which was proposed by the celebrated Danish zoologist, A. Lund, based on their form and grouping, and in which almost all the variations are characterized.

First Class.

Masses of capsules irregular. The egg-capsules by their union form irregular masses.

First Order. The egg-capsules are attached to each other. (*Capsulæ cohærentes*).

1. The capsules open by a cleft.
2. The capsules open by a round hole closed by a round operculum or lid.

Second Order. The egg-capsules are attached to a common membrane, which is attached to some foreign body, and are separated from each other.

1. The capsules open by a cleft.
2. The capsules open by a round hole, which is closed by a lid.
   a. The capsules are sessile upon the basal membranes. (*Sessiles.*)

α. *Tubiformes.*

b. The capsules are pedunculate, connected to the basal membrane by a stalk. (*Petiolatæ.*)

α. *Oviformes.*
β. *Cyathiformes.*
γ. *Infundibuliformes.*

Second Class.

Masses of capsules regular. The egg-capsules by their union form regular masses.

First Order. The egg-capsules are attached to each other. (*Capsulæ cohærentes.*)

Second Order. The egg-capsules are attached to a common basis. (*Capsulæ adhærentes.*)

a. The capsules are attached around an axis.
b. The capsules are attached longitudinally on one side of an axis.

α. *Sessiles.*
β. *Petiolatæ.*

I will not here dwell upon the particular form of egg-capsules produced by each prosobranchiate genus, because I shall illustrate as many of these as possible in connection with the various monographies which will be hereafter presented. In the present volume I figure only those belonging to the genera which are herein discussed, and for convenience of comparison they are grouped together. How these bodies are developed is still a mystery. (Pl. 7.)

We will now rapidly sketch the developmental history of the major portion of the prosobranchiates, illustrated by figures of the common Buccinum undatum and Purpura lapillus. (Pl. 8.)

The transformation of the egg into the embryo is preceded by division of the yolk mass into blastomeres (cells), which begins immediately after fertilization and is speedily completed. The yolk assumes the appearance of a cluster of round nucleated cells, the large ones internal, the smaller external; forming the embryo—except a portion which remains as nutritive material. The yolk first loses its spherical form, elongates somewhat, develops upon its entire surface a delicate ciliary covering, and begins its wonderful rotary movement. At the anterior part of the body a circlet or crown of long cilia arises; the portion of the body supporting this is then elevated into a ridge, then a ring, and finally it develops on each side into a rounded lobe. Both lobes together present somewhat the appearance of the figure 8: these are the vela which Forskäl had already described as the organs of locomotion of the univalve molluscan larva. Immediately below the velum the mouth is developed as an invagination; at the posterior end the anus is similarly formed; both open into the intestinal cavity which has been formed by the displacement of the large yolk cells in the centre. An intestinal is now present, and the large cells which are somewhat heaped up posteriorly, become in large part the liver and intestinal wall. A body-cavity between this large-celled intestinal wall and the small-celled body wall is not yet present, and originates later by a separation of the two walls and the appearance of a fluid between them.

Below the mouth the foot arises as a blunt ciliated appendage, whilst the ciliated covering of the rest of the body has become lost. The velum, that at first surrounded the fore-part of the body is more elevated to the dorsal side after the appearance of the mouth, since the mouth is not placed in the middle of the velum, but beneath its narrow portion, and is dorsally overhung by the velum, whilst ventrally the foot extends beyond it. The body becomes more elongate, and soon at its posterior dorsal portion the delicate, hyaline, cup-like shell appears, in which also a distinct laminated structure may be detected; at the posterior part of the foot the operculum appears at the same time. The sense organs are now developed; at each side in the velum the tentacle arises as a papilla; internally by the side of the œsophagus the auditory vesicles arise, the otoliths then appear therein; and immediately thereafter, or at the same time, alongside of the tentacles the eyes are formed, which, at first, like the organs of hearing are vesicles, lined with cilia internally, the lens appearing later. The central portions of the nervous system, the ganglia around the œsophagus, now become visible. Along the border of the shell the body wall is raised into a ridge, the beginning of the mantle, and, as the shell grows farther forward, the intestine in most prosobranchiates (not in Chiton), instead of terminating posteriorly, begins to be pushed forwards, so that the anus is likewise advanced with the border of the shell to the right side of the body.

The pharynx now appears as a distinct portion of the animal and within it, the different parts of the lingual membrane may be distinguished as the middle, inter, and lateral plates, and according to Troschel's observation, the genus to which the larva belongs may be already determined by the teeth. One may already notice the commencement or the spiral winding of the shell, and within it is contained one loop of the intestine and many large cells or yolk-spheres, which become the liver.

As soon as the anus commences to be pushed forwards and the intestine becomes a distinct canal, the body cavity begins to appear with blood in it. There is as yet nothing to be seen of the heart, and the circulation of the blood is effected by the contraction and dilatation of the hollow foot, or often by means of an elevation on the neck, consisting of a meshwork of fibres, the cervical vesicle. By means of the heart, as soon as it is developed, the fluid in the body-cavity, the blood, is put into motion, but often, as in Paludina, this circulation is assisted, and probably more effectively, by the contraction and dilatation of the foot.

At this stage the larvæ mostly leave the albumen of the egg-corpuscles, in which, up to this time, they have been enclosed, and swim freely about by means of their velum. Finally, the mantle cavity is formed; the mantle, heretofore simply a ridge around the front of the shell, now extends itself from the body as a fold and covers, with the shell, the mantle or respiratory cavity, in the base of which, a contractile structure—the heart—may soon be observed. The foot is developed still further, the velum, the only exclusively larval organ, slowly disappears, the tentacles are prolonged and in this way the swimming larva slowly becomes the creeping animal—of which the various organs finally attain maturity.

Prof. W. B. Carpenter has observed* that whilst a capsule of Purpura lapillus contains from 500 to 600 vitelline bodies, nevertheless only from 12 to 30 embryos are produced, each of these having from 20 to 30 times the bulk of the ovum from which it sprang; so that the material contained in the original mass of eggs is evidently appropriated by the comparatively few embryos which are thus developed at its expense. Prof. Carpenter examined a large quantity of capsules, in which a considerable number of small, free embryos presented themselves before the conglomeration of the great mass of the ova, so that he could not doubt they were generated independently of it. The embryos soon attach themselves to the conglomerate yolk-mass, and by the action of their cilia, the small segments of which it is composed are driven down into their interior, which is soon distended by them. The bodies which coalesce after segmentation, Prof. Carpenter regards as imperfectly fertilized ova, and they evidently supplement the insufficient supply of nutriment contained in the yolk-sack of each developing embryo. A similar consumption of a portion of the ova takes place in Buccinum and Nassa and very probably in a large portion of the prosobranchiates.

Before dismissing the subject of development, we must refer briefly to the temporary larval existence through which a por-

* *Rept. Brit. Assoc.*, 108, 1854.

tion of the prosobranchiates pass after exclusion from the egg-capsule. Generally, the shell and operculum developed within the capsule are retained by the animal, forming simply the nucleus of the adult structure, but in a few cases it has been discovered that a temporary shell and operculum are provided, which are eventually lost. Animals in this larval condition were formerly described as distinct genera of pelagic gasteropods, until Krohn, and after him Macdonald,* showed their true relationship; in this the lingual dentition became an important agent to indicate the connection with adult forms. Krohn discovered at Messina a curious mollusk which he called Echinospira (pl. 8, figs. 103–105), and which proved to be the larval state of Marsenia conspicua. He found the nucleus of the permanent shell to be developed within the spiny nautiloid larval shell, and that the latter was eventually cast off. I figure some other pelagic larval mollusks: Macgillivraya, which is the larva of Dolium (pl. 8, figs. 99, 100), and Cheletropis = Sinusigera which, on account of its dentition is referred to the Muricidæ (pl. 8, figs. 181, 102).† In all the egg-capsules of Muricinæ which I have examined the contained shells are miniatures of the adults. Mr. Arthur Adams has referred a Cheletropis to Purpura biserialis, and it is just possible that the species belongs to the Purpurinæ. Investigations of the transformations of free swimming larvæ are made with difficulty, and it will probably be many years before we shall have acquired a sufficient body of facts to understand the conditions under which a portion only of the prosobranchiates undergo this larval transformation after exclusion, whilst in most of the genera the newborn mollusk is the epitome of the adult.

Distribution in Time and Space.

I shall only recall some main facts here, and that very briefly, because the subject is properly larger than my present limits: that is, it can be more advantageously treated with reference to the whole molluscan sub-kingdom. On the other hand, peculiari-

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* Macdonald, On Metamorphosis of Mollusca, *Linn. Trans.*. xxii, 241; xxiii, 69.

† Chiropteron semilunare, Sars (*Beskriv. og Jagtta gelser*), t. 14, f. 38, 1835), is probably the larva of Aporrhais. *Mörch Ann. Mag. N. Hist.*, 3d Ser., xvi, 78, 1865.

ties of habit and of distribution characteristic of particular groups will find place in the volumes wherein they will be described.

Whilst the prosobranchiates are typically marine animals, there are many exceptions to the rule; for not only do we find a certain number of genera inhabiting brackish water, but some live in fresh water only; and others again, are terrestrial. It is not without modification of the breathing organs that such diversity of station exists, and this modification is co-existant with other adaptations.

Whilst the pulmoniferous mollusks have no operculum, the terrestrial and fluviatile sections of the prosobranchiates are provided with a very efficient one, completely closing the aperture of the shell. The canaliculate aperture of the shell, the operculum too small to fill its aperture, and, frequently, the want of an operculum are characteristic of the major portion of the prosobranchiates—the marine zoophaga, whilst the rounded aperture, and its efficient operculum belong to the phytophagous mollusks. In going over the groups of marine prosobranchiates another general law appears to coexist with the foregoing divisions, namely, that the zoophaga are the most active, and are deep-sea animals, whilst the phytophaga are necessarily more confined to shallow water, between tides, etc., where their food is more readily obtainable. Some of the zoophaga prefer a rocky station, whilst others affect sandy or muddy bottoms; the little genus Stylifer is parasitic upon echini, etc., immersed in which it dwells, and some other genera habitually seek special stations, as Pedicularia and Magilus upon corals, certain Vermetidæ upon other shells, etc. On the other hand, numerous animals dwell upon and within the substance of the shells of univalve mollusca, including sponges, worms, corals, molluscoids, etc., not to mention many of the true mollusca, and especially bivalve species.

The influence of structure and habit, of temperature, the chemical composition of the sea-water, etc., upon the actual geographical and bathymetrical distribution of the species, and the presentation of the resultant faunal regions, as already stated must be reserved for a future occasion. I purpose, in describing the species to note all facts of this nature that have been heretofore recorded, as a contribution towards generalizations, which, already become interesting and important, will increase in usefulness according to the correctness and extent of our knowledge of the data from which they are derived.

In the same manner, the geological history of each genus and species being carefully noted, we postpone to a concluding volume certain geological considerations which properly include the whole of the mollusca, rather than particular groups.

It may not be out of place to recall the observation of Dillwyn that the shells of carnivorous gasteropods, almost wanting in palæozoic and secondary periods were then replaced in the economy of nature by the almost extinct order of tetratranchiate cephalopods.*

Bronn has prepared the following synoptical table of the number of genera and species of prosobranchiates occurring in each formation; aggregating 7123 species: it would be largely increased, but its relative proportions probably not much changed, by the incorporation of material since made known to science.

PALÆZOIC. 737 species. 57 genera.	Silurian,	164	species,	11	Genera.
	Devonian,	244	"	20	"
	Carboniferous,	312	"	26	"
	Permian,	17	"		
SECONDARY. 1764 species. 166 genera.	Triassic,	393	"	36	"
	Jurassic,	488	"	56	"
	Cretaceous,	883	"	74	"
TERTIARY.		4622	"	179	"

The relations of the tertiary with the recent mollusca are daily appearing to be more intimate. It is probable that a very considerable proportion of its species will be found to be synonymous with existing forms, and that the juster and more comprehensive views of nature which have now obtained (and which are the happy result of the development theory—whatever may be said of the truth of its ultimate conclusions), will enable us to make proper allowances for influences producing variation in fossils as we do in recent species. Time has not been the only factor: as many of our so-called extinct species are obtained from particular local deposits, their characteristics are frequently more local and varietal than specific. Hundreds of cases might be cited of variations from a known specific type of recent mol-

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* *This work*, vol. i, p. 48, where is also a table of the number of genera of mollusca belonging to each geological period.

lusks, where the differences are much greater than those which palæontologists, seeking distinctive characters for their periods or formations, have been accustomed to consider as of specific and even generic value. It is not many years since some of the best palæontologists held, and actively worked upon, the opinion that each principal geological period closed with a cataclysm involving the destruction of all life, and a subsequent re-creation; and many hundreds of species derive their only title to validity from this hypothesis. It is no reproach to able and honest palæontologists that they have in this manner gone estray; nor have they erred more unfortunately than some conchologists, who have not hesitated to describe as new identical forms of recent mollusca, simply because they occupy different geographical areas. How many identical species have been described under different names when occurring on the opposite coasts of Central America, under the belief that, however similar they could not have a common origin? an error thoroughly dispelled by the researches of Gabb and others upon the geology and palæontology of Central America and the Caribbean area.

Bronn has also prepared a table of the number of species of each genus of prosobranchiates appearing in the various formations, with the totals of species, fossil and recent appertaining to each. As in his table just quoted, much allowance must be made for actual and relative increase of species made known since his publication. The Genera are within the Lamarckian limits, and those with which we are at present occupied will be found near the bottom of the table.

Number of Species.

	Silur.	Devon.	Carb.	Perm.	Triassic.	Juras.	Cret.	Tertiary.	Total fossil.	Recent species.	Total Species, fossil & recent.
CHITON		18		1	1			11	31	200	231
PATELLA	6	19	1		2	16	10	38	98	100	198
FISSURELLA		2					5	23	30	84	114
EMARGINULA						4	7	23	34	26	60
CAPULUS	1	10			1			12	24	7	31
PILEOPSIS	2	9					4	23	40		40
CREPIDULA								16	16	40	56
CALYPTRÆA								11	11	50	61
SIGARETUS		3						12	15	26	41
NATICA	5	20		1	6	23	56	88	230	100	330
NERITA	3	8				7	2	30	52	120	172
NERITINA		1				1		30	34	100	134
AVELLANA							13		13		13
NERINÆA						56	46		92		92
TURBONILLA		9		1				22	32		32
LOXONEMA	2	20		1					23		23
MACROCHEILUS	1	14	1	1					17		17
SCALARIA		1				1	18	80	100	100	200
TURRITELLA	4	29	4	1	6	17	71	107	296	30	326
PHASIANELLA		5			1	2	9	11	29	22	51
LITTORINA	1	2	2			3	8	15	31	60	91
TURBO	18	32	1	2	8	50	58	57	264	75	339
DELPHINULA		2				7	4	36	55	30	85
EUOMPHALUS	28	60				2			90		90
SOLARIUM						2	34	65	102	25	127
ROTELLA		4				4	1	4	15	10	25
PHORUS							3	14	17	7	24
TROCHUS	5	21	1	3	1	66	51	178	362	160	522
MURCHISONIA	18	30		1					48		48
SCHIZOSTOMA	4	13							17		17
PLEUROTOMARIA	28	128		5	1	41	63	2	310	2	312
CIRRUS		2	1			7	1		14		14
CERITHIUM		1	1				36	327	367	90	457
ROSTELLARIA					4	14	60	16	94	6	100
PTEROCERAS						11	17		27	10	37
STROMBUS							5	31	36	70	106
MUREX						5	13	179	187	210	397
FUSUS		1			1	7	53	290	357	100	457
PYRULA	1	2					17	36	56	40	96
PLEUROTOMA							6	344	350	370	720
FASCIOLARIA							2	32	34	15	49
CASSIS						1		35	36	35	71
BUCCINUM		7	3		1	15	5	142	173	100	273
TEREBRA						5	2	30	37	110	147
VOLUTA							13	93	106	70	176
MITRA							2	110	112	350	462
OLIVA								32	32	120	152
CYPRÆA							3	79	92	160	242
CONUS							3	89	92	270	362
Total	127	473	15	17	33	367	701	2783	4516	3500	8016

Classification.

The following rapid sketch of the history of the modern classification of mollusks and exposition of the system, based principally on the lingual armature of the gasteropods, is translated and condensed from a paper by the late Prof. Mörch, published in the *Journal de Conchyliologie* (xv, 232, 1867).

Ancient authors classified shells according to external forms, from which they derived generic names. Linnæus was the first to introduce characters independent of the form of the shell: as the teeth and ligament in bivalves, plications and sulcations in univalves. By these characters Voluta and Turbinella were separated from Murex, Buccinum, etc.

Linnæus classed the species of each genus, according to the height of the spire, in analogous sections, of which the most were adopted by Bruguiere as distinct genera. Thus the following genera were terminated by a section "turrita," Bulla by Achatina; Buccinum by Terebra; Strombus by Potamides and Pirena; Murex by the spiny Cerithiæ; Trochus by Telescopium and Pyramidella; Turbo by Turritella; Helix by Melania and Lymnæa.

Linnæus was the first to take the form of the animal into consideration as a generic character; but he indicated only five different types of animals, namely: Doris, Limax, Tethys, Sepia, and Ascidia. Thus the animal of Chiton is a Doris, that of Argonauta a Sepia: bivalves with simple mantle are Ascidiæ (Solen, Mya, Pholas) and those with fringed mantle Tethys. Nearly all the univalves are called Limax.

Adanson must be regarded as the founder of Malacology, but the number of mollusca known in his time was too few to permit the elimination of the principal systematic divisions. He was also the first to take into consideration the operculum and the shell structure as characters, and to divide the bivalves according to the number of muscular impressions.

The system of Cuvier, based on the respiratory organs, induced a great reform in Conchology. The shells of pulmonate mollusks, heretofore dispersed by all authors, with the exception of Adanson, among the pectinibranchs, were assembled in one group, which still remains intact. Although it may be difficult to indicate by a description the difference which exists between the shell of a pulmonate and that of a branchiate mollusk, there are, nevertheless, few collectors who will not recognize it at sight. Ancient authors, like Lister, Müller, Chemnitz and Schröter, who have treated upon the terrestrial and fluviatile mollusks specially, have rarely mistaken these shells; and a mistake of this nature is very rare among modern authors, although a few instances might be cited. One can say only that the shells of terrestrial pulmonates are inoperculate, with entire apertures (holostomate), never nacreous, rarely spirally striated; but one cannot give a single character expressible by words, notwithstanding that all who have seen a certain number of species can distinguish them with facility. The fluviatile mollusks, nearly always unicolored, although they may resemble marine groups as to form, can also be readily separated at a glance.

Ferrussac and several modern authors have thought that all mollusks inhabiting dry land respire by the aid of a pulmonary sack, but nothing is less certain. Among branchiferous genera, the Littorinas and many trophical Neritinæ, live a long while out of water. Tbe larvæ of Auricula swim in the sea, and consequently possess a branchial respiration during this period of their life. According to Semper, Ampullaria has an accessory pulmonary sack. If the inoperculate pulmonates are considered, with so much reason, as an incontestible group, it is because, apart from their pulmonary sack, they possess other collateral characters of equal importance, as for example, the position of the eyes, the organization of the mouth and of the sexual organs.

The rest of the gasteropods, after the exclusion of the pulmonates, were divided by Cuvier into several very natural groups, according to the form and position of the branchiæ (nudibranchs, heteropods, tectibranchs, scutibranchs, cyclobranchs). The magnificent work of Quoy and Gaimard is full of precious material for the amelioration of the great group of pectinibranchiates. The Trochidæ are here shown to be inseparable by their characters, as much external as internal, from Haliotis and other scutibranchs, notwithstanding the presence of an operculum and an elevated spire in the former. At the same time the great systematic value of the nacre was proved. Stomatella, with an animal similar to the Trochidæ, has a nacreous interior, whilst Sigaretus, with a non-nacreous shell, has an animal like Natica. The relations between the enamel of the shells of Cypræa, Oliva and Natica, and the structure of the animal were shown for the first time by the same work. As it has become evident to me that the presence of an operculum and the height of the spire, considered heretofore as prime characters, have, in reality, little value in distinguishing the families, I have sought to divine the natural affinities of mollusks according to the sculpture and structure of their shells.

In 1847 Lovén published four plates of lingual dentition, representing 94 species of cephalous mollusks. The first glance at these plates suffices to show clearly that the lingual armature confirms the most of the ancient divisions. Thus, the Cephalopods, Pteropods, Heteropods, Scutibranchs (in the sense of Quoy and Gaimard, including the Trochidæ), are also distinguished by the teeth. The conchological analogy between Pleurotoma and Conus had already been shown by Sowerby. There existed, nevertheless, certain anomalies until then inexplicable, on account of the small number of observations made, as for example, the analogy between Philine and Scaphander and the Gymnobranchs. The want of teeth must not be considered as fatal to the systematic value of characters found in these organs. The teeth accepted as an exclusive character have, doubtless, inconveniences, as in the whole animal kingdom, but it cannot be denied that all other organs taken as exclusive characters offer still greater inconveniences. Thus the shell may be wanting in very similar animals (for example, Notarchus, Aplysia; Pterotrachea, Cardiopoda; Limax, Tebennophorus). The operculum is often wanting in the adult, although the young may have it. There are even operculated and inoperculated species in the same genus, as understood by many modern authors (for example, Pleurotoma and Bela, Oliva and Olivella, Yetus, Voluta and Lyria, Spirialis and Limacina, Proserpina and Helicina). The organs of respiration and locomotion may be entirely wanting in closely related species (Firoloidea and Phyllirhoë).

Lovén has characterized the families according to the teeth, and has given Latin diagnoses. In 1848 Troschel* mentions the

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* *Handbook of Zoology.*

teeth as characters of all his sub-orders, and introduces into the nomenclature, for the first time, several new names taken from the form of the teeth. Thus the section *H.* of Lovén is called Rhipidoglossa, including the Scutibranchs, that is to say, Neritidæ, Trochidæ, Haliotidæ and Fissurellidæ. For the section *L.* of Lovén he proposed the term Toxoglossa. Tænioglossa corresponds to the Ctenobranchous Gasteropods, having seven rows of teeth (3. 1. 3.), excepting the operculate pulmonates, although they may have the same form of teeth. Thus Cyclostoma is placed in another sub-order from Valvata and Paludina. The Heteropods, which have the same general disposition of the teeth as Tænioglossa, are regarded as an order, with the same value as the Gasteropods—an opinion still maintained by this author.

In 1853, Dr. Gray, in adopting the names of Prof. Troschel, proposed several new groups, according to the form of the teeth.*

1. Hamiglossa. Three ranges of teeth (1. 1. 1.), the lateral versatile. This last character appears to Prof. Mörch to be consequent upon the rupture of the tissues; it is observed above all when there is abundance of water under the compressor,

2. Odontoglossa. Including only Fasciolaria, Mitra and Turbinella, which have the same form of teeth, but of which the laterals are not versatile.

3. Rachiglossa. A single row of teeth (0. 1. 0.); the laterals having disappeared.

4. Dactyloglossa. Only differing from Tænioglossa by their lateral teeth, which are wider, with very profound comb-like incisions.

5. Ptenoglossa. Teeth nearly subulate, in numerous longiitudinal rows; Scalaria, Acteon.

6. Gymnoglossa. No teeth: Architectonidæ, Acusidæ, Cancellariadæ, Pyramidellidæ. But teeth have been since discovered in the three first families. There are, doubtless, many genera indubitably deprived of teeeh, without, for that reason, forming separate groups.

Gray has regarded these different groups as having a systematic value inferior to that of the form of the proboscis. Thus

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* *Proc. Zool. Soc.*, 32, 1853.

he divides the Ctenobranchiates into two sub-orders: the Proboscidifera, which he believes zoophagous, furnished with an entirely retractile trunk, and the Rostrifera, having a contractile, but not retractile, trunk, and sometimes very long, as in Struthiolaria, which he supposes phytophagous.

This author has thus placed the sections of Toxoglossa, Gymnoglossa, Ptenoglossa and Tænioglossa in these two sub-orders. The small value of the retractile trunk as an ordinal character is proved for example in the Bullidæ (Bulla vexillum, possessing a very long retractile trunk). Odostomia has also a very long retractile trunk; and the rather short trunk of Janthina is very often retracted into the head.

In a more recent work,* Dr. Gray has reunited all the Toxoglossæ in a single division Toxifera, still retaining for the other divisions the separation into two widely removed sections. The name of Ctenoglossa is changed to Ptenoglossa; the name Trapezodonta is proposed for the Coriocellæ, the teeth of which do not appear to Prof. Mörch to differ from the Tænioglossæ except in the want of the two internal teeth on each side (1. 0. 0. 1. 0. 0. 1). Heteroglossa is proposed for the Cyclobranchiates.

In 1854, Mörch divided the cephalophora into five great groups, namely: I. Rhipidoglossata (including the Cyclobranchs); II. Ptenoglossata (Pulmonata, Tectibranchiata, Janthinidæ): III. Tænioglossata (including Pneumonopoma and Heteropoda); IV. Hamiglossata (Proboscidea of Troschel, Odontoglossa and Rachiglossa of Gray); V. Toxoglossata (including Pleurotoma and Terebra). In 1857, Mörch reduced the five principal divisions to three, namely:

I. Musivoglossata (corresponding to the Ptenoglossata of 1856, but thus modified because this name has been used by M. Troschel to characterize the group of Janthinæ and Scalariæ), Pulmonata and Tectibranchia.

II. Arthioglossata, including: 1. Tænioglossata, 2. Ancistroglossata, 3. Toxoglossata.

III. Rhipidoglossata, with the section Orthodonta (Cyclobranchiates).

In 1861–2, circumstances having induced Prof. Mörch to study the Planarians, he was struck with their great affinity

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* *Guide to Brit. Mus.*, 1857.

with the Pellibranchs, above all in the generative organs; this caused him to make a comparative revision of the genital organs of mollusks. He then ascertained that those belonging to his first division were androgynous and furnished with a retractile male organ; whilst those of the second section were diœcious, with a non-retractile male organ; and those of the third section differed from the others by the want of a copulative organ. In other words, he had thus arrived, independently, at the three groups proposed in accordance with the sexual organs by Blainville and Labreille.

In 1859 Mörch perceived that Mollusks were divided into two great groups, according to the construction of the heart and that these groups accorded also with those furnished by the sexual organs. Thus the Phanerogama Latr, with a retractile or non-retractile copulative organ, have a heart with a single auricle (Monotocardia Mörch), whilst the Agama Latr, which have no copulative organ, have a heart with two auricles (Diotocardia Mörch). It appears, doubtless, rather strange that the acephala should form a group with a considerable portion of the gasteropods (Rhipidoglossa and Heteroglossa), but there exists a similar division among the vertebrates, namely: the cold-blooded vertebrates, where the fishes are united with reptiles, the latter provided with well-developed locomotive organs analogous to those of the mammalia.

Stimpson proposed, a few years since,* to form a group Anandria, characterized by the want of a male copulative organ. This group includes the Melanians of North America, the Vermetidæ and Turritellidæ and certain Cerithiæ. M. Rüppel, however, has figured a male organ in Vermetus inopertus, and M. Lacaze-Duthiers has found a single male individual which circumstances did not permit him to examine sufficiently. As to the Melanians, they may want an external conical male organ, but the sexual character is with them represented by a groove. In the Agama of Latreille there is not the least external sexual difference.

Mr. Mörch believes that naturalists of the most opposite schools could agree to a scheme of classification which he submits, as follows:

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* *Am. Jour. Sci.*, 2 ser. 37, p. 47, 1864.

Sub-Kingdom 3,—*MOLLUSCA.*

Supra-class 1. Phanerogama Latr. (Monotocardia, Mörch).

Class 1. ANDROGYNA (Hermaphrodita, Latr.).

Order 1. Geophila, Fer. (Stylommatophora, A. Schmidt). *Phyllovora* with jaw. *Agnatha* without jaw.

Order 2. Hygrophila; eyes at the interior base of the tentacles. Planorbis, Physa, Limnæa, Siphonaria, Ancylus, Auricula.

Order 3. Tectibranchia (Pomatobranchia), Pyramidella (connecting with the preceding genus), Obeliscus, Odostomia, Chemnitzia, Actæon, Bulla, Aplysia, Notarchus. Gasteropteron connecting with the Pteropods.

Order 4. Pteropoda.

1. *Gymnosomata.* Clione, Pneumodermon.
2. *Thecosomata.* Clio, Hyalæa, Limacina, Heterofusus.

Order 5. Gymnobranchia.

1. *Pygobranchia.* Doris, etc.; branchiæ near the anus.
2. *Pleurognatha.** Pleurophyllidia. Dendronotus, Tritonia, Bornella, Æolis, Glaucus, Phyllirhœ.

Order 6. Pellibranchia. Tethys, Chioræa, Hermæa, Elysia, Limapontia, Pelta.

All these mollusks are placed at the head of the gasteropods by Cuvier. Messrs. Troschel and Gray arrange them between the Acephala and Patella, considering androgynism as probably a character of absolute inferiority; but the Acephala have generally separated sexes.

Class II. DIOICA, Latr. (Exophallia, Mörch).

Order 1. Tænioglossata, Troschel.

This is the only division where the family groups and their reciprocal relations do not appear to Mörch to be perfectly clear. In any case, it appears incontestable that all mollusks having seven ranges of teeth form a characteristic group. Recently, Troschel has divided the Tænioglossata into three groups according to the trunk:

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* Dr. Möbius has recently shown that the Doridæ have also lateral jaws, although very little developed.

1. Trunk not retractile.
2. Trunk retractile only by the end.
3. Trunk retractile from the base.

These differences appear to originate solely in the different length of the trunk. The old divisions Holostomata and Entostomata are not very faulty.

Troschel's first section commences with the Pulmonates, but Mörch considers very doubtful their having a true pulmonary sack closed by a contractile opening. Gray calls these respiratory organs of the Cyclostomæ "gills vascular, branched," and "gills indistinct in the form of series of vessels on the inner surface of the mantle."

Sect. 1. Fam. 1. Aciculacea; 2. Pomatiacea; 8. Cyclotacea; 4. Cyclostomacea.

Sect. 2. Respiring by branchiæ and lungs; Ampullariacea.

Sect. 3. Branchiferous Holostomata. Fam. 1. Valvatæ; 2. Hydrobiæ (Lithoglyphus); 3. Littorinidæ; 4. Rissoidæ; 5. Paludinidæ; 6. Meianiidæ; 7. Potamidæ; 8. Cerithiidæ (Planaxis)

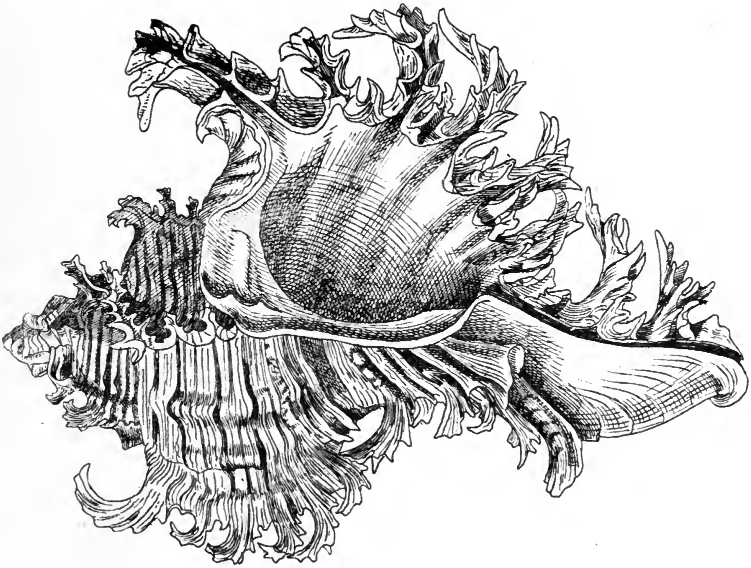
The Aporrhaidæ form a passage between the Cerithiidæ and Strombidæ. Crepidula and Capulus belong with Hipponyx in a group, notwithstanding differences in the labial palpi. Onustidæ connects the Crepidulidæ with the Heteropods.

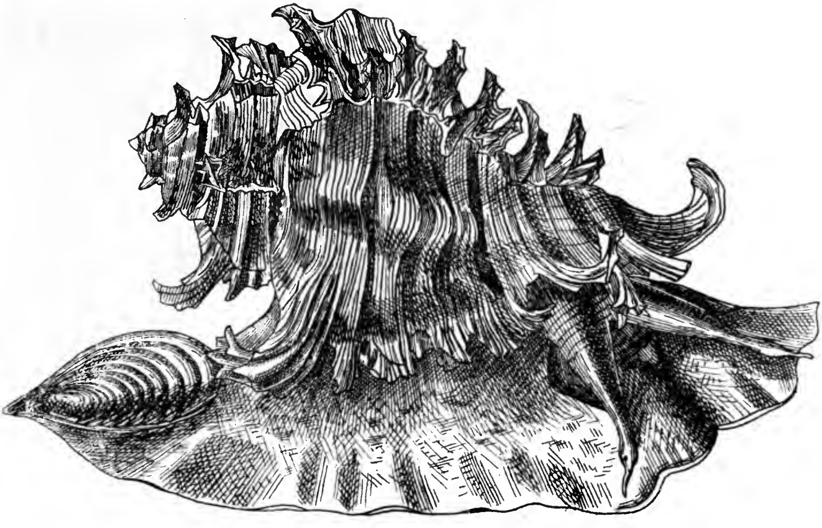
Ovulidæ (including Pedicularia), generally placed close to Cypræa, is strongly distinguished from the latter by its non-retractile proboscis. Notwithstanding this character, Mörch considers it intermediate between Cassis and Cypræa.

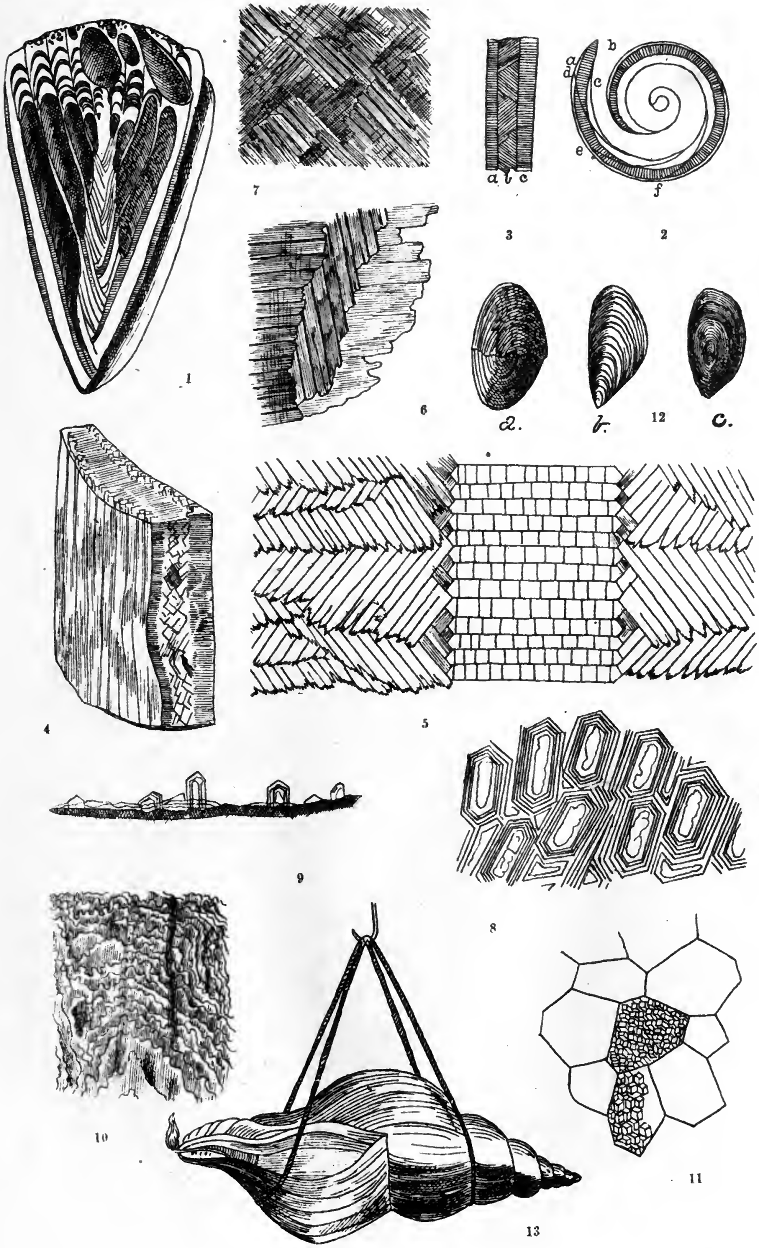
The 3d section of Troschel (trunk retractile from the base) contains the genera which Mörch united in 1852 in the family Tritonidæ, namely: Cassis, Dolium, Pyrula, Triton, Ranella.

Onchidiopsis, Velutina, Marsenia, Tylodina, form, probably, a very natural division, notwithstanding the want of the two lateral teeth in Marsenia. The family Naticidæ stands next in relationship. It is in the Tænioglossata that the greatest incertitude relative to a natural grouping of the families exists; in the orders which follow, these relationships are more positively defined.

Order 2. Rhachiglossata, Troschel. Never more than three rows of teeth. All mollusks having coriaceous ovisacs, heretofore known, belong to this order.



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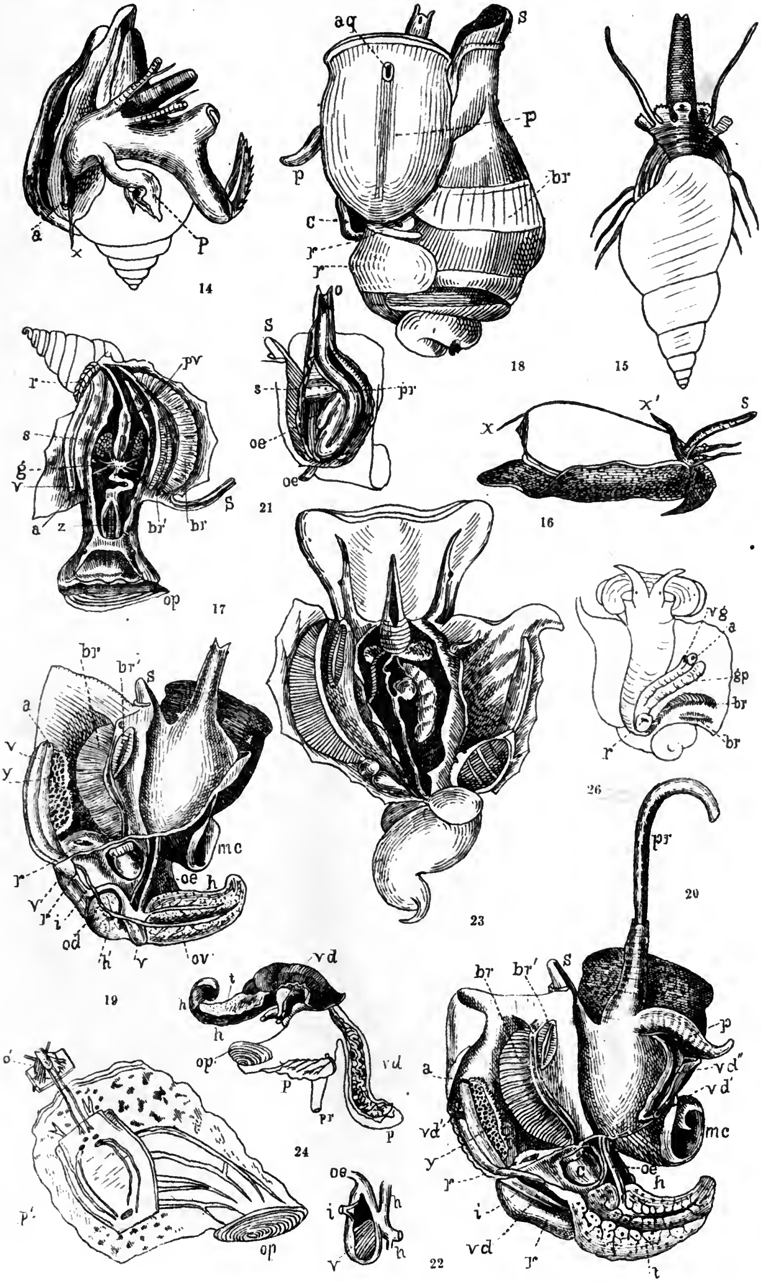
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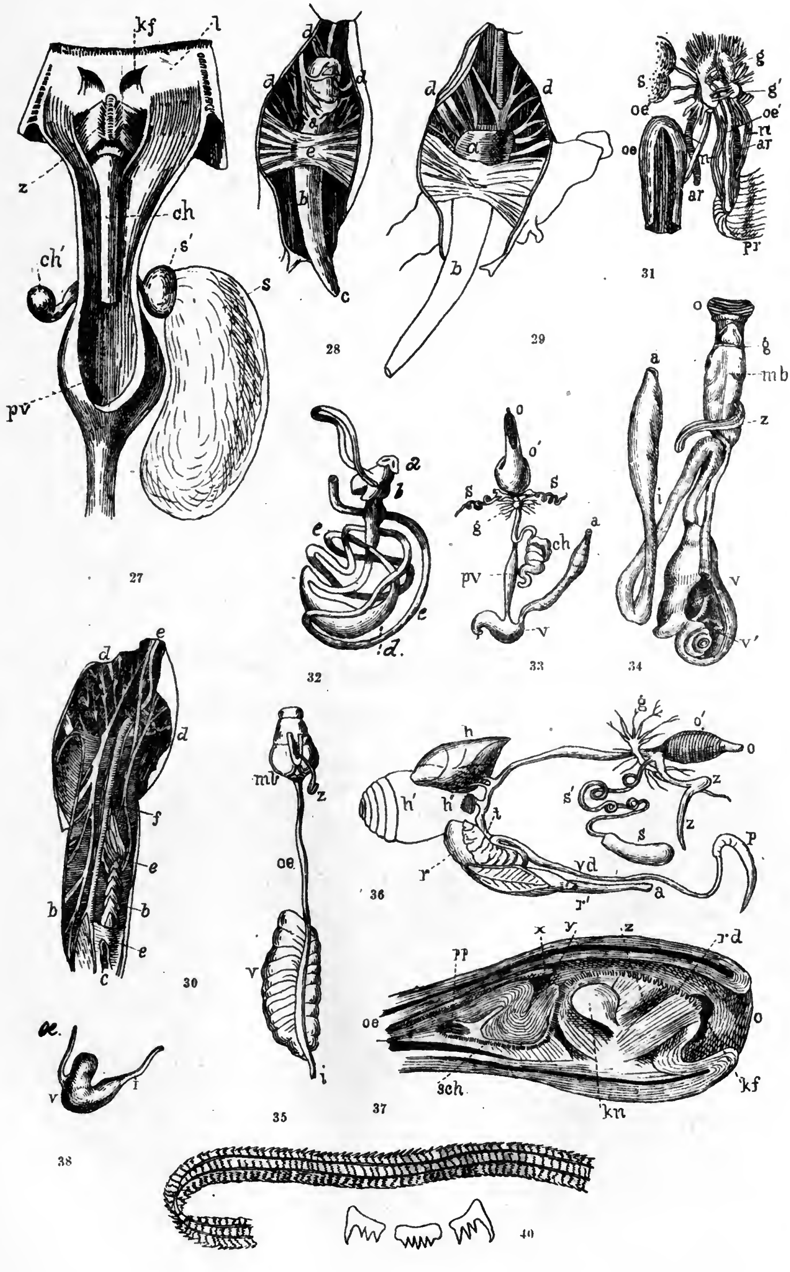

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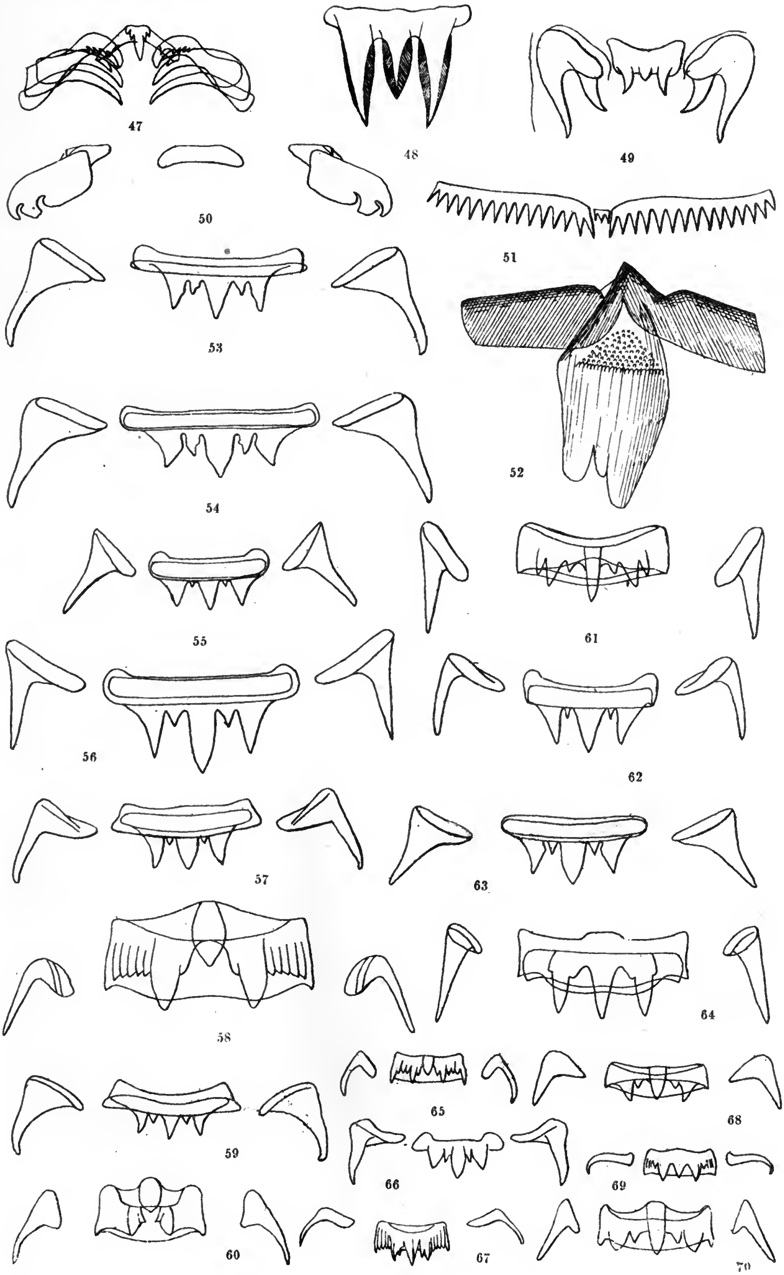
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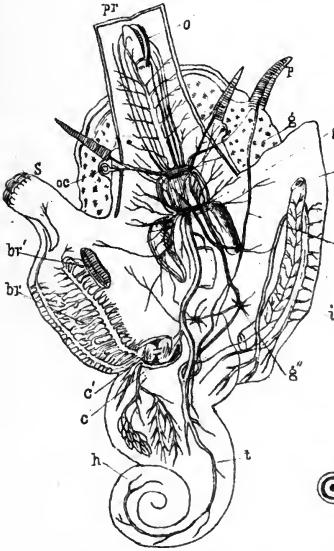

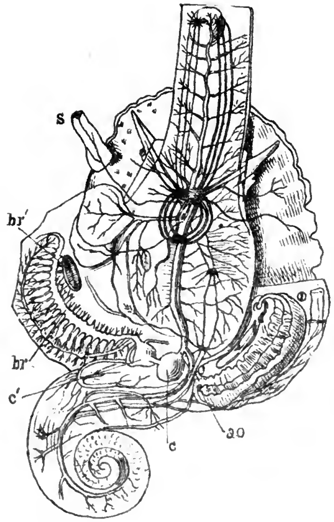

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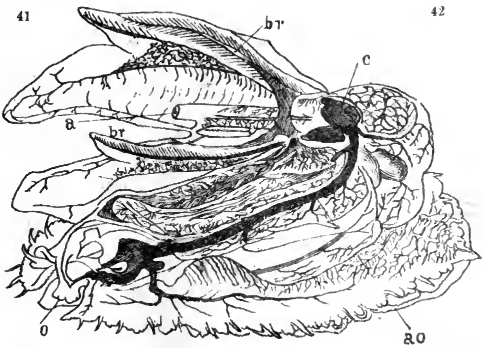

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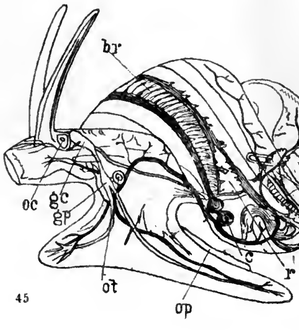

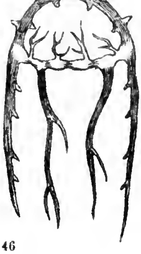

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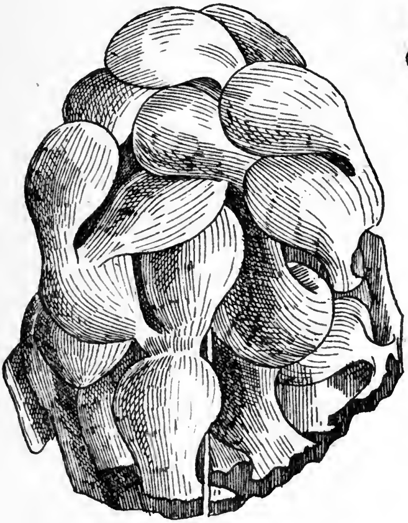

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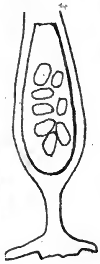

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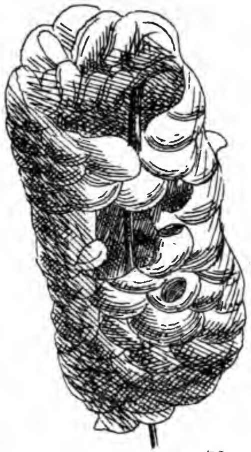

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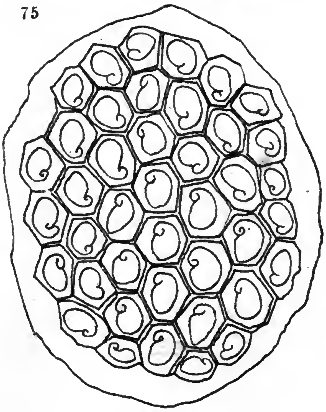

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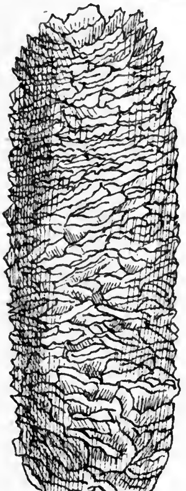

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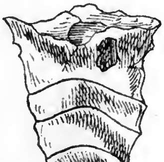

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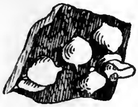

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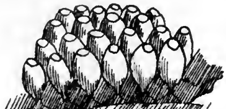

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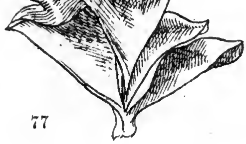

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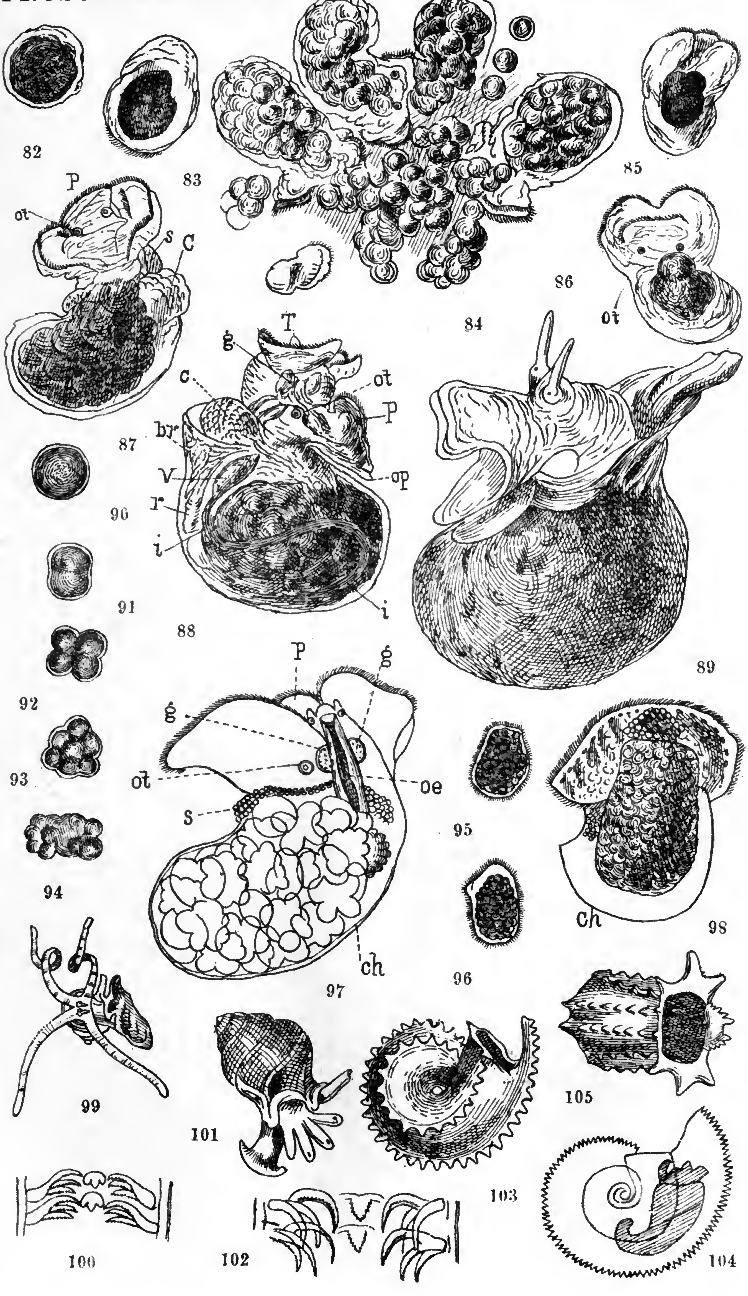
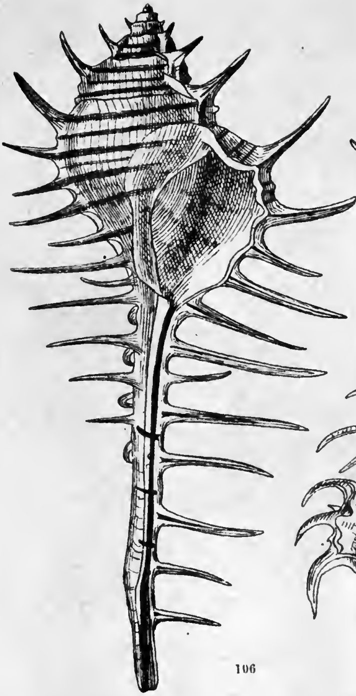
PROSOBRANCHIATA. PLATE 8.





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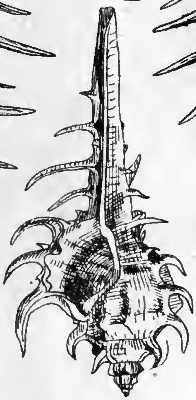

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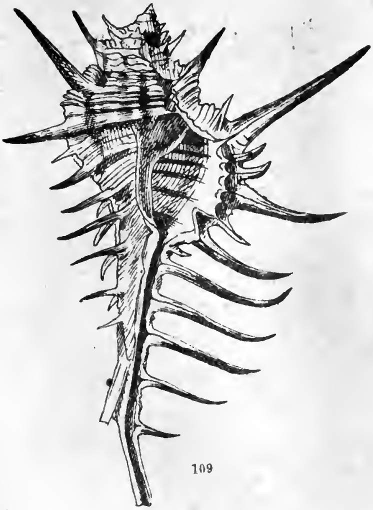

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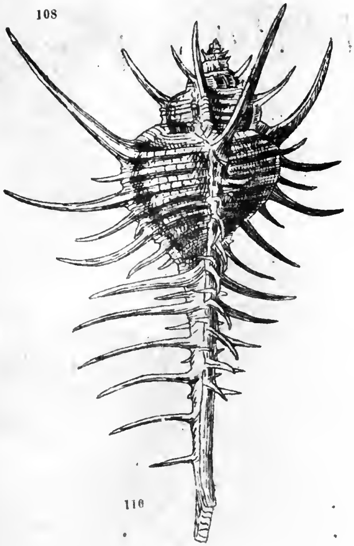

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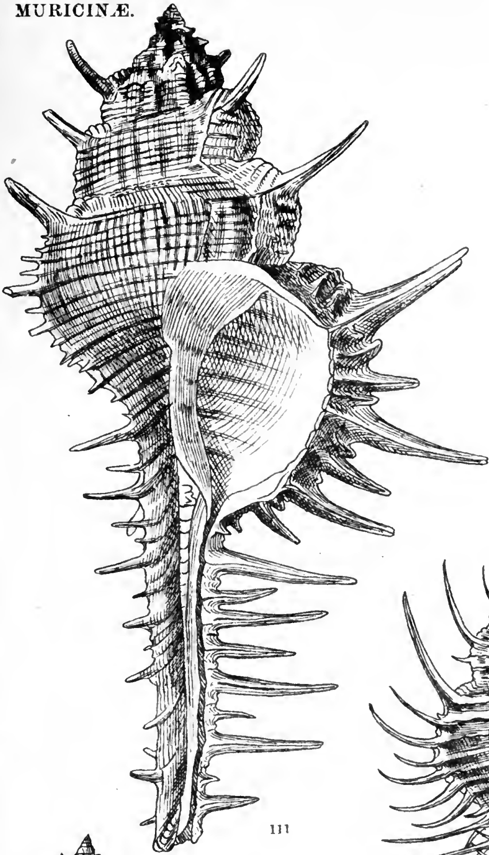

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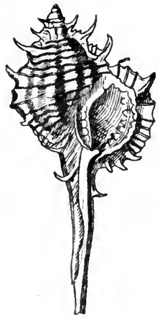

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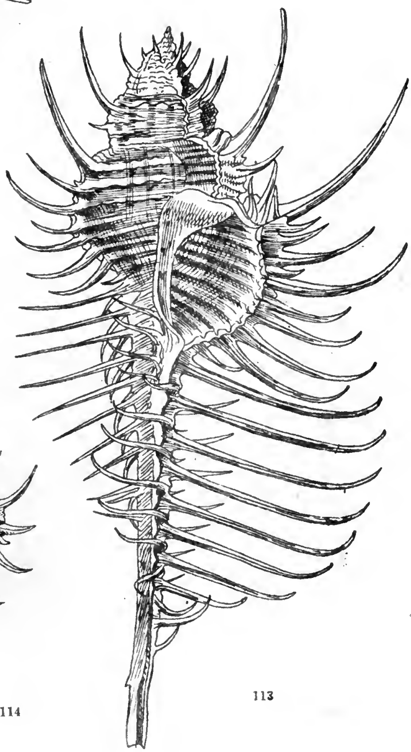

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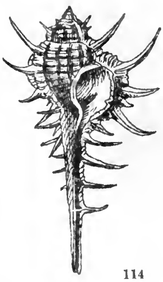

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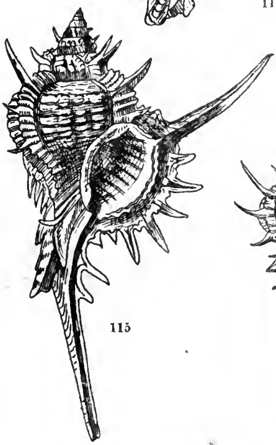

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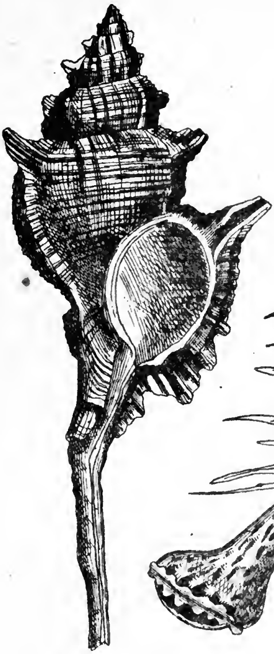

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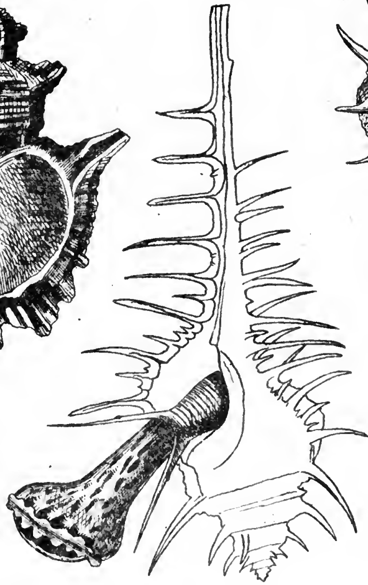

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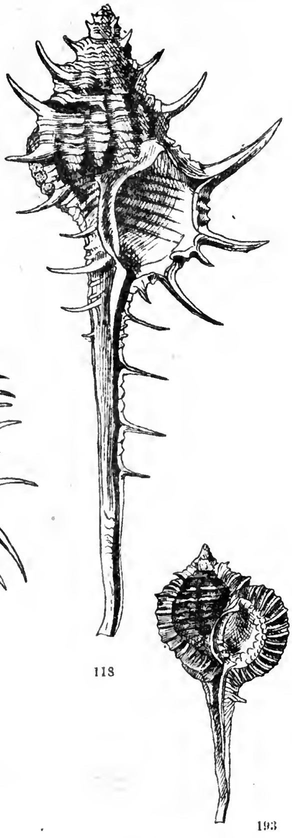

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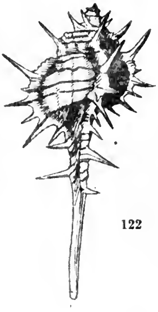

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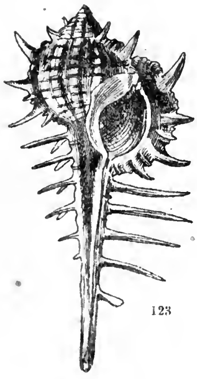

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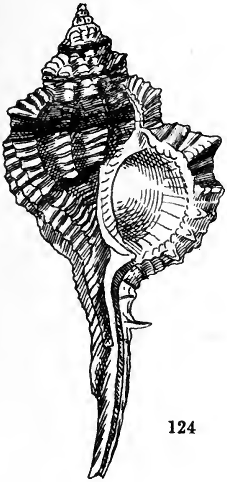
MURICINÆ. PLATE 12.



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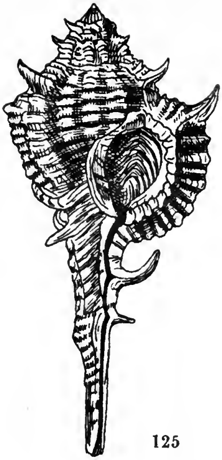

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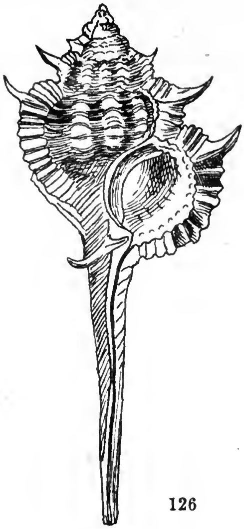

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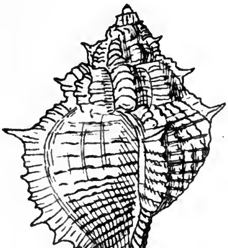

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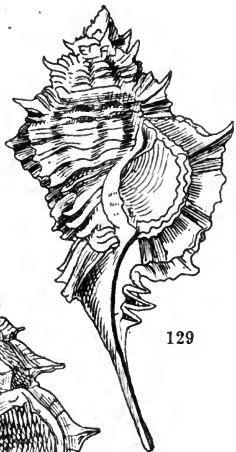

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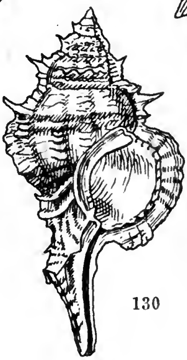

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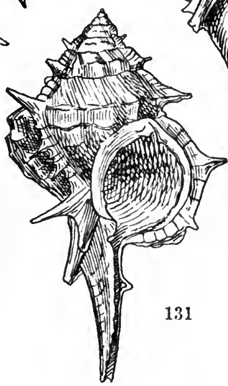

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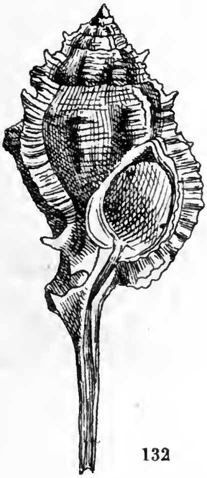
MURICINÆ. PLATE 13



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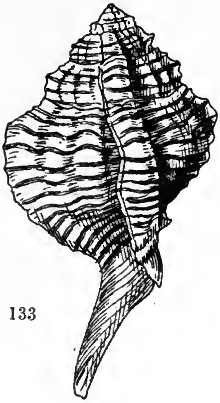

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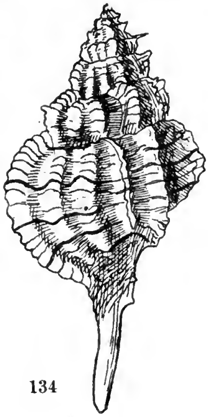

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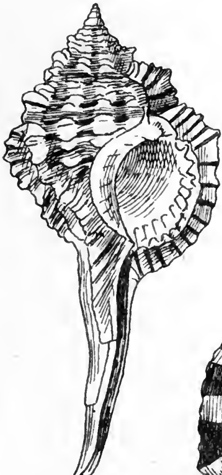

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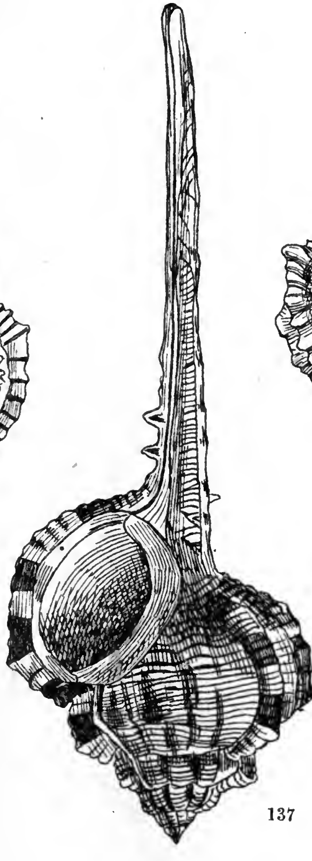

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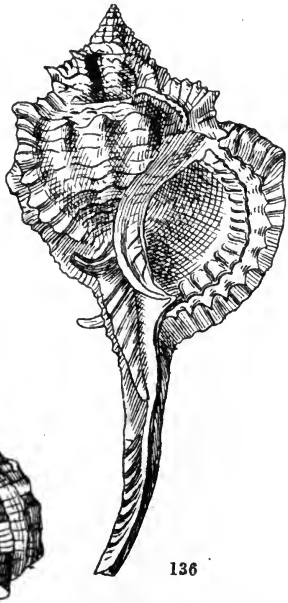

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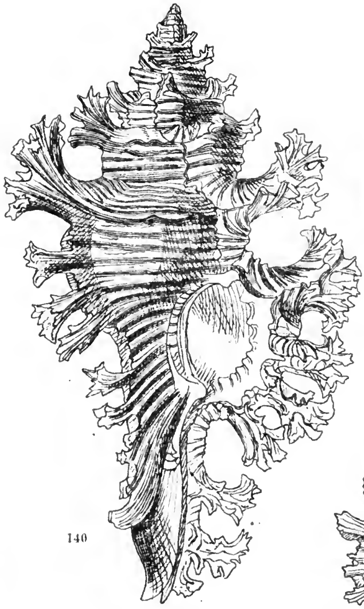

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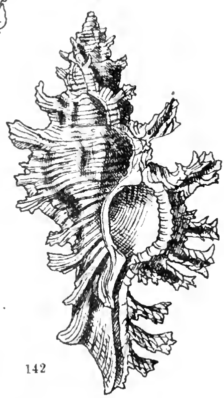

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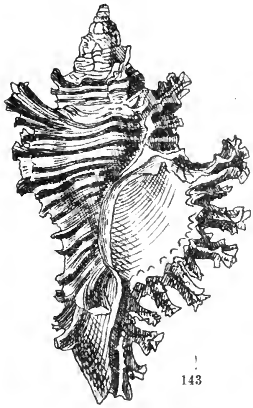

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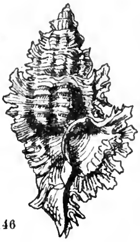

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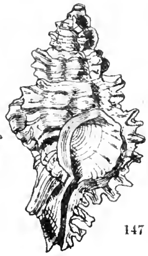

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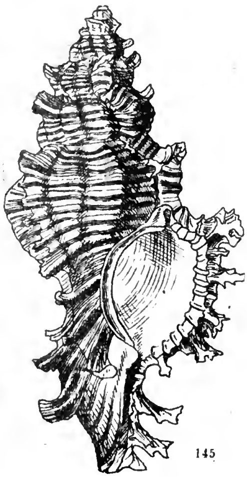

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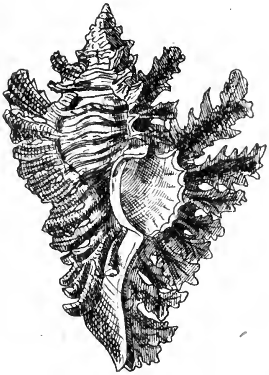

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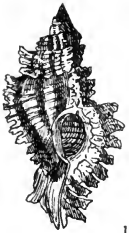

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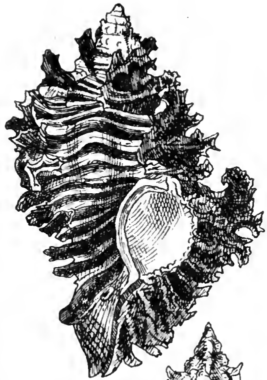

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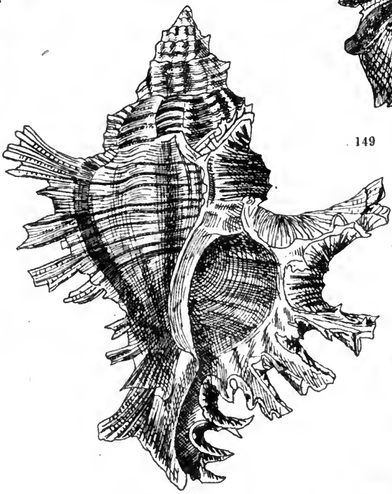

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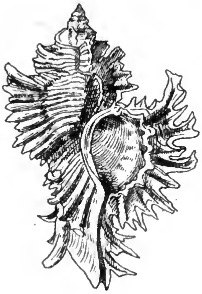

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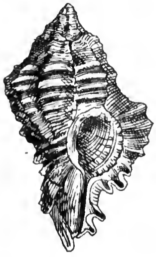

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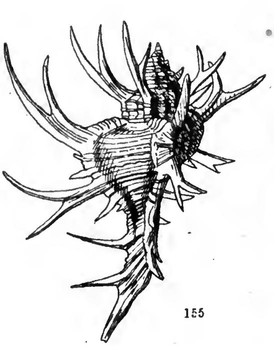

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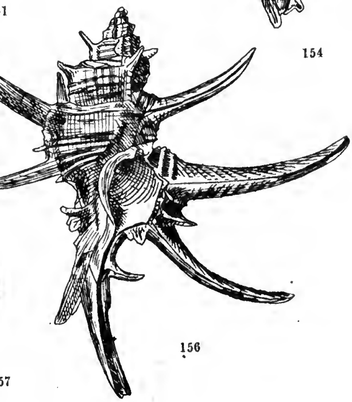

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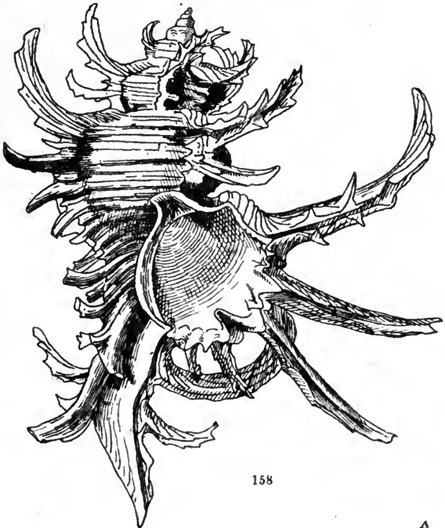

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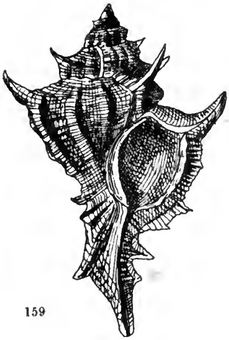

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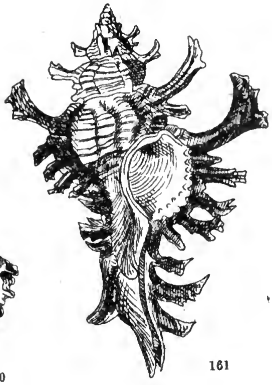

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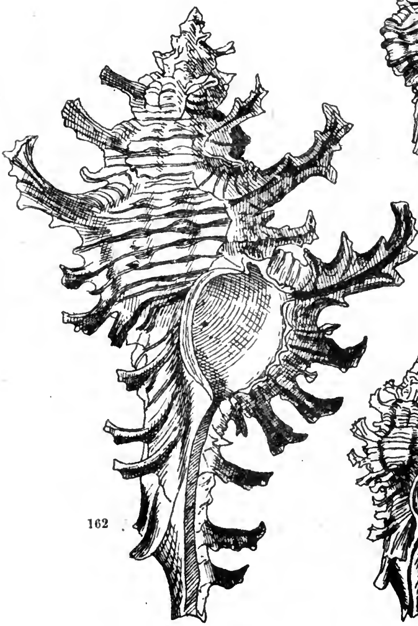

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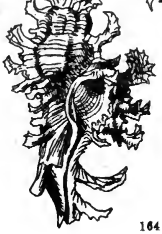

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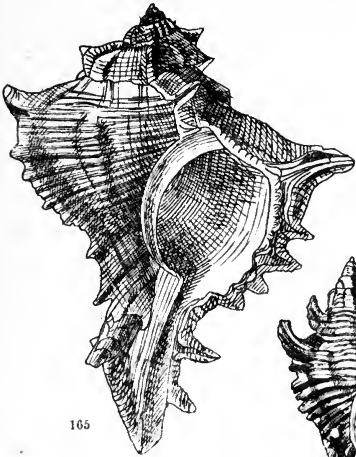

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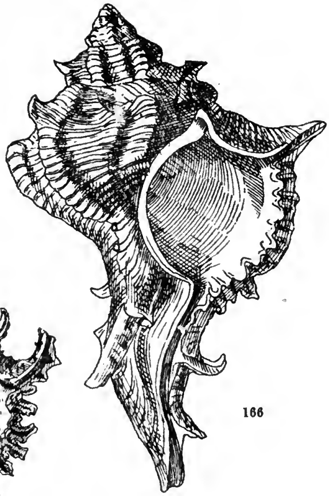

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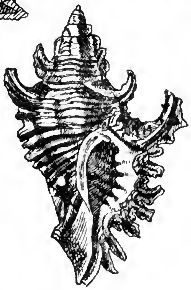

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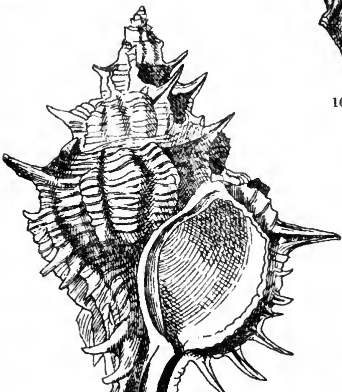

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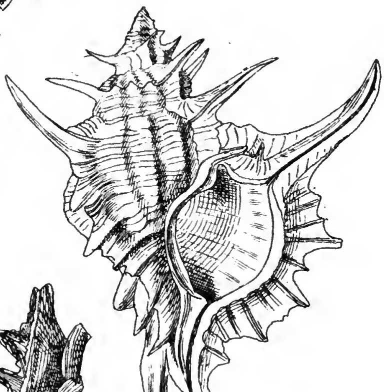

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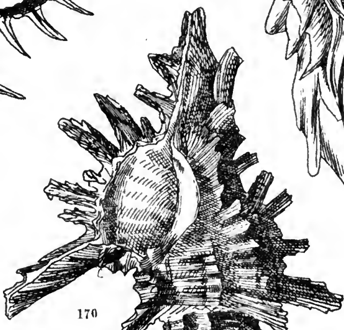

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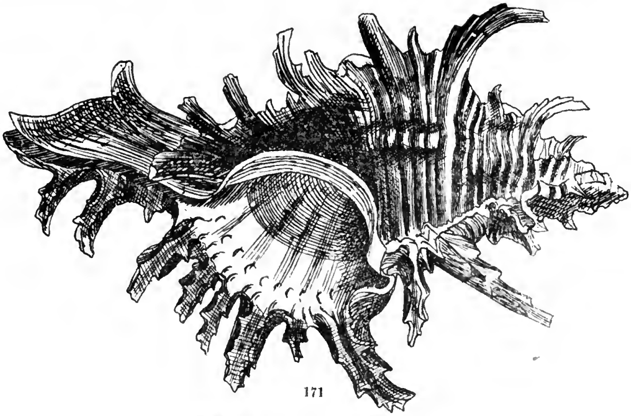

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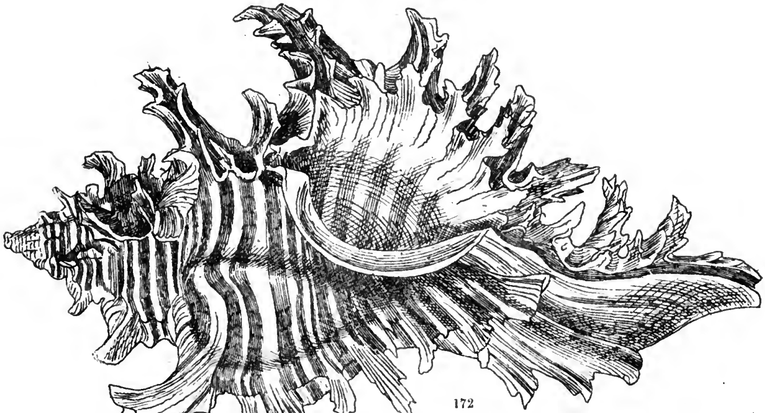

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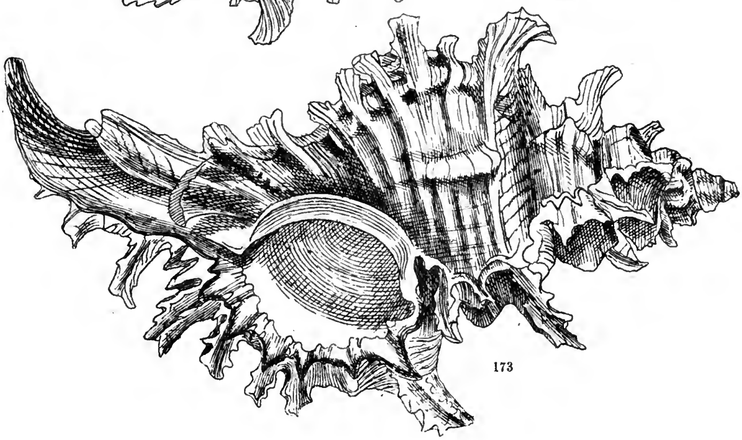

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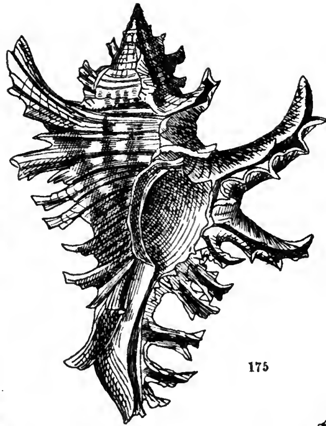
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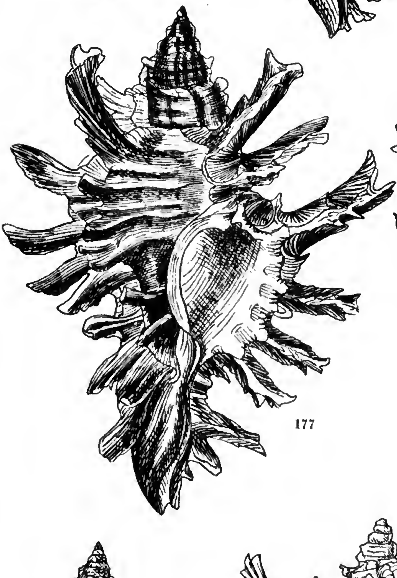
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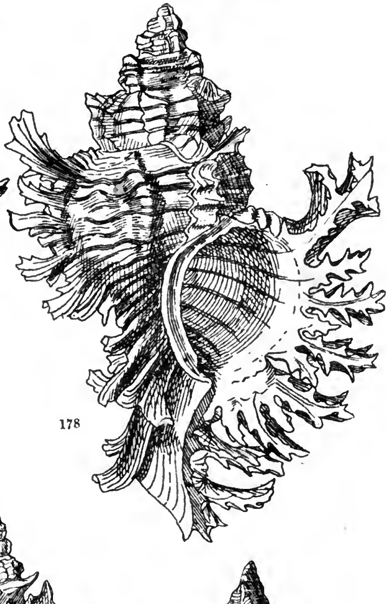
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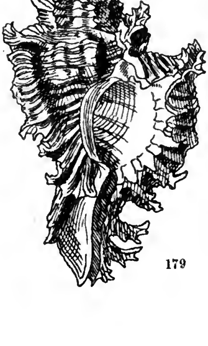
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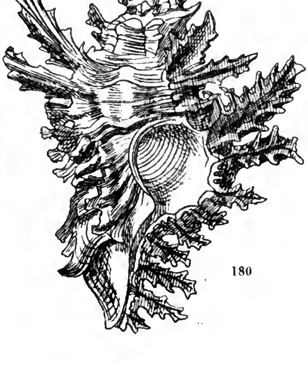
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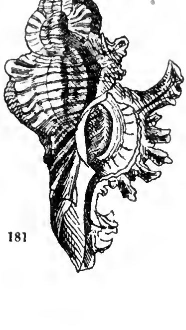
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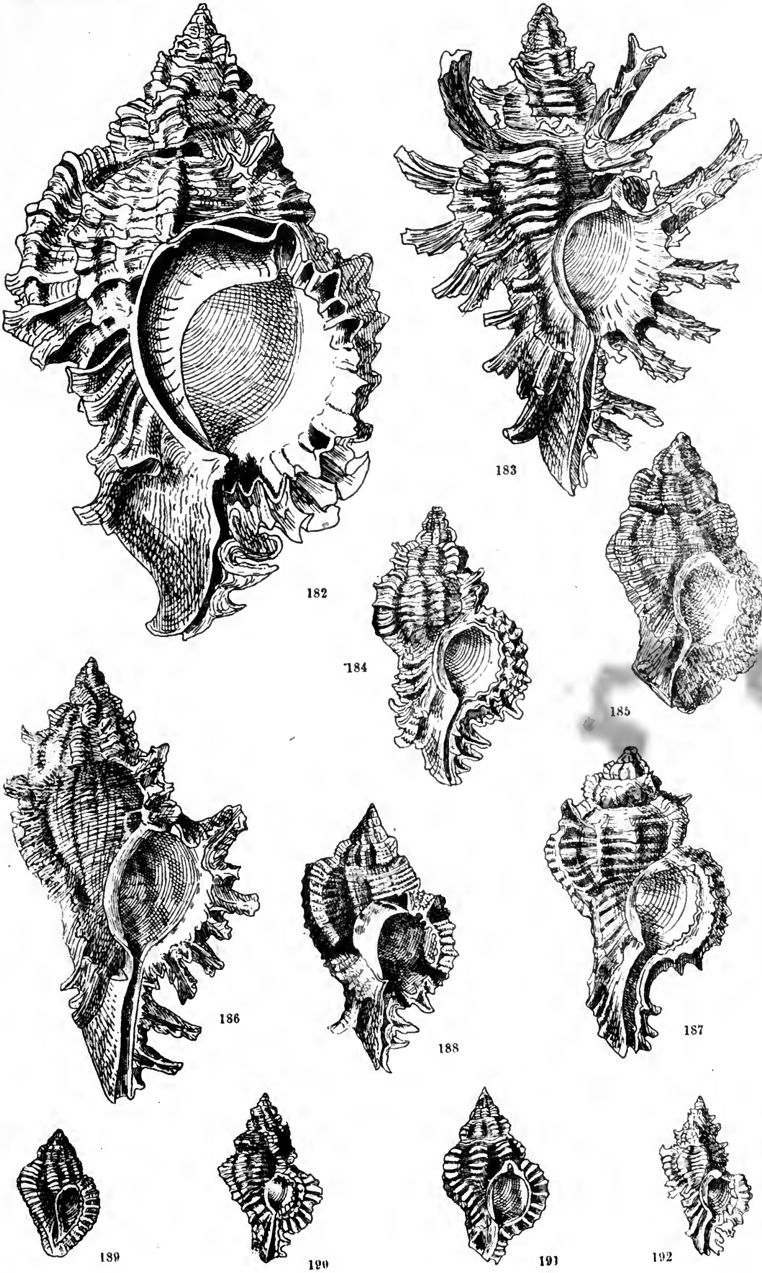
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Sect. 1. Marginella, Voluta, Volutilithes, connecting with Cryptochorda and Harpa; Oliva, Ancillaria, Bullia, Nassa, Mitra, Columbella.

Sect. 2. Buccinum, Fusus, Fasciolaria, Turbinella, Purpura, Murex, Magilus.

Order 3. TOXOGLOSSATA. Two rows of teeth. Stimpson has recently discovered a median tooth in Clionella sinuata, Born. Conus, (Borsonia?), Pleurotoma, Clionella, Terebra, Cancellaria, Halia, Lachesis?

Supra Class II. AGAMA, Latr. (Diotocardia, Mörch).

Mollusks without copulative organ. Heart with two auricles, placed nearly always around the intestine.

Class 1. EXOCEPHALA, Latr. (Pseudophallia, Mörch).

Order 1. RHIPIDOGLOSSA, Troschel. Proserpina, Helicina, Hydrocena, with sessile eyes.

Gray, in figuring the teeth of Proserpina (Ceres), formed for this mollusk a distinct suborder, alongside of the Neritinæ, which he called Pseudobranchia. In the same year (1857) Mörch placed Helicinæ in the Rhipidoglossates, with Neritina, notwithstanding the want of an operculum in Proserpina, an example followed by Troschel with some hesitation.

Eyes sessile. Shell not nacreous. Neritina, Nerita.

Shell nacreous. Phasianella, Turbo, Trochus, Margarita, Stomatia, Haliotis.

Eyes not petiolate. Shell not nacreous. ? Scissurella, Emarginula, Fissurella, the affinity of which with Haliotis, is incontestable.

Order 2. HETEROGLOSSATA, Gray. (Orthodonta, Mörch, Docoglossa, Troschel.) Patella, Tectura, Pilidium, etc., Chiton.

Class 2. ACEPHALA, Cuvier. (Endocephala, Latreille; Dithyra, Anst.)

Dimyaria (Plagymiona, Latr.).

Heteromyaria (Mytilacea).

Monomyaria (Mesomyona, Latr.).

Notwithstanding that the systematic value given above to these different groups varies from that of other authors, their order of succession differs but little from Cuvier. The separa-

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tion of the Rhipidoglossata (Pectinibranchiates) and Scutibranchiates, is the principal change. The arrangements of Gray and Troschel differ still more, above all in the Androgyna, which are placed between the Heteroglossa and Acephala, probably because androgynism is considered as a character of inferiority; notwithstanding that the Acephala, which are inferior, have the sexes separate, with some exceptions. The little division, Ptenoglossa, including only Janthina, Scalaria, Solarium, is placed, in the system of Troschel, between the Rhachiglossa and Rhipidoglossa. If we admit a special concordance between the teeth of these three groups, Mörch still does not consider the difference sufficient to justify a separation from the Androgyna. Janthina appears to him more close to the Pteropods by its lateral wings, and Scalaria, notwithstanding the position of the eyes, approaches Chemnitzia.

As in the entire animal kingdom, the greatest difference exists amongst authors relative to the value of the swimming organs. Latreille has united the Cephalopods and Pteropods in a single division Pterygia, to which he attributes the same value as to his Apterygia, comprehending all other mollusks. Gegenbauer and Huxley have demonstrated that the Pteropods are veritable Gasteropods furnished with a pair of accessory swimming organs. Already the discovery of Gasteropteron has shown the little value of the Pteropods as a division equivalent to the Gasteropods. The Heteropods merit still less to be considered as a division of equal value.

The late Prof. O. A. L. Mörch, although attaching as much systematic value to the lingual dentition as any other conchologist, acknowledged that no single organ could be used in classification unless its differential characters accorded with differences of other portions of the animal and shell; but he endeavored to show that conchologists have erred in estimating too highly for systematic purposes the *form* of the shell, whilst neglecting other external characters, such as sculpture, structure (nacreous, porcellanous, etc.) and color. "According to my views, one must consider shells, so to say, from a mineralogical point of view." Having thus chosen conchological characters heretofore neglected, in grouping the genera and families, the discrepancies between a natural classification of the shells and one founded on dentition, according to Prof. Mörch, will disappear. "I have united in the family Tritonidæ, according to the sculpture, Ranella, Triton, Pyrula (Ficus), Dolium, Cassidaria and Cassis, placing them near to Cypræa." This is in accord with the character of their dentition, which widely removes Triton and Ranella from the Muricidæ, close to which they have heretofore been placed, upon conchological characters—principally the form of the shell, the presence of varices, the operculum, and also upon a decided resemblance of the animals.

I have carefully re-examined these genera and their relationships with others, in the point of view taken by Prof. Mörch, and the result of this examination is to convince me that he has in the first place selected in the sculpture a character that is of generic importance only in the single genus Dolium—that is to say, its species happen to possess revolving ribs, and that even in the sculpture the relationship of Triton and Ranella with Murex is exceedingly close, whilst they have little or no affinity with Dolium, Cassis, etc. In fact, it is precisely because Prof. Mörch has regarded lingual dentition *à priori* as an "infallible criterium" that he has been enabled to detect supporting resemblances in the shells. It is easy to show in many other instances, as in the group under discussion, how heterogeneous is the assemblage united by means of the "infallible criterium." There is, besides, a growing conviction, in which I share, that there are no sharply-defined groups in nature; that a generic character, for example, cannot be made to cover all its species; that upon its borders occur forms which partake of the characters of other so-called genera, and that families, orders, etc., similarly coalesce upon their confines. I anticipate a future period when our larger collections, together with our better knowledge of external influences and of the power of adaptation to them of these creatures, shall reveal to us a series of recent and fossil forms having relationships so intimate, that our present system of classification and resulting nomenclature shall become utterly valueless.

In this point of view classification is essentially arbitrary and we can only help ourselves by choosing that which does least violence to natural affinities. The value of a classification founded on a single organ (the lingual ribbon), which does violence to most of the apparent affinities, whilst at the same time it fails of signification even in one of the most important functions with which it is connected, in that it does not enable us to certainly separate the phytophagous from the zoophagous animals, may be seriously questioned. We have many most important characters of the mollusks which impress themselves upon their shells, so that they are in accord and enable us to predicate reciprocally their relationships; and such characters appear to me to be much more useful for classification.

If it be proposed that a single arbitrary standard shall be used because it *is* arbitrary and hence will remove all doubt as to the position of a given species, then the standard selected should be the most universal and the most apparent—namely, the shell. But if a *natural* arrangement be attempted, still less can we make account of any character which is not in accord with the assemblage of characters. A natural sequence can only result from an accordance of most of the organs and functions. That dentition in the mollusks is a character worthy of study, that it will throw light on many doubtful points, that it will correct many errors is not to be disputed; but the claims made for it are preposterous;—for whilst a few hundred species only have had their tongues examined, described and figured, many thousands have been arbitrarily placed and displaced in consequence. Stimpson has examined the tongue of Ranella caudata and finds it to be that of a Murex; accordingly he separates from Ranella a few other species *because their shells resemble the shell of Ranella caudata* and unites them also with Muricidæ and this is practically the course (and necessarily so) pursued by all these dentition systematists. If conchological characters may be used to support the fabric reared upon the knowledge (I had almost written the want of knowledge) of a single structural character, why may they not be equally used against it. Is it not impertinent to make use of a few hundred observations of an organ which only pervades a portion of the mollusca, to establish a classification which is frequently in violent contrast with natural affinities ascertained by long examination of all the species, recent and fossil?

If the exo-skeleton or shell carries the impress of its animal, its right appreciation will afford us the *only possible* classification.

It is not partial, but pervades nearly the whole mollusca—as well those which have no lingual ribbon; its universality is the proof of its higher systematic importance; its relationships are not single, it is the epitome of the modifications of molluscan structure. Supposing the dentition of all living forms to be examined (an impossibility), we are still confronted by the fossil shells, which absolutely refuse to be classified by any other than conchological characters. What shall we do with them? Shall we use for these 30,000 species obvious external, universal characters, yet discard these in the recent mollusca for the modifications of a partial character, the very slight observation of which has sufficed to show that it may not be predicated with certainty from either the shell, operculum, external features, or anatomy of the animal?

Whilst I shall continue to find in the shell the usual characters for the discrimination of genera and families, I shall not refuse all the aid which I can obtain from the study of lingual dentition as well as from all other sources which may enable me to more rightly appreciate natural relationships, to correct error, to avoid it. For the present, I prefer to treat Triton and Ranella as transitional genera having many relationships with the Murices, but partaking in their dentition and in some other structural details in the characters of Cassis, Dolium, etc.

Prof. Theodore Gill published in 1871, under the auspices of the Smithsonian Institution an "Arrangement of the families of Mollusks," largely founded on their lingual dentition. Whilst this classification presents many features as novel as praiseworthy, reflecting the highest credit on the philosophical views and critical acumen of its author, it is, I think, equally unacceptable with those classifications heretofore proposed by European authors in which this character has been used as an exclusive guide. I reproduce Prof. Gill's arrangement below, as far as it relates to the Rhachiglossate mollusca. It will be noticed, as particularly affecting the groups of mollusks included in the present and succeeding volumes of this Manual, that the families of Fasciolariidæ (including Fusinæ) Buccinidæ, and Muricidæ are widely separated, being each placed under a group founded on a modification of dentition, and that other families of mollusks otherwise not nearly related to these, are nevertheless interposed between them, as for instance, to take an extreme case, the Olividæ. Of course Ranellidæ and Tritonidæ do not appear at all in this table of Rhachiglossates—their dentition places them in the Tænioglossates.

GASTEROPODA.

Sub-class *DIŒCA.*

Order III. PECTINIBRANCHIATA.
(Sub order TOXOGLOSSA.)
Sub-order RHACHIGLOSSA.

	(*Typica.*) Formula 0·1·0· (Pl. 5, fig. 48).	
Family 50.	CYSTISCIDÆ	= Cystiscidæ, Stm.
Family 51.	MARGINELLIDÆ	< Marginellacea, Troschel.
Family 52.	VOLUTIDÆ	= Volutacea, Tr.
	a. *Volutomitrinæ*	Volutomitrina, Gray. Amoriana, Gray.
	b. *Volutinæ*	Volutina, Gray. Yetina, Gray.
	(*Odontoglossa.*) (Pl. 5, figs. 49, 51),	
Family 53.	FASCIOLARIIDÆ	= Fasciolariacea, Troschel.
	a. *Fusinæ.*	
	b. *Fasciolariinæ.*	
Family 54.	MITRIDÆ	= Mitracea, Tr.
	(*Duplohamata.*)	
Family 55.	MELONGENIDÆ	= Cassidulina, Tr.
Family 56.	BUCCINIDÆ	< Fusacea, Tr.
	a. *Photinæ*	= Photina, Tr.
	b. *Buccininæ*	= Buccinina, Tr.
	c. *Chrysodominæ*	= Neptunina, Tr.
Family 57.	NASSIDÆ	= Nassacea, Tr.
	a. *Cyclonassinæ,*	
	b. *Nassininæ.*	
Family 58.	CYNODONTIDÆ	< Fusacea, Tr.
	a. *Cynodontinæ*	= Vasina, Tr.
	b. *Imbricariinæ*	= Imbricariina, Tr.
? Family 59.	TURBINELLIDÆ	< Vasidæ, H. & A. Ad.
	(*Hamiglossa.*) (Pl. 5, figs. 52, etc.)	
Family 60.	TURRIDÆ	= Strigatellacea, Tr.
Family 61.	OLIVIDÆ	= Olivacea, Tr.
	a. *Olivinæ*	= Dactylina, Tr.
	b. *Olivellinæ*	= Olivellina, Tr.
	c. *Ancillinæ*	= Ancillina, Tr.

Family 62. HARPIDÆ = Harpacea, Tr.
Family 63. PTYCHATRACTIDÆ = Ptychatractidæ, Stm.
Family 64. MURICIDÆ.
a. *Muricinæ* = Muricea, Tr.
b. *Purpurinæ* = Purpuracea, Tr.

(*Atypoglossa.*) (Pl. 5, fig. 50.)

Family 65. COLUMBELLIDÆ = Columbellacea, Tr.

The relations of the typical Fusi with Fasciolaria are intimate and a species of the former examined by Stimpson* has the saw-like lateral teeth of the latter; on the other hand, Macdonald† found the dentition of another species of the typical Fusi to agree with that of Murex in having simple, uncinate pleural teeth.

I propose to follow a classification which does not differ very essentially from that most approved before the advent of the lingual system, but modified nevertheless by certain ameliorations which the latter has enabled us to perceive for the first time. It is not denied that this arrangement is exceedingly artificial—all are so; but it it believed to be the most obvious, therefore, the easiest. It may be remarked here, that one of the inherent difficulties of arrangement in a lineal line is caused by inter-relationships; thus, I have chosen to proceed from Murex to Purpura, then to Triton, to Fusus and to Buccinum; yet the three latter groups are equally related to Murex and with one another, and the passage from one group to another is so gradual that the assignment of some of the out-lying forms to a genus is very difficult.

Classification adopted in this Work.

FAMILIES.

1. MURICIDÆ. Including Muricinæ and Purpurinæ.
2. TRITONIDÆ. Tritoninæ, Ranellinæ.
3. FUSIDÆ. Fusinæ (typical) Fasciolariinæ, Ptychatractinæ.
4. BUCCINIDÆ. Neptuninæ, Melongeninæ, Buccininæ, Pisaniinæ, Photinæ.
5. NASSIDÆ. Nassinæ, Cyclonassinæ.

(6. Turbinellidæ. 7. Volutidæ. 8. Mitridæ. 9. Columbellidæ. 10. Marginellidæ. 11. Olividæ, including Ancillaricinæ. 12. Harpidæ, etc.)

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*Am. Jour. Conch. i. 54.

†Ann. Mag. Nat. Hist., 4 ser., ii. 243.

SYSTEMATIC.

Class **GASTEROPODA.**

Head distinct, furnished with eyes and tentacles. Body usually protected by a spiral or conical univalve shell. Lower surface of body developing a thickened, expanded, creeping disk or foot.

Order I. **PROSOBRANCHIATA.**

Animal, creeping or swimming, protected by a shell usually large enough to contain it. Breathing organs (branchiæ), plume-like, situated in advance of the heart. Sexes distinct.

(Section A. Siphonostomata.) Animal with its mantle margin prolonged into a siphon conveying the water into the branchial chamber. Carnivorous. Marine. The shell is spiral, the axis usually imperforate, the aperture prolonged into a canal, or simply notched below. Operculum lamellar, horny.

(Section B. Holostomata.) Respiratory siphon wanting, or represented by a mere lobe in the collar of the mantle. Shell spiral or limpet-shaped, generally globular or pyramidal, with the aperture entire below, and rounded. Marine, fluviatile or terrestrial. Phytophagous usually. (Natica is carnivorous.) Operculum spiral, horny or calcareous.

SIPHONOSTOMATA.

Family Muricidæ. Shell spiral, fusiform; aperture more or less canaliculate, or simply notched in front.

Sub-family *Muricinæ.* Shell canaliculate; whorls crossed by varices. Operculum ovate. Nucleus subapical.

Sub-family *Purpurinæ.* Shell with very short canal, or simply notched in front; but frequently ribbed or nodulous; columella usually broad and flattened; operculum oblong, nucleus elongate, forming the long outer edge.

The above division into two sub-families holds good as to a majority of the species, but does not cover them all. Thus, some of the Muricinæ have the operculum and short canal of the Purpurinæ, whilst some of the latter possess the varices of the former.

In the following synopsis of genera and subgenera, the discriminative characters used separate widely groups, which really appear to be closely related: thus, Cerostoma and Pteronotus are intimately allied, notwithstanding the difference of the operculum; and Phyllonotus and Chicoreus have the same general facies, although they differ in the number of varices. Owing to their inter-relationships, no attempt to present the genera in succession can be other than exceedingly artificial.

Sub-Family MURICINÆ.

Synopsis of Genera.

MUREX. Shell ovate or oblong; spire prominent; whorls convex, crossed by three or more continuous varices; aperture ending below in a canal, which is generally partly closed.

a. Operculum with sub-apical nucleus.

* *Varices three.*

Typical Murices. Shell spinous; spire elevated; canal very long, narrow, nearly straight.

Subgenus PTERONOTUS. Shell triangular; varices fin-like or foliated; canal moderate, closed, somewhat curved.

Subgenus CHICOREUS. Shell ovate-pyriform; varices foliated and sometimes spinose; canal short, curved, wide, nearly closed.

** *Varices four to ten.*

Subgenus RHINOCANTHA. Has the short body whorl and long canal of the typical murices; differs in having more numerous varices.

Subgenus HOMALOCANTHA. Whorls rounded and sutures very deep; varices foliated, and peculiarly produced into expanded digitations; canal long.

Subgenus PHYLLONOTUS. Like *Chicoreus*, but varices numerous.

b. Operculum purpuroid.

* *Varices three.*

Subgenus CEROSTOMA. Varices wing-like; aperture usually dentate within the outer lip, with a produced tooth near its base. Analogous with *Pteronotus.*

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*** Varices numerous.*

Subgenus VITULARIA. Shell oblong; spire short; body whorl long; canal very short, wide; outer lip thickened and dentate within. Varices nearly obsolete.

Subgenus OCINEBRA. Spire elevated; canal more or less closed; varices foliated, sometimes spinose.

UROSALPINX. Fusiform. No proper varices, which are replaced by longitudinal ribs.

EUPLEURA. Ranelliform, with a pair of lateral varices, one on either side, and intermediate smaller varices; aperture dentate within.

TYPHIS. Ovate or oblong, with projecting hollow tubes between the three spinose varices; aperture sub-orbicular, prolonged in front into a closed siphonal canal.

TROPHON. Varices numerous, lamelliform or laciniated; spire prominent; aperture ovate; canal open, usually turned to the left; shell white, often dark-colored within the aperture; typically, Arctic and Antarctic.

Sub-Family PURPURINÆ.

As already stated, whilst the Muricidæ naturally subdivide into two groups, one of them (Murices) distinguished by varices on the shell. operculum with terminal initial point, whilst the other (Purpuræ) has nodules but no varices, patulous columella, short canal or mere basal notch, operculum with lateral nucleus; yet on the confines of these two groups occur forms which partake of the characters of either, and the classification of which is entirely arbitrary. Ocinebra, species of Trophon, Urosalpinx and Eupleura, have undoubted relationships with Purpura, yet are classed with Murex—partly because the species have usually been considered or were described as Murices; on the other hand, *Purpura crispata* and its allies possess the variceal features of Murex. Kobelt has, on this account, included them in his catalogue of the genus Murex; but on account of the extreme variability of the species (some specimens being without varices) and the number of connecting forms between the smoother varieties and typical Purpuræ, I prefer to retain them in the group to which they have usually been referred.

If the difficulty of defining these two sub-families is great, still greater does it become when we descend to the genera and subgenera of either of them. Various authors have attempted it, from the "groups" of Kiener's monograph to the genera and subgenera of H. & A. Adams. I adopt the latter as a mere convenience, premising that nature presents her specific forms here (as frequently elsewhere) in such continuous series, that no real line of demarcation can be traced; the characters represent simply the high tide of an osculation, which at its ebb merges into the next incoming wave.

Synopsis of Genera.

PURPURA. Shell oblong-oval, last whorl large; spire generally short; aperture ovate large, terminating in a very short, oblique channel, or notched; columella flattened; outer lip simple.

PURPUROIDEA. Shell turriculated, ventricose; summit of the spire sharp; whorls convex, with a line of spines or tubercles on the shoulder; columella smooth, rounded, excavated in front; siphonal notch wide; outer lip thin. Fossil.

LYSIS Gabb, Stomatiform, very oblique; spire moderate; whorls costate; aperture narrow, outer lip simple, inner lip straight, concavely expanded over the wide umbilicus so as to completely cover it. Fossil.

IOPAS. Shell ovate, rugose, last whorl large; spire acuminate; aperture moderate, emarginate and channelled in front; columellar lip covered with a thin enamel, and with a prominent plait-like callosity at the hind part; outer lip sinuous, crenate within.

VEXILLA. Shell purpuriform; inner lip flattened and depressed, but outer lip, when adult, thickened, inflected and toothed; aperture wide.

RICINULA. Shell ovate, solid; spire short, whorls tubercular or spinous; aperture linear, narrow, contracted by callous projections, with a short, oblique, emarginate canal in front; inner lip tubercularly wrinkled; outer lip internally with plait-like teeth, often digitate.

MONOCEROS. Shell ovate, last whorl large; spire rather elevated; aperture semilunar; inner lip wide and flattened; outer lip crenated, with a prominent tooth at the fore part.

PSEUDOLIVA. Shell ovate, solid, subglobose; spire very short, suture slightly channeled, whorls tumid round the upper part; aperture oval, canal very short; inner lip arcuated, with a callosity at the hind part; outer lip thin, furnished at the fore part with a small tooth or callosity.

CHORUS. Shell laminately varicose, spinose on the shoulder; canal rather long; outer lip with a spine as in Monoceros.

PINAXIA. Shell conical; spire short, acute; aperture oval-oblong, emarginate anteriorly; inner lip flattened, with several transverse plaits in the middle; outer lip acute, grooved internally.

CONCHOLEPAS. Shell ovate, last whorl very large, expanded; spire very short, obliquely inclined towards the left side; aperture very wide, slightly channeled anteriorly; inner lip flattened; outer lip with two small teeth in front.

CUMA. Shell pyriform ; spire elevated, acute, whorls angular or spinose ; aperture oval-oblong ; columella convex, sometimes with a strong angular tubercle in the middle ; outer lip acute, grooved internally.

RAPANA. Shell ventricose, axis perforated to the apex ; spire depressed ; aperture oval, narrowed anteriorly ; canal open, slightly recurved; inner lip reflected, free anteriorly; umbilicus wide, corrugated.

RHIZOCHILUS. Shell when young free, resembling Rapana ; when adult, sometimes with more or less irregular solid shelly extensions of the outer and inner lips, which clasp the axis of coral or the surface of neighboring shells, and at length close the month with the exception of the anterior siphonal canal which is converted into a shelly tube. No operculum.(?)

SEPARATISTA. Shell turbinate, subdiscoidal, the first whorls contiguous, the last more or less separated ; aperture expanded, slightly angulated, the margin everted ; umbilicus very wide, infundibuliform with the whorls visible to the apex. No operculum.

MELAPIUM. Shell ovate-pyriform, ventricose, imperforate, porcellanous ; spire very short, apex papillary ; aperture expanded, inner lip with a thick, smooth callus at the hind part, columella twisted anteriorly, with a prominent oblique plait ; canal wide, recurved, directed towards the left. Operculum unknown.

WHITNEYA. A cretaceous fossil possibly synonymous with Melapium.

RAPA. Shell thin, globosely pyriform ; axis perforate ; umbilicus partly concealed by the reflected inner lip ; spire obtuse ; aperture oblong, produced anteriorly into a wide, subrecurved canal. Operculum unknown.

MAGILUS. Shell when young, spiral, thin ; when adult, white, solid, tubular, spiral for three or four whorls, the last prolonged into an irregular straight or flexuous tube, solid posteriorly, and with a siphonal keel on the left side. Operculum ovate, nucleus sublateral.

MAGILINA. Young shell free, formed of a single whorl ; finally prolonged into a tube which is attached by one side to the surface of submarine bodies.

NISEA. Shell composed of a discoidal portion and of two tubes ; the last whorl recurved upon itself in the same way as Anastoma, in two tubes of variable length and less sinuous than the single tube of Magilus. (Fossil.) Relationships very doubtful.

Genus **MUREX**, Linn.

Mr. W. Kobelt has published a catalogue of the genus Murex (excluding the genera Trophon, Vitularia and Typhis) in the "Jahrbücher" of the German Malacozoological Society, 1877. Whilst it is the most complete catalogue of the genus heretofore published, I find that it does not include more than about half the number of specific names amassed during my researches. His introductory remarks upon classification are important, and fairly state the difficulties attendant upon any attempt to separate the species into natural groups.

Five monographs, illustrated by colored figures of the species, have been published, viz., in Sowerby's "Conchological Illustrations," in Reeve's "Conchologia Iconica," in "Kiener's "Coquilles Vivantes," in Küster's "Conchylien Cabinet," and in Sowerby's "Thesaurus Conchyliorum." The fossil species number more than one hundred and fifty, beginning with the Eocene.

On the coasts of the Adriatic *Murex brandaris* and *M. trunculus* are constantly seen in the markets, where, under the names of "bulo maschio," "bulo femina," and "garusola," they are sold to the poorer classes for food.

1. *Typical Murices, or Tribulus Group.*

M. scolopax, Dillw. Pl. 9, figs. 106, 108; pl. 24, fig. 208.

The comparative smoothness of the surface of this species will distinguish it from *M. ternispina*, with which it is too closely allied. The revolving ribs are much darker in color than the general surface, so that Reeve describes the specimens as banded. Full grown specimens attain 8 to 9 inches.

Red Sea, Indian O., China.

M. occa, Sowb. (fig. 108), is a depauperate young state, the spines not so well developed, only three of them prominent on the body, the intermediate ones becoming more noticeable with increase of growth. *M. Macgillivrayi*, Dohrn. (fig. 208), from Lizard Isles, Australia, is similar to *occa*.

M. tribulus, Linn. Pl. 9, figs. 107, 109.

The whorls are crossed by numerous, somewhat nodulous transverse ribs (4 to 6 between varices), decussated by close, alternately larger and smaller revolving lines. The typical form has also several revolving series of brownish spots, but these are not constant The spines of the canal are not so numerous or so long as those of *M. scolopax*. Attains 4·5 inches.

Red Sea, China, Japan.

M. nigrospinosus, Reeve (fig. 109), is simply a state of this species in which the spines become dark colored.

M. TENWISPINA, Lam. Pl. 10, fig. 113.

The distinguishing character of this, the most beautiful of the Murices, is the large number of long, parallel, curved spines which adorn the canal and lower portion of the body, with alternating, recurved, smaller spines. In its sculpture it is like *M. tribulus*, and some of the succeeding species.

Length, 6 to 8 inches.

Indian Ocean, Japan. Torres Sts., N. Australia, in 20 to 30 fathoms, sandy bottom.

M. TERNISPINA, Lam. Pl. 9, fig. 110; pl. 10, figs. 111, 114; pl. 11, figs. 117, 118.

Usually smaller, narrower, especially the canal, and with fewer and shorter spines than *M. tribulus;* yet it is by no means readily distinguished from that species. It has the same sculpture, and even sometimes the same revolving spots of brown color. It is more graceful usually, in form, its spines are not so stout, and the upper and middle series on the body whorl are not much larger than the others, as in *tribulus*. Its claims to specific rank are allowed with considerable hesitation.

Length, 6 inches, but usually not over 3 inches.

Indian Ocean, Japan, China, Philippines.

The animal is figured by Quoy and Gaimard (under the name of *tenuispina* (fig. 117) as greatly extended from its shell in order to regain its normal position when placed on its back. The extended foot is quite large, subcylindrical, yellowish, marbled on the sides with yellow, brown and red. Two very long, cylindrical, thin and pointed tentacles carry eyes on their middle. The mantle is grayish; its margins undulated.

M. Martinianus, Reeve (fig. 118), and *M. aduncospinosus*, Beck (fig. 114), I cannot separate even as varieties; they are simply degrees of spinous development of this species. *M. Troscheli*, Lischke (fig. 111) is founded on a very large, stout specimen, which, when perfect, must have been nearly 7 inches in length. I place it here; yet it has affinities with *M. tribulus*, particularly in its solid, stout appearance.

M. SOBRINUS, A. Ad. Suppl. Pl., fig. 536.

The seven whorls are convex, longitudinally nodosely plicate and transversely lirate, very spiny; the long, straight canal is spiny; the body whorl has two reddish-brown bands.

Length, 36 mill.

Japan, 29 to 55 fms.

M. RARISPINA, Lam. Pl. 10, fig. 115; Pl. 11, fig. 119.

The best character of this form is found in the great development of the superior spines on the body whorl. The lower part of the canal is smooth, and the upper part has only a few short spines. Length, 3·5 inches.

Indian O.

M. Mindanensis, Sowb., (fig. 119) I believe to be a depauperate state of this species. Messrs. Kiener & Reeve consider *M. formosus*, Sowb., (fig. 115), a synonym, and as the former cites *rarispina* in the Lamarckian collection, I am disposed to agree with them. Mr. Sowerby figures an entirely different shell for *rarispina*—a shell which appears to me to be a *M. tribulus.*

M. BREVISPINA, Lam. Pl. 11, fig.121; Pl. 24, fig. 209.

The spines are very short, scarcely longer than the tubercles which, in double series, two in each, divide the space between the varices; these tubercles define a somewhat flattened periphery.

Length, 3 inches.

Red Sea, Ind. O., So. Africa, N. Australia, 6-11 fms.

M. senilis, Jousseaume, (fig. 209), can scarcely be regarded as more than a thin variety of this species, in which the spines are better developed. It is said to inhabit the Philippine seas.

M. CONCINNUS, Reeve. Pl. 11, fig. 122.

The colored, narrow revolving lines, and short, direct spines give this shell a very lively appearance. Only a single specimen is known (Metcalfe Museum). It can scarcely be regarded as a well-established species because these narrow bands are found in individual specimens of several of the following forms (and have in these cases caused them to be described as new species), without being at all characteristic.

Locality unknown.

M. Cabritii, Bernardi. Pl. 11, fig. 123.

The short, thick-set spines, extending over the canal, remind one of *M. plicatus*, Sowb., with which it also has other relationships. Only a single specimen is known, without locality.

Length, 2·5 inches.

M. plicatus, Sowb. Pl. 40, fig. 508.

This species is well distinguished from others of the group; it is thick and heavy, the spines are obtuse, short on the whorls and long on the canal. The color is purplish white, darker within the aperture. Length, 3 inches.

W. Coast of Central Am. to Gulf of California.

Two specimens in the Mus. Philad. Acad. have thread-like brown bands like *M. concinnus*, Reeve.

M. Beaui, Petit. Pl. 11, fig. 116.

Described from a single specimen which, except in its much greater size, much resembles varieties of *M. recurvirostris.* The shell is not in good condition, and presents no satisfactory specific characters. Length, 5 inches.

Isle of Marie-Galante, W. I.

M. eximius, Brazier.

Whorls seven, with two short, blunt spines on each varix of the body and no spines elsewhere; spaces between the varices longitudinally five-ribbed, crossed by alternately larger and smaller striæ. Cream color, violet-tinged in the aperture.

Length, nearly 2 inches. Not figured.

Darnley Isl. Torres Sts. N. Australia; 30 fms. sandy bottom.

M. recurvirostris, Brod. Pl. 11, fig. 193; Pl. 10, fig. 112, Pl. 12, figs. 124-128.

This is a comparatively small species, rarely exceeding two inches in length. The varices are thick, plait-like and tuberculated by the crossing of elevated lines—which also cut the three inter-variceal ribs into tubercles. These tubercles are sometimes developed into short spines, one on the upper part of each varix, and there are also one or two on each varix below the aperture. The color varies from whitish to livid with two or three broad brown bands—which are most visible within the aperture.

West Indies; W. Coast of Central America to Mazatlan.

Having a very extensive suite of this species, including specimens from well-authenticated localities on both sides of the American continent, I find no difference in them whatever as to the typical form described above, and which may be recognized at once by its general dark color. *M. nigrescens*, Sowb. (fig. 124), is simply a large specimen of the typical form and *M. lividus*, Carp., cannot be distinguished as a variety. *M. funiculatus*, Reeve (fig. 112) is founded on an unusually light colored specimen; similar ones are in the collection before me as well as examples of intermediate coloration. *M. messorius*, Sowb., (fig. 125), is similar to *M. funiculatus* and also has relationships with the form with straight canal which the same author has named *M. rectirostris*, (fig. 126).

There is also a West Indian form, much lighter in color, and with the spines usually somewhat more developed whilst the canal is generally shorter. If I had fewer specimens I might be able to distinguish this form as a variety, but my material supplies all intermediate gradations. Of these lighter-colored shells Sowerby has made his *M. similis* (fig. 130), whilst another specimen has been figured by him in mistake for *M. motacilla*, Chemn. Two eager English conchologists discovered this error and Mr. Hinds has added to his scientific laurels by describing the wrongly identified shell as *M. Antillarum*, whilst Mr. Reeve has called it *M. nodatus* and refigured it. Of course neither of these investigators felt called upon to study the group to which Mr. Sowerby's wrongly identified species belonged and equally of course neither of them had time to ascertain whether any other naturalist had made and published a similar discovery. Thus I place eight so-called species in the synonymy of *M. recurvirostris* in addition to a number of synonyms acknowledged by preceding authors and upon which I therefore refrain from dwelling. Mr. Arthur Adams has issued a short Latin diagnosis (Zool. Proc. 1851), of *M. pulcher* from St. Croix, W. I. No figure has been published and the description mentions neither color, dimensions nor distinctive characters (nearly all the species published by him in this paper are similarly indefinite), so that it is impossible to ascertain what species he *intended* to describe; the description itself, however, as far as it goes, will characterize very exactly our present species, and such being the case, I have a right to so identify it.

M. MOTACILLA, Chemn. Pl. 12, figs. 129, 131; pl. 13, figs. 132–134.

There are usually two prominent longitudinal tubercles between the varices instead of three, as in the last species. The surface is closely covered with revolving lines which become tuberculous on the elevations, and here and there slightly spinous. The canal is very narrow, and turned to the right. There are two or three brown bands, usually.

Length, 2·5 inches.

Senegal, West Indies.

This species is rather variable, and presents, among others, two forms which may retain the specific names given them, as varieties:

VAR. CAILETI, Petit. Figs. 131, 132.

Shell smoother, more angulated on the periphery, more spinous, the nodules smaller, forming two or three ribs or tubercles between the varices. The principal revolving lines are colored brown so that the surface appears variegated with revolving, narrow, thread-like bands. I figure a specimen from the original lot collected by M. Caillet, which is much more angulated than the type (fig. 131) and I have before me a fine series of intermediate forms.

VAR. ELEGANS, Beck. Figs. 133, 134.

Longitudinal tubercles two between the varices, prominent, spines not developed, periphery only obtusely angulated, the raised revolving, thread-like lines dark-colored. This is a very beautiful variety which may include as a synonym *M. trilineatus*, Reeve, (fig. 134).

M. CHRYSOSTOMA, Gray. Pl. 13, figs. 136, 135.

In general appearance not unlike *M. motacilla*, Var. *elegans*, this species presents the following distinctive characters, which appear to be permanent: it is larger, stouter, the canal is proportionally shorter and straight or but little turned to the right; there are one or two spur-like spines on the varices at the lower part of the mouth;—generally on the left-hand varix and sometimes on the back varix, but very seldom on the right hand or lip varix; the lips of the mouth are tinged with more or less brilliant orange color. I consider *M. bella*, Reeve, (fig. 135), a synonym.

West Indies.

M. AUSTRALIS, Quoy.

Shell fusiform, a little ventricose, with long canal turned to the left; with revolving striæ, and short tubercles on the varices. Yellowish-white. The animal has short tentacles of a sooty color, white towards the points, near which are placed the very small eyes. The rest of the body is pale yellowish, mottled with white. Length, 33 mill., breadth, 14 mill.

Port Western, Austr.

This species has not been figured nor identified; I think it belongs to the Tribulus group.

M. LIGNARIUS, A. Adams.

Ovately fusiform, sub-umbilicated; spire acuminate, reddish brown; whorls excavated above, with two medial, elevated, nodulous lines; transversely lirate, the lines unequal, elevated, rugulose; longitudinally three-varicose, the varices with two elevated spines; aperture round-ovate, white within; canal as long as the aperture, subrecurved.

West Africa.

This shell has not been figured nor are dimensions given. I cannot, therefore, be sure that it belongs to this group. Sowerby (Thes. Conch.) refers *lignarius* to *M. quadrifrons;* I do not know whether it be this species, but the description of it does not agree at all.

M. HAUSTELLUM, Linn. Pl. 13, fig. 137.

This well-known species will end the section of typical Murices. Like *M. chrysostoma* it is never spinous. Adult specimens vary from 2 to 6 inches in length.

Red Sea, Ind. O., China, Mauritius, Philippines.

Sub-genus **Pteronotus**, Swainson.

This group may be advantageously restricted to those species possessing a muricoid operculum and three varices. Its position is somewhat difficult to define, inasmuch as its relationships are varied—with *Chicoreus* rather than with *Phyllonotus* perhaps, and on the other hand with *Cerostoma*:—which latter may include the forms, likewise with three varices, with or without the lip-spine which Conrad makes the typical character of his group, but with *purpuroid operculum*, and in general aspect forcibly suggesting a connecting link with *Purpura*. Kobelt has indeed, included such species as *Purpura plicata* and *lactuca* in his group of *Cerostoma*, but I think the line between the Purpuroid Murices and *Purpura* proper may be drawn just here, if anywhere—that *Cerostoma* is a normal *Murex* in its three continuous varices; whilst the numerous varices of *P. plicata* and its allies insensibly degenerate into shells without varices = typical Purpuræ.

It may be remarked that *Pteronotus*, as thus restricted, consists of East Indian and African species, whilst the distribution of *Cerostoma* is North Pacific, extending from the west coast of North America to Japan.

a. With two or three ribs or tubercles between the varices.

M. TRIGONULUS, Lam. Pl. 11, fig. 120.

Owing to the insufficiency of the original description and the want of reference to a published figure this species has been variously identified with several others since described. I prefer the decision of Reeve, because it relieves these other species from doubt. Kobelt gives "Antilles" as locality, which shows that he has supposed it related to the *motacilla* or *recurvirostris* group—which it certainly does somewhat resemble. Tapparone in quoting it from the Red Sea, confounds it with *triqueter*, Born, and Sowerby figures for it (Conch. Ill.) an example of *M. pellucidus*, Reeve. It will be seen that the form selected by Reeve to represent the species stands intermediate between *M. recurvirostris* and *M. triqueter*. I have before me a specimen said to come from Gambia. The shell is rosy-white, with two darker bands.

Length, 1·5 inches.

M. Sowerby, in his latest monograph (Thes. Conch.), makes the *trigonulus* of Reeve (not Lamarck) = *pulcher*, A. Ad., and gives the Red Sea as locality. Adams, however, described his *pulcher* as from St. Croix, W. Ind., 60 fathoms, M. Swenson; and I have made it a synonym of *M. recurvirostris*. Sowerby's figure of *pulcher* represents a *trigonulus*.

M. TRIQUETER, Born. Pl. 40, figs. 506, 515.

Length, 1·5 to 3 inches.

Red Sea, Ind. O., Philippines, Paumotus Is. (W. H. Pease).

M. roseotinctus, Sowb. (fig. 515), is a synonym.

M. RUBRIDENTATUS, Reeve. Pl. 40, fig. 507.

The foliated varices are not dentate as in *M. triqueter*, and the lip has a row of teeth tipped with red. Length, 2·5 inches.

Hab. unknown. Two sp. in Cumingian Coll.

M. BARCLAYI, Reeve. Pl. 41, fig. 535.

A much larger, wider species than *M. triqueter*, Born, with which it is frequently confounded, and which is its nearest ally. It is beautifully colored: pinkish, the ribs and varices golden yellow. Length, 3·5 inches.

Mauritius.

M. TRIFORMIS, Reeve. Pl. 40, fig. 511.

Uniform dull yellowish-brown. Shell thin, appearing as though not adult. Length, 2 inches. On oyster-banks in 2–10 fms. Probably fond of oysters.

Port Lincoln, Austr. (Angas).

M. BIPUNCTATUS, Sowb. Pl. 40, fig. 509.

Orange colored, the varices striped with red; two intervariceal purple spots on the shoulder. Length, 1·25 inches.

Austr.

Very close to *M. triformis*, Reeve; the purple spots are the only important distinctive character.

M. ACANTHOPTERUS, Lam. Pl. 40, fig. 512.

Whitish, stained more or less with light brown. Somewhat related to the preceding species. Length, 2·25 inches.

Watson's Bay, N. S. Wales (Angas).

M. ALABASTER, Reeve. Pl. 41, fig. 529.

Shell ivory-white. Length, 5·5 inches.

Philippines.

Only a single specimen known.

M. CANALIFERUS, Sowb. Pl. 40, figs. 519, 524, 510.

White. Length, 1 inch.

Hab. unknown.

M. cancellatus, Sowb. (fig. 510), is a synonym.

b. With one nodule between the varices.

M. LINGUA, Dillw. Pl. 40, figs. 513, 518.

White, more or less stained with brown. Length, 1·5–2 inches.

W. C. Africa.

M. flavidus, Jousseaume (fig. 518), of which a single dilapidated specimen is known, appears to me to be a synonym. Jousseaume's figure is named on the plate *M. rusticus*—a name preoccupied by Reeve, and therefore changed in his text to *M. flavidus.*

M. HEMITRIPTERUS, Lam. Pl. 40, fig. 516.

The whorls are slopingly shouldered, below which they are gradually attenuated to the end of the canal, and the varices are not so broadly fimbriated as in the preceding species. It is very probable, however, that it will prove to be only a variety of *M. lingua.* Length, 1·5 inches.

Senegambia.

M. ABYSSICOLA, Crosse. Pl. 40, fig. 520.

This little shell is finely decussated by growth and revolving lines, and has a single prominent tubercle between the varices. Pale brown, with a light chestnut revolving band. Length, 11 mill.

Guadeloupe, W. I.

Obtained by coral fishers at a depth of 500 metres.

Its resemblance to *M. lingua* is very close, and it may be remarked in this connection that many species of the Western Coast of Africa extend their range to the West Indies.

M. ADAMSI, Kobelt. Pl. 40, fig. 514.

Light yellowish or white, with a single rib between the varices. Length, 30 mill.

West Indies.

Described by A. Adams under the name of *alabastrum*—which is preoccupied by Reeve. Very like *M. triqueter*, Born, but differs in having only a single intervariceal rib.

M. MACROPTERUS, Desh. Pl. 40, fig. 517.

Of the same general appearance and color as the three preceding species, and appearing like a particularly well-developed *M. lingua.* The four-lobed, widely expanded, scabrous foliation of the marginal varix is its chief characteristic. Length, 1·5 inches.

Hab. unknown.

In the original figure the operculum approaches purpuroid, but the nucleus is scarcely marginal. It has evidently been carelessly figured. Reeve's figure has the typical operculum of *Murex.*

M. TRIPTERUS, Born. Pl. 41, fig. 531.

Columella and lip dentate, foliations very wide, oblique, regular. Light yellowish-brown, darker within the aperture.

Length, 2 inches.

Red Sea, Ind. O., Philippines (Upolu).

M. PINNATUS, Wood. Pl. 41, figs. 526, 530.

This well-known Chinese species attains a length of 2·5 to 3·5 inches. It is always pure white throughout. *M. pellucidus*, Reeve (fig. 530), "found upon a coral bottom at a depth of 7 fathoms, Island of Bantayan, Philippines," is evidently the same; in fact, I have before me a suite of specimens connecting the two forms.

M. CLAVUS, Kiener. Pl. 41, figs. 533, 534.

Whitish or flesh-colored. Length, 3·25 inches. In the young shell (= *M. bipinnatus*, Reeve, fig. 534) the nodes and revolving striæ are much more prominent.

Philippines.

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M. OSSEUS, Reeve. Pl. 41, figs. 525, 527.

Whitish, more or less tinged with brown. Length, 2·75 inches.

Hab. unknown.

This is the first of a group of species in which the foliated varices terminate on the shoulder of each whorl in a hooked spine. *M. Gambiensis*, Reeve (fig. 527), from the mouth of the Gambia, W. Coast of Africa, is evidently the same species, and I suspect that *M. uncinarius*, Lam., from Cape of Good Hope, will prove to be the young; I find no other difference than size between them.

M. SPECIOSUS, A. Adams. Pl. 41, fig. 532.

Ovate fusiform, whorls seven, spire acute; varices three, foliate, dilated into spines posteriorly; surface with revolving ribs and nodulous; aperture oval, canal straight, closed. Whitish tinged with red. Length, 3 inches.

No dimensions or habitat given in the original description, but said to be somewhat allied to *M. alabaster*. Mr. Sowerby has recently figured the species, and assigns Yokohama, Japan, as the habitat.

M. UNCINARIUS, Lam. Pl. 40, figs. 521, 523.

Shell whitish or light brown. Length, ·75 inches.

Cape of Good Hope.

Probably the young of *M. osseus.*

M. ANGASI, Crosse. Pl. 40, fig. 522.

Light yellow, with a violet band. The body whorl appears to be somewhat more swollen below than in *M. uncinarius* and the spines are shorter and more direct than in that species. Described as a *Typhis*, and as having two internodes, but the figures show only one large node. Length, ·75 to 1 inch.

Under rocks and stones low water.

Port Jackson, Austr.; New Zealand (= *Murex eos*, Hutton).

M. QUINQUELOBATUS, Sowb. Pl. 41, fig. 528.

Yellowish; the varices developed into five hooked fronds, connected by a narrow web-like lamina at their base.

Length, 28 mill.

Hab. unknown.

Possibly only a form of *M. uncinarius*, Lam.

Sub-genus **Chicoreus**, Montf.

The species are mainly oriental in distribution, yet there are well-defined groups inhabiting the seas of the West Coast of Africa, and the West Indies.

M. PALMA-ROSÆ, Lam. Pl. 14, fig. 140.

This may be taken as the type of a group of Indo-Pacific species, very closely related and yet readily distinguishable by minor characters. They are solidly built, with elevated spire and the spines are peculiarly frondosely branched. *M. palma-rosæ* may be recognized by the denticulated border of its inner or columellar lip. In its brownish hue, with darker tint on the raised revolving lines, and in its pink-tinted fronds it resembles other related species. Two or three longitudinal ribs are formed between the varices. Length, 4 inches.

Ind. O.

M. MAURUS, Brod. Pl. 14, figs. 138, 139, 142.

This species is usually smaller in size than the last and has no teeth on the columellar lip. The fronds also, have intermediate smaller fronds. Length, 3 inches.

Philippine to Marquesas Isles.

The type is dark colored, purplish; lighter colored specimens. tinged with pink are called *M. Sauliæ*, Sowb., (fig. 142) and a somewhat depauperate, small specimen has been figured and described by Reeve as *M. affinis*, (fig. 138).

M. MICROPHYLLUS, Lam. Pl. 14, fig. 144.

The fronds like in *M. maurus* but more stunted in growth; the shell is narrow, with spire much longer than the canal; the inner lip has a denticulate margin, like *M. palma-rosæ;* there are three ribs between the varices; the color is light brown with dark brown or purplish black on the revolving lines and fronds.

Length, 3 inches.

Ind. Ocean.

M. BANKSII, Sowb. Pl. 14, fig. 141.

Somewhat like *M. microphyllus* in form, but a thinner shell, the fronds more developed, the revolving lines neither so close nor so prominent, the ribs, three in number, merging into two as the shell becomes older. 3·75 inches.

Moluccas.

M. TORREFACTUS, Sowb. Pl. 14, figs. 143, 145; Pl. 15, fig. 151.

Like *microphyllus* this has a short canal, but it is usually a much stouter species; in fact the stoutest of the group. The fronds are as in *Sauliæ;* the inner lip is not denticulate on its margin and there is only one large tuberculous rib between varices, or at most with an occasional second, much smaller rib. Usually dark colored, but sometimes as light as *M. palma-rosæ* and like it pink-tinged. Length, 4 inches.

China.

The typical *torrefactus* may be regarded as a rather slim, elongated form of the species, the usual state of which is better represented by *M. Steeriæ* (fig. 151), one of its synonyms.

M. ADUSTUS, Lam. Pl. 15, figs. 148, 149; pl. 24, figs. 210-212; pl. 25, fig. 217.

Its jet black color, remarkably frondose spines, crowded even on the canal, and pink (sometimes yellow) lipped aperture, separates this species from *M. torrefactus;* which it resembles in having a single large rib between the varices.

Length, 3·5 inches.

Ind. O., Philippines, Japan.

Mr. E. A. Smith* has compared the type of *M. despectus* A. Ad. (fig. 211), with specimens of *adustus* and finds it to agree perfectly. The locality of *despectus* "West Indies" is certainly an error, as no species of this group is found there. The figure of *despectus* published by Sowerby leaves no room to doubt its identity with *adustus.*

M. rufus, Lam., (fig. 148), is the young of this species. *M. fuscus*, Dunker, and *M. trivialis* A. Ad., (fig. 212), are also founded on a young state. *M. Australiensis*, Angas, (fig. 210), and *M. Huttoniæ*, Wright, (fig. 217), may be classed as mere color variations of *M. adustus.*

M. PALMIFERUS, Sowb, Pl. 14, figs. 146, 147; pl. 24, fig. 215; pl. 25, fig. 218.

This is a small species, ranging from 1·5 to 2 inches in length, usually whitish with the long spire tipped with pink; the peculiarly scabrous surface is raised into two ribs between the varices. The fronds are short and so close as sometimes to form a continuous frill.

Red Sea, Ind. O., N. Austr.

M. corrugatus, Sowb., (fig. 147), does not differ and *M. dilectus*, A. Ad., (fig. 218), as well as *M. multifrondosus*, Sowb., (fig. 215), may also be added to the synonymy.

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* Ann. Mag. Nat. Hist. Ser. 4, xv. 419, 1875.

M. TERRITUS, Reeve. Pl. 15, fig. 152.

Closely allied to the above species in color and surface; the spines are so close as to form a continuous frill towards their bases, but they are longer, more direct and less frondose. The principal distinction is that this species has only one large tubercle between the varices—yet I have before me specimens of *M. palmiferus* in which one rib is much enlarged at the expense of the other. Until more specimens of *M. territus* are examined it must be considered a somewhat doubtful species.

Length, 2 inches.

Sydney, Austr.

M. PENCHINATI, Crosse. Pl. 15, fig. 150.

Much more narrowly elongate than *M. palmiferus*, and delicately tinted with rose-red, the revolving lines and fronds being darker; like *palmiferus* it has two ribs between the varices.

Length 1·6 inch.

Liu-Tschiu Islands.

In the index to his Thesaurus, Sowerby makes this a synonym of his *M. emarginatus.* These species are so different that I suspect he intended to quote some other name.

M. NUBILUS, Sowb. Pl. 15, fig. 153.

"A dusky, ordinary looking shell; and yet there is no other species which exactly corresponds with it," remarks Mr. Sowerby. Its principal features are the single, large inter-variceal rib and the three revolving brown bands. Length, 1·5 inches.

Hab. unknown (Coll. Cuming).

M. ROSSITERI, Crosse. Pl. 15, fig. 157.

The single specimen on which this species appears to be founded presents unmistakable evidences of depauperization in its depressed spire and suppressed spines—the latter only appearing on the lower part of body-whorl and canal. The red aperture and the single large rib between the varices show some relationships to *M. adustus.* Length 35 mill.

Lifou Isl., Loyalty Group, New Caledonia.

M. THOMASI, Crosse. Pl. 15, fig. 154.

Said to have three large, slightly spinous varices, and three intermediate smaller ones; the latter are probably only tubercles, or ribs, as the species is compared to *M. maurus*, Brod. Yellow-pink, pink within the aperture. Length, 1·8 inches.

Nouka Hiva ; Marquesas Archipelago.

This is also a depauperated shell; it has close relationships with *M. Rossiteri*, Crosse.

M. CERVICORNIS, Lam. Pl. 15, fig. 155.

Readily distinguished from all others by its bifurcated spines. White to fulvous. 2 inches.

Ind. O., Torres Sts., Austr. 20-30 *fms.*

M. LONGICORNIS, Dunker. Pl. 15, fig. 156.

The double series of very long, closed variceal spines, devoid of fronds give this shell a very distinctive character, causing the body-whorl to appear biangulate and the spire babylonic. Light brown, revolving lines darker. Length, 3 inches.

Amboina.

M. MONODON, Sowb. Pl. 16, fig. 158.

This has the same long spines as the preceding, but they are more curved, somewhat frondose and three in number on each varix of the body-whorl, whilst on the upper part of the canal there is another very long spine curving backwards so as to form almost a semicircle; there are many smaller spines and the external lip is also spiniferous, including, inferiorly, a long, direct tooth. Whitish or brownish, aperture red.

Length, 4½ inches.

Torres Sts., Austr.

M. AXICORNIS, Lam. Pl. 16, figs. 161-164.

There are from two to three longitudinal ribs between the varices, and the latter are frondosely spinous; upper spine long and curved, appearing on the spire whorls; there is a shorter prominent spine on the lower part of the body-whorl, and another, still shorter, between the two; there are also several well-developed spines on the canal portion of the varices. Yellowish-white to dark brown, the raised revolving lines darker.

Length, 1·5 to 4 inches.

Ind. Archipelago.

Messrs. Higgins and Marrat have described *Murex imbricatus* (fig. 163), said to have been dredged in Carinage harbor, Island of Grenada, W. I. The shell figured by them (and which I copy) agrees in all particulars with specimens of *M. axicornis* before me from undoubted East Indian localities, as well as with published figures of that species by Sowerby and Reeve. I do not doubt its identity. The Swift collection, the largest West Indian collection of shells in existence, contains nothing like this form, and I cannot help thinking there must be some mistake about the locality. *M. spectrum*, Reeve, (fig. 162), of which there is a single specimen in the Cumingian collection is also a synonym and *M. aculeatus*, Lam., (fig. 164), is scarcely different enough to constitute a variety.

M. RUBESCENS, Brod. Pl. 16, fig. 160.

Thick, fusiform; varices tuberculate, with a few very short fronds; one large rib between varices. Orange red, the tubercles and revolving lines brown. Length, 1·8 inches.

Coral Reefs, *Taheiti.*

M. ANGULIFERUS, Lam. Pl. 17, figs. 165, 166; pl. 24, figs. 213, 216.

This may be regarded as the type of a series of species distinguished by their pyriform, angulate shape and short spines. *M. anguliferus* has usually only one very prominent node between the varices, and the mouth is bordered with pink. The surface is either light brown with sometimes a medial, darker band, or dark brown, not banded—the latter forming the var. *ferrugo* (fig. 166). It is the largest species of the group, measuring nearly 4 inches.

Red Sea, Ind. O., Seychelles, Isle Bourbon.

I follow Sig. Tapparone-Canefri, who has made a special study of the Murices of the Red Sea, in making *M. Erythræus*, Fischer, a synonym of this species. *M. cyacantha*, Sowb. (fig. 213), is also a synonym, and *M. ponderosus*, Chemn. (fig. 216), is a small, thick-shelled variety.

M. CLAUSII, Dunker. Pl. 24, fig. 214.

Shell yellowish-brown, more or less clouded with light chocolate color, chocolate within the aperture. Length, 2·5 inches.

Gulf of Guinea, W. Africa.

Said to differ from *M. Senegalensis* principally in having only a single intervariceal node, more tumid and turbinate form, etc.

I have before me specimens, however, which are very suggestive of its derivation from the typical *Senegalensis*.

M. SENEGALENSIS, Gmel. Pl. 16, fig. 159; pl. 17, figs. 168, 169.

Body superiorly angulated, and armed on the varices with a single, more or less produced spine, not frondose; varices nodose, but usually not spinous elsewhere; inter-ribs usually two or three, whitish or brownish; generally, in fresh specimens, banded with brown; aperture varying from flesh to chocolate color. Length, 1·5–2 inches.

Senegal, Rio Janeiro.

I have a good suite of specimens which enables me to connect satisfactorily *M. calcar* with this species; it may be designated as a variety, however.

VAR. CALCAR, Kiener (fig. 169).

The shell is whitish, with fimbriately-laminated varices bearing, superiorly, a long spine, which is not frondose. Length, 2–3·5 inches.

Senegambia.

M. pliciferus, Sowb. (fig. 168), is apparently the same as *M. calcar;* it was described from a single specimen in the Cumingian collection.

M. GUBBI, Reeve. Pl. 17, fig. 167.

Of triangular fusiform shape, compressed on the lower part of the body; with slight spines except around the shoulder, where they are well developed. The aperture is toothed within, and white; the rest of the shell blackish-brown. Length, 1·75–2·5 inches.

W. C. Africa.

M. CAPUCINUS, Lam. Pl. 19, fig. 174.

Shell narrow, with elongated spire; varices thick, depressed, fimbriated but not spinous, or but slightly so; with nodulous, revolving, elevated lines, and two inter-variceal nodes. Chocolate color; usually same tint within the aperture—the outer lip of which is denticulate. Length, 2·5 inches.

Philippines? Valparaiso, Porto Rico.

The two latter localities are authentic, the first is that given in the books, and is doubtful. It should be found on the West

Coast of Africa, as it has unmistakable affinities with the preceding species.

M. RAMOSUS, Linn. Pl. 1, figs. 1, 2.

The present species appears to be distinguished from its relatives in being more pyriform in shape, the spire shorter, the lips tinged with rose-pink. It is the largest species of the genus, reaching sometimes a foot in length and acquiring considerable solidity. Younger specimens, varying from 3 to 4 inches, are considerably more frondose.

Red Sea, Ind. O., Hong-Kong, Isle of Bourbon, N. Zealand, Austr., Cen. Pacific O.

Very commonly used as chimney-place and mantle-shelf ornaments throughout the civilized world.

M. ELONGATUS, Lam. Pl. 20, fig. 183.

Longer and narrower than *M. ramosus*, with the same tooth on the edge of the outer lip; but usually darker or brownish, the interior of the aperture not red, but white or chocolate-brown.

Length, 4·5 inches.

Ind. O., China.

M. Sinensis, Reeve, is a synonym, but the *elongatus* figured in Reeve = *brevifrons*, Lam., a species readily distinguished by the absence of the tooth on the outer lip.

M. BREVIFRONS, Lam. Pl. 18, figs. 171–173; pl. 19, figs. 175, 179, 180.

I unite under this, the oldest name, a dozen species inhabiting both the East and West Indies, and which possess typically certain distinctions. The union of most of these forms has already been surmised by several good conchologists, and the very large series of specimens at my command enables me to supply connecting forms which remove all doubt upon the subject. If these shells were all inhabitants of one faunal province exclusively, this union would seem more natural, yet there is no means of distinguishing a typical *M. calcitrapa* (fig. 175) from the Indian Ocean, from a West Indian specimen. Usually, the shell is frondosely spinous, rather thin, with two ribs between the varices; covered with close revolving striæ, of which those that develop the variceal spines are larger and more elevated. The color is yellowish to dark brown, and the smaller striæ are usually colored in bands of a chocolate color. Within the aperture, generally white, sometimes chocolate. When the shell becomes adult, and especially in West Indian specimens, it takes the form described by Lamarck as *M. brevifrons* (fig. 172). The spines are then thicker, shorter, not so frondose, the two ribs generally run into a single, large one, and the shell is very thick and heavy. Mr. Krebs * states that he has collected specimens taken out of the eggs and in every stage of growth thereafter, and that they fully prove the identity of *M. calcitrapa*, *M. brevifrons* and *M. purpuratus* (fig. 173). "It is proper to remark that some specimens have one and others have two nodules between each varix, although taken out of one cluster of eggs, but all the old and full-grown specimens have only one nodule, some with a very faint indication of a second; young specimens have no sculpture before the fourth or fifth whorl." Egg-clusters deposited on blue mud in smooth water, 10 or 12 feet below the surface.

Red Sea, Ind. O., China, Brazil, West Indies.

The West Indies is certainly the metropolis of this species, and I cannot help thinking that possibly the eastern localities have arisen from error, either directly or by identifying with this species shells which belong to other species, as *axicornis*, *Banksii*, etc. *M. elongatus*, Lam., as elaborated in the second edition of the Anim. sans Vert. by Deshayes, includes references to ancient figures which represent our American species as well as exotic, but I follow Sowerby in restricting it to an East Indian form with tooth on lower part of lip, and more nearly allied to *M. ramosus*. *M. purpuratus*, Reeve, is a light-textured specimen of the adult (= *brevifrons*); I have similar specimens. *M. florifer*, Reeve (fig. 180), from Honduras, is a rather stout, young shell. *M. crassivaricosus*, Reeve (fig. 179), is a still younger state. A somewhat longer, narrower form, darker in color, is the shell figured by Reeve as *M. elongatus* (fig. 171) (= *approximatus*, Sowb.), and to this form we may add the abused specimen which Bernardi has called *M. Toupiollei* (fig. 186).

* "The West Indian Marine Shells," 1864.

M. CROCATUS, Reeve. Pl. 19, fig. 181; pl. 20, fig. 192.

There are two to three intervariceal ribs, which are more or less nodulous. Surface orange or amber color, white within the aperture. Length, 1·5–2 inches.

St. Thomas, West Indies.

I had at first arranged this species and its synonym, *M. pudoricolor*, Reeve (fig. 192), in the synonymy of *M. brevifrons*, as juvenile specimens; and I still have doubts of its specific distinctness. The shell, however, appears to be mature, notwithstanding its much smaller size, and the peculiar color is constant in a number of specimens before me.

M. LACINIATUS, Sowb. Pl. 20, figs. 184, 185, 187.

Closely allied to the well-known West Indian *M. pomum*, Gmel., but somewhat narrower, smaller, and differs in color. It is brownish, with a tinge of pink, and darker bands, and the aperture is reddish within. Length, 2 inches.

Red Sea, Philippines.

M. scabrosus, Sowb. (fig. 187), is a somewhat larger, denuded specimen.

M. Jickelii, Tapp. (fig. 185), described from a single Red Sea specimen, appears to be the same.

M. LAQUEATUS, Sowb. Pl. 20, fig. 190.

Varices slightly frondose, with a single intermediate rib. Light brown or yellowish. Length, 1 inch.

Hab. unknown.

Possibly a variety of *M. fasciatus*, Sowb.—of which I have specimens before me nearly as narrow in form, and which is occasionally also three variced.

M. ANGISTOMA, Küster. Pl. 20, fig. 189.

Described as having a single tubercle between the varices, although the figure shows two. Whitish, the revolving ribs brown. Length, ·8 inch.

Hab. unknown.

Possibly a worn specimen of *M. fasciatus*.

M. POMUM, Gmel. Pl. 20, figs. 182, 188.

I end the series of *Chicoreus* with this species, which in form approaches nearest to the more numerously variced section *Phyl-*

lonotus, as I commenced it with those species most resembling the true Murices (*Tribulus* group). It is readily recognized by its form, its peculiarly rough, scabrous and nodulous surface, its close succession of frills on the varices, its dark chocolate bands, particularly visible on the outer lip, its tuberculate columellar lip, frequently also tinged with chocolate.

West Indies.

M. Mexicanus, Petit, (fig. 188), and *M. oculatus*, Reeve, are in no way distinguishable. The description of *M. Salleanus*, A. Ad., also applies well to this species, and a specimen received recently from Mr. Sowerby under this latter name is certainly identical. I figure the embryonic shell, enlarged, and a group of egg-cases from St. Thomas, W. I., (pl. 7, figs. 72, 73).

Sub-genus **Rhinocantha** H. & A. Ad.

M. BRANDARIS, L. Pl. 21, figs. 193-195.

Med., W. C. of Africa.

A variety of this species with three rows of spines, occurring at Gibraltar, has been separated as distinct by Frauenfeld, who has revived for it the name *M. trifariospinosa*, Chemn., but as Von Martens has shown (Zool. Record, 1869), the character is not constant, and sometimes only one instead of the usual double row of spines occurs. Eaten by the poorer classes but not much esteemed.

M. CORNUTUS, L. Pl. 21, figs. 196-198.

W. C. of Africa.

The curious variety which Mr. Sowerby calls *M. tumulosus*, (fig. 198), whilst unmistakably belonging to this species yet, by its smaller size, short, direct spines and general aspect indicates a tendency towards *M brandaris*. The two species, though closely allied, are readily distinguished ordinarily. Is *M. tumulosus* a hybrid?

Sub-genus **Homalocantha** Mörch.

M. SCORPIO, Linn. Pl. 25, fig. 225.

The color of this well-known type varies from pure white to chocolate-brown, the varices and spines being generally dark colored. Length, 1·5-2 inches.

Moluccas, Philippines.

M. ROTA, Sowb. Pl. 25, figs. 219, 220.

Very similar to *M. scorpio*, but not so scalariform, the suture not so much excavated, the whorls fuller, the varices palmated, the canal shorter. Whitish. Length, 2 inches.

Philippines, Moluccas, Per. Gulf, Red Sea.

M. SECUNDUS, Lam. Pl. 25, fig. 221.

Smaller than *M. rota*, with five varices, that of the margin much more numerously digitated, but the digitations not palmate at the end. Brownish, spines and varices darker.

Length, 1-1·5 inches.

Philippines.

M. VARICOSUS, Sowb. Pl. 25, figs. 222, 224.

Has more varices than the three preceding species, counting from six to eight; marginal digitations palmate, more numerous than in *M. scorpio* or *M. rota*. Whitish or light brown, varices dark brown. Length, 1-2 inches.

Red Sea, on Madrepores.

I do not find any essential characters by which to separate *M. digitatus*, Sowb., (fig. 222).

M. FENESTRATUS, Chemn. Pl. 25, fig. 223.

An elegant shell, of marked individuality. The specimens usually seen in cabinets are, however, much worn; so that but little or no trace of the fimbriated spines remains. Ordinarily five to six varicose. The coarse lattice-work of ribs and interstices of dark colored pits which cover the surface is very characteristic.

Length, 1·5-2 inches.

Philippines, Red Sea.

Sub-genus **Phyllonotus,** Swains.

M. ROSARIUM, Chemn. Pl. 22, fig. 199; pl. 28, fig. 255.

Shell covered with coarse revolving ribs, which are tuberculate on the seven or eight scaly varices and on the single intermediate ribs. Yellowish brown, with three interrupted chocolate bands; rose color, with three deeper bands within the aperture.

Length, 3 inches.

Senegal, Fernando Po.

M. ananas, Hinds, is said to resemble *M. rosarium* "in its size and proportions, but finds its specific distinction in its greater massiveness, the superior size of its upper series of spines, and the absence of nodules on the interstitial ribs. Both shells have a distinct fasciation of three dark bands, but our species is entirely wanting in that beautiful and elegant covering of striæ which is so conspicuous in the fine specimen of *M. rosarium* in Mr. Cuming's collection." Not figured. (Mus. Cuming.)

W. C. of Africa.

This is very probably a *M. rosarium*. *M. bifasciatus*, Sowb., (fig. 255), is a variety.

M. BRASSICA, Lam. Pl. 22, fig. 200.

Shell with six to eight flat, folded varices, with serrated edges becoming spinous towards the base; a large spinous tubercle arises on the shoulder of the whorls behind each varix, giving the shell a somewhat coronated appearance; on the body-whorl there are occasional tubercles, two or more in a single longitudinal series between the varices; surface covered with fine, elevated revolving striæ. Light brown, whitish or pinkish, with three brown revolving bands; fimbriæ of the varices and aperture bright pink. Length, 6 to 8 inches.

Mazatlan, Gulf of California.

M. rhodocheilus, King, is described from a small specimen, which is perfectly typical. *M. brassica* is the largest species of Phyllonotus.

M. REGIUS, Wood. Pl. 22, figs. 201, 202.

The six to eight varices consist each, of a double row of serrated spines, and the interspaces are simply covered with revolving striæ. Brown, more or less tinged with pink, especially on the varices; aperture bright pink, deepening into black on the columellar lip. Length, 4 to 5 inches.

Panama to Mazatlan.

M. tæniatus, Sowb., (fig. 202), Gulf of California, is the young of this species.

M. BICOLOR, Val. Pl. 23, fig. 204; pl. 22, fig. 203.

Resembles the preceding species but is distinguished by its less luxuriently fimbriated and spined varices, which are fewer in number, usually four or five, with single spinous ribs in the interstices. Exterior light yellowish brown, aperture pink, which does not become black on the columellar lip. Length, 6 inches.

Panama to Guaymas.

M. hippocastaneum, Phil., (fig. 203), is a young specimen of this shell, in not very good condition, said by him to come from Chili.

M. IMPERIALIS, Swains. Pl. 23, fig. 206.

Four or five varicose, the varices stout; rounded, depressed tuberculate, but scarcely spinous; usually an interstitial, nodulous rib; spire pointed, conical. Shell very thick and heavy. Light brown, sometimes with a darker band; aperture sulphur-yellow or pink, in the latter case sometimes black on the columellar lip. Length, 4 inches.

Isle of Margarita, W. I.

This shell is generally attributed to the Pacific coast of North America, which appears to be a mistake. Its different zoological region taken in connection with its great solidity may serve to distinguish it from *M. bicolor* and *M. regius*, both of which it mimics so closely in coloration; it appears to hold the same relation to these species that the var. *M. calcitrapa* does to *M. brevifrons*. It also has relationships with the West Indian *M. pomum.*

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M. SAXATILIS, Lam. Pl. 27, fig. 245; pl. 26, fig. 226.

Varices six to eight, singly spinous, the spines somewhat frondose, those on the shoulder of the whorls usually larger and curved; no interstitial ribs. Light yellowish brown, usually more or less pink-banded; aperture pink, with three or four darker bands. Length, 6 to 8 inches.

Ind. O., West Coast of Africa.

The Museum of the Academy of Natural Sciences of Philadelphia possesses a fine series of this species from the Gabon coast of Africa, some of which have all the richness of color and size of the finest Indian Ocean specimens. Dr. Fischer has described *M. hoplites*, (fig. 226), from the West African coast distinguishing it by possessing eight varices instead of six, and by its smaller size. The specimens before me are seven to eight variced, and some of them correspond well with the figure of *M. hoplites.* A starved condition of the animal is shown by the multiplication of varices or rest periods, less luxurient spines or fronds and smaller size :—such is *M. hoplites.* I cannot doubt its identity with *M. saxatilis.*

M. ENDIVIA, Lam. Pl. 26, figs. 227–229.

Whorls ventricose, becoming flat-shouldered and thick with age; transversely ridged and striated; with six to seven frondose varices, the fronds elevated, recurved. Yellowish-brown, frequently banded with a darker tint, fronds usually dark brown or blackish; aperture white, or lips tinged with pink.

Length, 4 inches.

Ind. O. (?), Philippines.

Mr. Broderip described the variety with declinate, flat shoulders as *M. saxicola*, and Dunker has called it *M. depresso-spinosus* (fig. 229); it bears the same relation to the typical form as does a variety of the Mediterranean species *M. trunculus.* I have seen specimens of an all-white variety (var. *albicans*) from the Philippines.

M. Norrisii, Reeve (fig. 228), (no locality given), appears to me to be the young of var. *albicans.*

M. CORONATUS, A. Adams.

An ovate-trigonal shell, fuscous, with conical spire; there are six flattened whorls, angulated behind, with four revolving liræ and numerous intermediate smaller ones; seven varices, fimbriated and laciniated, widely uncinate behind; aperture oblong, acuminated in front, outer lip fimbriated; canal short.

Tsusaki, Japan; 35 fathoms.

"A somewhat small, neat species, with the whorls very prettily coronate." No dimensions are given. Appears to be related to the preceding species. Sowerby (Thes. Conch., fig. 199), has figured a specimen of *M. sobrinus*, A. Ad., in error, for this species.

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M. HUMILIS, Brod. Pl. 26, figs. 234, 235.

Pyriform, the whorls depressed on the shoulder, spire rather short and canal longer; eight frondose varices, crossed by distant revolving costæ. Light brown, pink-tinged.

Length, 1·5 inches.

St. Elena, W. C. Cen. America.

M. octogonus, Sowb. (fig. 235), said to come from New Caledonia, and described from a specimen in the Cumingian collection, appears to me to be a depauperated specimen of the same species. The specific distinction pointed out by Sowerby does not hold good against the more perfect specimen of *M. humilis* figured by Reeve.

M. MULTICRISPATUS, Dunker. Pl. 26, fig. 231.

Pyriform, with ten frondose varices, the spines of which form a coronal on the body; transversely ribbed, ribs alternately larger. Light brown, the larger ribs chocolate colored as well as the fronds. Length, 2 inches.

Pacasmayo, Peru; found on a reef, at a depth of 25 fathoms, 12 miles from shore.

This shell was originally described by Broderip as *M. crispus;* which name was pre-occupied by Lamarck for a fossil species.

M. MELANOMATHOS, Gmel. Pl. 26, fig. 230.

Globosely pyriform, with eight spinous varices, crossed by revolving ribs; some of the spines erect, long, especially those on the lip-varix. Whitish or yellowish, spines frequently black.

Length, 2·25 inches.

Real Llejos, W. C. Cen. America.

This, and the two preceding species, may hereafter prove to be identical.

M. FIMBRIATUS, A. Adams. Pl. 26, fig. 240.

Shell pyriform, fulvous; shoulder excavated and crossed by wing-like continuations of the seven digitated varices. Aperture ovate, external margin crenate, canal attenuated.

Length, 1·45 inches. *Gulf of California.*

I place this species here with considerable doubt, as it has other relationships which are quite as close, judging from Sowerby's figure of the back of the shell. It is allied to *M. gemma*, for instance, which I have considered a variety of *M. incisus;* it has also the appearance of a *Vitularia.*

M. STAINFORTHII, Reeve. Pl. 26, fig. 237.

Ovate, with seven to eight frondose varices, fronds alternately larger, short, close-set, sharp; with revolving, alternately larger ribs. White, fronds dark brown or black. Length, 2·25 inches.

N. Austr.

M. ANGULARIS, Lam. Pl. 26, figs. 241, 239.

Ovate, spire elevated, body-whorl more or less shouldered, varices five to eight, frondose, the fronds on fresh specimens raised into short, sharp spines; with alternately larger, revolving lines of darker color, on a light brown surface; spinous fronds blackish. Length, 1·5 inches.

Senegal.

Spire more elevated, spines longer, not so close-set, less frondose than preceding species. Frequently the varices are denuded of fronds altogether, and are simply nodulous, and in this state the resemblance to *M. fasciatus,* Sowb., is rather suggestive of their identity. I think that M. *tenuis*, Sowb. (fig. 239), may = *angularis*, juv.

M. FASCIATUS, Sowb. Pl. 20, fig. 191; pl. 26, figs. 232, 236, 238.

Shell thick, varices seven or eight, sometimes only ribs, so that in occasional specimens the number of true varices is reduced to three (fig. 191); surface covered with revolving, rib-like striæ. Light brown, the varices darker; frequently the entire surface is variegated with rufous bands on the revolving striæ. Outer lips thickened, dentate-lirate within; aperture white. Length, 1·25–1·5 inches.

W. C. of Africa.

M. angularis, Lam., when denuded of spines, much resembles this species, but is thinner. It is singular in forming indifferently ribs or varices, varying in number. I figure a specimen from Cape Verde Isles sent to me by Mr. Sowerby as *M. lyratus,* A. Ad. (fig. 236); it appears to me = this species; as does also the figure of *lyratus* in Thes. Conch. (fig. 238).

M. FIMBRIATULUS, A. Ad. Suppl. pl., fig. 537.

Ovate-fusiform; light fuscous; spire produced; whorls six, convex, longitudinally nodosely subplicate, transversely lirate, lines squamulose, equal, crowded; aperture ovate, entire; outer lip elegantly fimbriated, fimbriæ wide, laciniated on the margin; canal straight, produced, closed. There are no varices on the whorls, except the broad, fimbriate one which margins the outer lip. It is an elegantly formed species with squamulose liræ crossing the very convex whorls. Fawn or light-reddish, with a narrow, interrupted darker median band; pale pink or flesh color within. Length, 19 mill.

Japan.

Described as a *Trophon*—which it certainly is not. Mr. E. A. Smith has recently published a figure of the species, which we copy.

M. NITIDUS, Brod. Pl. 26, fig. 233; pl. 27, figs. 242, 243.

Ovately pyriform, ventricose, spire short, body-whorl shouldered; with flat, broad revolving ribs, which, as well as the interstices, are covered with close fine striæ; varices eight to thirteen in number, frondose, the alternate fronds much largest, long, spinous. Whitish, ridges and fronds black. Length, 4–7 inches.

Mazatlan.

I give to this species its oldest name, which was, however, applied to a young specimen. The adult has been described as *M. nigritus*, Phil. (fig. 243), under which name it is more generally known. *M. ambiguus*, Reeve (fig. 242), is not entitled to distinction even as a variety.

M. RADIX, Gmel. Pl. 27, figs. 244, 247, 248.

Shell globose, very solid and thick, spire and canal very short; spirally ribbed; varices ten to fifteen, very close set, prickly with stout, short, sharp spines. Color whitish, ribs and spines black; but the latter are so close as to give the shell a black appearance. Length, 3 to 5 inches.

Panama.

Although belonging to a different zoological province, I think that the differences between this and the preceding species are due to a more stunted and slower growth in *M. radix*, and that eventually they will be found to merge one into the other, when numerous localities between their respective stations shall be ex amined. If my surmise should prove correct, the species must bear the name of *radix*.

M. PRINCEPS, Brod. Pl. 28, fig. 250.

Pyriform, spire rather longer than in *M. nitidus* and with a shoulder on the whorls; varices five to eight, raised into distant spines, of which a single series on the shoulder of the body, and continuing on the spire is much more prominent. Whitish, ribs and spines sometimes chestnut brown.

Length, 2·5 to 4 inches.

W. Coast Central Am.

A beautiful species; the operculum is not fimbriated like that of *M. radix*.

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M. TURBINATUS, Lam. Pl. 28, figs. 252, 257.

Ovate-pyriform, somewhat angulated on the periphery and flattened above it; with revolving raised ribs and six to eight varices; the latter tuberculate or shortly spinous on the angles of the whorls. Whitish or yellowish, with brown bands, most prominent on the varices; aperture white or pink, columella bright pink. Length, 2·5 inches.

Senegambia.

The *M. turbinatus* figured by Sowerby (Thes. Conch., fig. 185), is *M. rosarium*, Chemn. *M. spinosus*, A. Ad., (fig. 257), is a synonym of *turbinatus*, being merely a thickened variety. The same form has been described by M. Tapparone-Canefri from sub-fossil specimens under the name of *M. Küsterianus*.

M. BECKII, Phil. Pl. 28, fig. 249.

Very like *M. turbinatus*, but wants the tuberculations on the varices, whilst it is heavier and more spinous. Light brown externally, pink within the aperture. Length, 3 inches.

Hab. unknown.

May be a form of *M. turbinatus* and also possesses characters in common with *M. spinicostata*.

M. spinicostata, Val. Pl. 23, fig. 207; pl. 28, fig. 251.

Very closely allied to the three preceding species, and may prove to be identical with them. It is more spinous and less frondose, larger in size and different in color, being white with pink brown on the principal narrow ribs; it comes moreover from the West Indies. A single, much battered dead specimen found at Beaufort, North Carolina. Length, 5 inches.

M. Hidalgoi, Crosse. Pl. 27, fig. 246 a.

Somewhat thin; uniform light brown; varices six, frondose, long spiny on the shoulder; lip varix broad, fimbriate spinose.

Length, 1·4 inches.

Dredged from coral beds in *West Indies,* at great depth.

Its nearest ally is *M. spinicostata*, Val.; from which it is distinguished by its smaller size, shouldered whorls and more foliated varices.

M. quadrifrons, Lam. Pl. 17, fig. 170; pl. 19, figs. 176-178; pl. 28, figs. 254-256.

Varices four, the inter-space with one not very prominent tubercular rib and sometimes a trace of a second. Yellowish or brownish. Length, 2·5 to 4 inches.

West Africa.

This was at first supposed to be an accidentally four variced variation of *M. brevifrons*, Lam., but the occurrence of specimens in the Taylor collection recently studied by Mr. Sowerby, the agreement with a miocene four variced fossil species named by Mr. Tournouer *M. Bourgeoisii*, (fig. 256), and a fine example in our collection in Philadelphia, make it expedient to treat it as distinct. *M. megacerus*, Sowb., (figs. 177, 178), (= *M. Moquinianus*, Duval, fig. 170), appears to be a variety of lighter growth. Mr. Sowerby (Thes. Conch.) admits the identity of his *M. castaneus*, (fig. 176), with *M. quadrifrons.*

M. varius, Sowb. Pl. 27, fig. 246; pl. 28, fig. 253.

Subrhomboidal, with revolving, alternately larger, bead-like striæ; varices four to six, spinous at the shoulder and occasionally so elsewhere, otherwise tuberculate. Whitish or light brownish, the lines and spines darker in color.

Length, 1 to 2·5 inches. *West Africa.*

This species is usually represented by specimens of the smaller dimension; it will probably prove to be the young of *M. Beckii* or *M. turbinatus.*

M. TRUNCULUS, L. Pl. 23, fig. 205; pl. 29, figs. 258-261.

The commonest species of Southern Europe, being found everywhere throughout the Mediterranean Sea as well as from the southern Atlantic coast of France to Senegal and the Canary Islands; also Red Sea? Fossil, as far back as the miocene. Varies much in form, as shown by our figures. Usually light brown, with about three broad purplish bands—which are very distinctly marked within the aperture.

Length, about 3 inches.

M. turbinatus, Lam., and *M. Beckii*, Phil., are analogous species from the West Coast of Africa.

M. ZELANDICUS, Quoy and Gaim. Pl. 29, fig. 268.

Pyriform, spire short, canal rather long; with five rows of varices armed with sharp spines, of which those round the shoulder and the lower part of the body-whorl are much longer than the others. Yellowish-brown. Length, 2 inches.

Cook's Straits, New Zealand.

I copy one of the original figures, including the animal. It does not appear to resemble any of its congeners closely.

M. CRISTATUS, Brocchi. Pl. 29, figs. 263, 267.

Shell whitish or yellowish, frequently darker, or chocolate colored within the aperture. Length, 1·5 inches.

Mediterranean, Atlantic Coasts of So. Spain to Senegal; Madeira. Littoral to 40 fathoms. Fossil; miocene and pliocene of *So. Europe.*

M. Blainvillei, Payr., (fig. 265), is merely a small variety of this species. The columella is somewhat tuberculate towards the base and the lip has a few large teeth within; these characters in connection with the less spiny, but more frondose varices will distinguish it from the nearly related *M. hexagonus*, Lam. *M. serotinus*, A. Ad., is, according to Sowerby, a synonym.

M. DIADEMA, Aradas and Benoit. Pl. 29, fig. 265.

Length, ·5 inch.

Mediterranean at Palermo.

M. HEXAGONUS, Lam. Pl. 29, fig. 262.

Usually pale yellow; operculum dark brown, its initial point sharp. Length, 1 to 1·75 inches.

West Indies.

M. DUBIUS, Sowb. Pl. 29, fig. 266; pl. 30, fig. 275.

Yellowish to chestnut brown, the spinous tubercles darker.
Length, ·75 to 1·25 inches.

Panama.

Var. *squamulata*, Carp.
Shell white; minutely imbricately squamose.

Cape St. Lucas.

Closely allied to *M. cristatus* and *M. hexagonus*. It has been referred to *Sistrum* on account of its tuberculate (almost plicate) columella and teeth within the lip, but its operculum is muricoid.

M. PAZI, Crosse. Pl. 29, figs. 269-271.

A remarkable shell dredged at considerable depth with corals in the West Indies. It has seven varices, a rather short but sharp spire and long spines on the shoulder. Color milk white.
Length, 1·4 inches.

The type figured appears to be much distorted. Sowerby figures a better example. Looks very like a miniature edition of *M. spinicostatus*, Val.

M. PAUXILLUS, A. Ad. Pl. 29, fig. 264.

Very small, narrowly elongated; varices seven, crossed by a few elevated ribs, forming short, sharp fimbriations; shouldered, spire elevated, sharp; aperture narrow, lip with five internal teeth, canal short, partly open, purplish, the revolving ribs usually white. Operculum like *Murex*.
Length, ·5 inch.

Mazatlan.

M. ANGASI, Tryon, (*M. scalaris*, A. Adams).

Shell scalariform, whitish, variegated with reddish-brown; whorls shouldered, the last with nine rounded varices and rather distant revolving liræ, which become spinulose on the varices; canal sub-produced; lip lirate within.

So. Australia.

Said to resemble *M. cristatus*, Brocchi. Possibly identical with *M. octogonus*. As Brocchi, has used the name for a fossil species, this may be known as *M. Angasi.*

M. OCTOGONUS, Quoy and Gaimard. Pl. 30, figs. 272-274.

Shell eight varicose, varices fimbriately spinose. Reddish brown, violet and striated within the aperture. The animal has a reddish mantle, sides of the foot, head and tentacles yellowish with red striæ, locomotive disk whitish. Length, 1·4 inches.

Bay of Islands, New Zealand; Japan.

M. cuspidatus, Sowb., (fig. 274), is a synonym.

M. DIPSACUS, Brod. Pl. 30, figs. 277, 281.

Length, 1 inch.

St. Elena, W. Columbia; from a rocky bottom at the depth of 12 fathoms. —Cuming.

Reeve has figured as *M. octogonus*, Quoy, a shell which Sowerby described as *M. Peruvianus*, (fig. 281), and which, I think, is the same as *M. dipsacus*. It comes from Pacasmayo, Coast of Peru.

M. VITTATUS, Brod. Pl. 30, figs. 280, 279.

Seven varicose, short spiny; canal open. White with narrow purple-black revolving bands. Length, ·85 inch.

Bay of Guayaquil; sandy mud, at 11 fathoms.

M. lepidus, Reeve, (fig. 279), described without locality, does not appear to me to differ.

M. BALTEATUS, Beck. Pl. 30, fig. 278.

Seven varicose. White tinged with pink, lips pink, spines and tubercles tinged with brown. Length, 1 inch.

Philippines; on coral reefs.

M. NODULIFERUS, Sowb. Pl. 30, figs. 282, 288.

The shouldered whorls give the spire a babylonic appearance; two distant ribs revolve on the middle of the body, forming a pair of fronds on each varix; a smaller frondose rib encircles the canal; the aperture is denticulate within and, like *M. cristatus*, there are small tubercles on the lower part of the columella. White, the fronds tinged with brown.

Philippines; Upolu, Navigator's Islands.

Murex (*Trophon*) *fruticosus*, Gould, (fig. 288), is the same species, described from worn specimens. In the index to his latest monograph of *Murex* (Thes. Conch.) Sowerby refers this species, doubtfully, to *Purpura*.

M. euracanthus, A. Ad. Pl. 30, fig. 287.

This differs from the preceding, (with which it has been confounded by Reeve), in the double series of short fronds being replaced by long, straight, hollow spines.

Length, ·75 inch.

It is probably only a well-developed specimen of *M. noduliferus*. *Hab. unknown.*

Sowerby (Index to *Murex*, Thes. Conch.) refers it to *Purpura* doubtfully.

M. cirrosus, Hinds. Pl. 30, fig. 285.

Six to nine varicose, crossed by about six ribs, forming sharp, spinous processes—these form a coronal on the shoulder. Light brown, varices whitish. Length, ·75 inch.

Sts. of Macassar, in sand and fine gravel, 15 fathoms—Hinds. *Japan.*

Except by locality it is hard to distinguish this from *M. exiguus*, Broc.

M. rusticus, Reeve. Pl. 30, fig. 286.

Shell solid, tuberculately varicose, fronds short; yellowish white, the varices chestnut. Length, ·9 inch.

Hab. unknown.

M. interserratus, Sowerby. Pl. 30, fig. 284.

Varices seven, very short fronded, hooked at the shoulder of the shell; distantly spirally lirate, the interstices of the ridges serrated with small scales. Yellowish brown.

Length, 21 mill. *Hab. unknown.*

M. laminiferus, Reeve. Pl. 30, fig. 283.

Eight varicose, whitish, with a brown band around the upper part of the body. Length, 1 inch.

Hab ?

Probably this is not an adult shell.

M. PUTEOLUS, A. Ad.

Ovately fusiform, spire elate, conical, light fuscous; whorls five, angulated in the middle; with squamose, subdistant revolving liræ, and seven varices; costately spinose and produced into squamate spines behind; aperture ovate; canal short, open, recurved.

Japan.

No dimensions given; not figured.

Subgenus **Cerostoma**, Conrad.

It is very difficult to define the boundary between this group and *Pteronotus*, inasmuch as the operculum of several of the species is not known; moreover the labral tooth does not always appear even in those species having a purpuroid operculum. It is possible that some of the last species of *Pteronotus*, as I have arranged them, belong in *Cerostoma*, and on the other hand that some of the first species of *Cerostoma* may be true Pteronoti. All the species with more than one inter-variceal node appear to be true Pteronoti, and the distribution of the genus is mainly Indo-Pacific; *Cerostoma*, on the other hand, is North Pacific in distribution, extending from Japan northwards to Behring's Straits, and on the opposite American coast south to Central America. In no other group is the difficulty so great in obtaining good specific characters. I have been forced to admit a number of species, which my knowledge of specific variation causes me to suspect very strongly to be mere individual variations of form; a considerable reduction of these may be expected as soon as extensive suites from numerous Japanese localities shall be obtained.

M. PINNIGER, Brod. Pl. 34, fig. 378.

Light yellow or flesh color. Length, 1·75 inches.

West Columbia.

Has very close analogies with *M. osseus*, Reeve, and indeed, is so like the young of that species (*M. Gambiensis*) that, were it not for the wide difference of locality, I would scarcely hesitate to put them together. Found at Xixipati, in sandy mud, at 8 fathoms.

M. GOULDI, A. Adams.

Ovate fusiform, fuscous, sparsely maculated with chestnut; spire acute, whorls flattened and somewhat shouldered; transversely lirate, the lines unequal; varices shortly foliated, foliations each ending in a posterior recurved spine; aperture ovate, closed, the lip margin broadly fimbriated; canal straight, closed, longer than usual in the group.

Tsu-Sima, Japan.

No dimensions given; not figured.

M. CENTRIFUGA, Hinds. Pl. 34, fig. 377.

Light brown. Length, 1·75 inches.

W. C. of Veragua, N. Grenada;
dredged in 52 fathoms, sandy floor.

M. EURYPTERON, Reeve. Pl. 34, figs. 374, 379.

Light yellow. Length, 2 inches.

Japan.

M. expansus, Sowb. (fig. 379), supposed to come from China, is evidently the same species.

M. TRIALATUS, Sowb. Pl. 34, figs. 372, 375; pl. 35, fig. 387.

Decidedly too close to *M. eurypteron.* Light yellow, usually banded with a darker color, The want of a tooth on the lip, the usually smaller size, and the strong development of the single node between the varices suffice to distinguish it from *M. foliatus.* Length, 2·5–3·25 inches.

Todas Santos Bay, L. California (H. Hemphill).

M. Californicus, Hinds (figs. 375, 387), is a synonym.

This shell is wrongly referred to *Muricidea* by Carpenter and others; it has three varices, and its relationships are certainly with *Cerostoma.* Carpenter in his Mazatlan Catalogue describes *M. ? erinaceoides* var. *indentata*, which I think may be a synonym of *M. Californicus.* His variety has *three* varices, whilst the true *M. erinaceoides* (= *lugubris*, Brod.) has *six.*

M. FOLIATUS, Martyn. Pl. 34, figs. 370, 371, 373.

White, usually banded with light chestnut. Length, 2–3 inches.

Sitka to Santa Barbara, Cal., Asia?

M. phyllopterus, Lam. (fig. 373), is perhaps the same species; but does not appear to have been properly recognized by either Reeve or Sowerby.

M. Burnetti, Adams and Reeve. Pl. 34, figs. 367, 368.

Pale fawn-color, with numerous whitish undulating streaks, within the aperture purplish red with whitish stripes; labral tooth very large, the inner side excavated, instead of being convex as in *M. foliatus*.

Mr. E. A. Smith calls attention to the revolving ribs being not very prominent on the whorl, but becoming very strong on the varices, which thus become digitate; he also mentions distinct protuberances on the central revolving ribs between the varices, which he says are not found on *M. foliatus*. They *are* so found, however, and very distinctly so, too, on Sitka specimens of the latter now before me. I add to the original figure a much better one from Sowerby's Thesaurus.

M. Coreanicus, A. Adams. Pl. 34, fig. 376.

Ovately fusiform, light fuscous, sparsely maculate with chestnut; whorls nearly smooth, obsoletely lirate; varices foliated, crenate, reflexed; a single variceal node; lip tuberculate within, with an anterior produced tooth. Length, 2 inches.

Corea.

Too closely allied to *M. monachus*, Crosse.

M. plorator, Adams and Reeve. Pl. 34, fig. 369.

Chestnut brown, with a white band in the middle. Length, 1·5 inches.

Corea.

Perhaps young of *M. Burnetti;* it possesses the same angulate periphery and inferior excavation.

M. brachypteron, A. Adams.

Ovately fusiform, light fuscous, sparsely maculate with chestnut and with a central white band; whorls crossed by longitudinal and revolving crenulated lines; margin of aperture fimbriated; canal closed, recurved. The winged varices shorter than in the allied forms.

Uraga, Japan; 12 fathoms.

Appears to be closely allied to *M. plorator*, above.

M. STIMPSONI, A. Adams. Pl. 35, fig. 392.

Ovately fusiform; light fuscous; spire acute; whorls seven, flattened, shouldered, with smooth revolving lines, the interstices clathrate; varices widely foliated, rounded and dilated behind; lip margin widely fimbriate; canal short, straight, closed.

Uraga, Japan; 21 fathoms.

A young shell of no decided character.

M. EMARGINATUS, Sowb. Pl. 35, fig. 380.

White, blotched with light brown. Length, 2 inches.

Japan.

Belongs to the *Nuttallii* group, but is more gibbous.

M. FOURNIERI, Crosse. Pl. 35, fig. 382.

Light brown. Length, 1·5 inches. *Japanese Sea.*

So like *M. Nuttallii*, Conrad, that I find no distinctive characters, and I think it will prove to be the same.

M. NUTTALLII, Conrad. Pl. 35, figs. 381, 386, 391.

This is the type of Conrad's genus *Cerostoma.* The shell is, when fresh, whitish, yellowish, brownish or dark chocolate, with sometimes central and basal white bands.

Length, 1·5–2 inches. *California.*

M. aciculiger of Val. (fig. 391) and *M. unicornis*, Reeve (fig. 386), I consider synonymous.

M. MONOCEROS, Sowb. Pl. 35, figs. 388, 389.

More shouldered, the revolving ribs more tuberculate, the varices not so much frilled as in *M. Nuttallii*, Conr.; there are fewer teeth within the aperture, and they are much larger. Usually lighter colored than *Nuttallii*, with a pink blush within the aperture. Length, 1·5 inches.

L. California.

This species is described by Sowerby as four to five varicose, but I think it is only abnormally so; the excellent figure in Reeve is but three varicose, and so are specimens before me which otherwise correspond exactly with Sowerby's fig. 97. Mr. R. E. C. Stearns thinks that *M. monoceros* is a variety only of *M. Nuttallii.* Mr. Gabb has re-described fossil specimens under the name of *Muricidea paucilirata.*

M. RORIFLUUS, Adams and Reeve. Pl. 35, fig. 390.

Light chocolate-brown, the varices white, lip-tooth prominent. Length, 1·3 inches.

Corea.

Evidently a young shell.

M. FESTIVUS, Hinds. Pl. 35, fig. 383.

Whitish, closely encircled by incised lines, which are brown, varices reflexed, widely laminar, crossed by close rows of elegant semicircular scales. No tooth. Length, 1·5–2·5 inches.

California.

Subgenus **Ocinebra**, Leach.

This group, as well as *Muricidea*, is made by Messrs. Adams an *omnium gatherum*, including true Murices, purpuroid Murices, Purpuræ, Fusidæ, etc. *Muricidea* as defined by them has no really distinctive characters from *Ocinebra*, and Swainson included species of *Trophon*, *Triton*, etc. I have suppressed *Muricidea*, and retained *Ocinebra* for a group of small Murices with numerous varices and purpuroid operculum; the species having muricoid operculum are relegated to *Phyllonotus*, from which they do not differ. A number of species the operculæ of which are unknown, are ranged arbitrarily in *Phyllonotus* or *Ocinebra*, and with regard to these I claim the indulgence of brother conchologists who may have similarly found themselves in the predicament of being compelled to place something somewhere just to get it off their hands.

*** *European Group.*

M. ERINACEUS, Linn. Pl. 36, figs. 400–404.

Four to seven varicose, nodulous, encircled by prominent cord-like, raised ribs, alternately smaller, the smaller ones minutely scabrous; varices sometimes frondose, sometimes lamellated, occasionally appressed. Occasionally the larger revolving ribs thickly overlap the varices, forming a succession of elongated nodules (var. *torosus* (fig. 404). Yellowish-brown; whitish within. Length, 1·5–2 inches.

Europe, from Norway to Black Sea, Azores, Madeira; range, shore to 30 fathoms; fossil in European tertiaries and quarternaries.

The animal has a yellowish body, mottled with white, with slender, tapering, orange-colored tentacles, and eyes on long stalks exterior to and united to the tentacles for two-thirds their length; foot small, narrow, rounded in front, pointed behind, the sole with a slight median groove; gills very small, brownish; tongue cylindrical, rather long, the teeth shown in fig. 58, pl. 5.

Like *Purpura lapillus*, this animal yields a purple dye, but the tint is variable. Its egg-cases are attached in clusters of 15 to 150 to shells and stones, and each case contains from 12 to 20 embryos. The cases are triangular, with compressed sides, and the attaching stalks are short and narrow.

The *Murex erinaceus* is a well-known depredator on the oyster-beds of Europe, and is considered one of the most dangerous enemies with which the ostreiculturist has to contend. The English fishermen know it under the name of "sting winkle," and the French call it the "cormaillot" or "perceur." So destructive is it in the oyster-parcs of Arcachon (near Bordeaux) that it is incessantly hunted by the fishermen, who spend whole days in destroying it by removing with a knife a portion of the foot and the operculum, after which the animal is left to die at its leisure or become the prey of other carnivores. The *Murex* seats itself firmly upon the shell of the oyster and applies its rostrum to the surface of the latter, invariably at a point near the beak; after which a regular movement of the body to right and left ensues during a term of three or four hours and results in piercing a small, round hole through the oyster shell, exposing the most essential viscera to the rapacity of the patient tunneler. It is believed that the denticles of the tongue are applied to the surface to be bored and then the gyration of the animal gradually rasps through the hole; it has been supposed by some that an acid solvent is also used in this operation, but this is only conjectural. M. Fischer* has observed at Arcachon that young Murices chose young oysters, whilst adults select larger oysters. The bored oyster soon dies or else exhausted, opens its valves, when a myriad of other animals: crabs, mollusks, worms, fishes hasten to profit by the fruit of the winkle's labor. Dr. Fischer says that the *Murex* only (at Arcachon)

* Jour. Conch. 5, 1865.

attacks the living oyster; the *Nassa* and *Natica*, on the contrary, living on dead flesh, and possessing a delicate sense of smell which enables them to perceive from a great distance the presence in the water of a decaying animal.

Murex torosus, Lamarck, (fig. 404), is considered with some doubt, a monstrous variety of this species. The spire is much shorter, and but for the remains of varices, nearly hidden under the nodules of the revolving ribs the form and appearance are very suggestive of *Purpura*, and particularly of *Purpura cingulifera*, L., (*P. trochlea*, Lam.), of South Africa. This variety(?) comes from Sicily and Algiers.

M. Edwardsi, Payr. Pl. 36, figs. 410-412.

This little shell, as Reeve remarks, appears to oscillate between *Murex* and *Purpura;* its dark aperture, toothed lip and numerous ribs recalling the latter, whilst the occasional appearance of two, three, or more distinct varices indicates *Murex*. Varies considerably in form; sometimes the whorls are well-rounded above, sometimes shouldered—in the latter case the ribs become nodulous on the shoulder. Light brown, purplish or livid within; frequently an obscure light band on the periphery.

Length, ·8 inch.

Mediterranean, So. Atlantic coasts of Spain, Portugal, Madeira, Canaries. **The typical form on rocky bottoms at small depth, the variety (= *P. nux,* Reeve), on sand at 4 to 8 fathoms.**

Reeve has figured the variety with a shoulder, and no varices as *Purpura nux;* but every intermediate grade of form and development of varices exists, so that it cannot be separated from the type except as a mere inconstant variety.

M. pumilus, Küster. Pl. 36, fig. 413.

This little shell, only about one-fourth inch in length is very probably the same as *M. Edwardsi*, var. *nux;* to which Kobelt doubtfully refers it.

Hab. unknown.

The specific name is twice preoccupied—by Broderip and A. Adams; the species is too doubtful to rename.

M. semiclausus, Küster. Pl. 36, fig. 414.

A shell about ·35 inch long, having close relationships with *M. Edwardsi.*

Hab. unknown.

M. HYBRIDUS, Aradas and Benoit. Pl. 36, fig. 415.

A rare shell found at Palermo. Length, ·5 inch. It has seven ribs forming a coronal of spines at the shoulder; the lip is denticulate within, and the short canal is closed.

M. ACICULATUS, Lam. Pl. 36, figs. 405, 407, 408, 409; pl. 37, fig. 441.

Brownish, with numerous ribs; canal short, open.
Length, ·5 inch.

Channel Islands, stony and rocky ground, at low water mark and in the laminarian and coralline zones. *Canary and Azores Islands, Mediterranean* 4 to 40 fathoms. Fossil, Coralline Crag, *England;* Italian tertiaries.

The animal is coral-red or scarlet, sometimes speckled with light yellow; the tentacles are paler in color, extensile, microscopically ciliated, especially at the bluntly pointed tips. Mr. Jeffreys has seen the barrel-shaped, strongly corrugated ova capsules, attached, solitary, to the under side of the shell; the ova being elliptical and prismatic. Monterosato makes two varieties of this species, the first being *Fusus minutus* Desh. = *F. Titii*, Stossich; the second, *Fusus Hellerianus* Brusina = *Murex Weinkauffianus*, Crosse, (fig. 441).

M. badius, Reeve, (fig. 407), and *M. pistacia*, Reeve, (fig. 405), I refer to this species as suggested by Kobelt. *M. pereger*, Brugnone, (fig. 408), appears to me to be very much nearer related to this species than to *M. erinaceus* to which it is referred by Monterosato. It is found in African sponges.

M. SCALAROIDES, Blainv. Pl. 30, fig. 276; pl. 36, fig. 416.

Six varicose; white or yellowish; canal short; aperture rounded. Length, ·5 inch.

Mediterranean; rather rare.

M. INERMIS, Sowb. Pl. 36, fig. 417.

White; the varices narrow, six in number, canal rather long, open. Length, ·5 inch.

Japan.

Has some resemblance to *M. scalaroides*, Bl.

M. PURPUROIDES, Dunker. Pl. 36, fig. 418.

Whorls slightly shouldered, wide, with numerous ribs and revolving raised lines; yellowish, with a pale brown band; aperture large, canal short, open. Length, ·5 inch.

Cape of Good Hope.

Except in the canal being open, much resembles *M. Edwardsi*, var. *nux*. It also looks like an immature *Triton labiosum*, Wood.

M. PLEUROTOMOIDES, Reeve. Pl. 36, fig. 406.

Shell somewhat shouldered, with numerous crispate varices, crossed by revolving ridges; lip toothed within, columella with two or three tubercles, canal moderate, open.
Length, ·5 inch.

Hab. unknown.

Reeve does not state whether the columellar tubercles are the remains of revolving teeth or not; if they are, the species will be better placed in the genus *Peristernia*.

M. BÆTICUS, Reeve. Pl. 36, fig. 421.

Shell dark purple-brown, purple within; varices about eight, narrow; crossed by revolving ribs; whorls a little shouldered; canal short, closed; lip toothed within.
Length, ·7 to ·85 inch.

Hab. unknown.

Reeve's figure represents a shell with numerous varices, corresponding with specimens before me; his description, however distinctly states that it has three varices.

M. INGLORIUS, Crosse. Pl. 36, fig. 419.

Narrower, thinner and darker colored than *M. Edwardsi*, Payr; its mouth is also proportionally smaller, it has ribs instead of varices, and its six whorls are less rounded and slightly shouldered. Brown purple, purple within. Length, ·75 inch.

Hab. unknown.

M. CONFUSA, Brazier.

Pyriformly ovate; spire short, sharp pointed; whorls five and one-half, five varicose, varices laminated, interstices crossed by four laminated ribs, forming hollow pits; last whorl somewhat smooth below; aperture round-ovate, lip denticulated; canal rather short, attenuated and recurved. White, stained with brown between the varices. Length, 1·12 inches.

Darnley Isl., Torres Sts., Austr. Only one specimen, dredged in 30 fathoms. Not figured.

M. ANOMALA, Angas. Pl. 36, fig. 422.

Shell rather solid; light brown, with a darker, black-spotted median band, and undulating longitudinal stripes, which are more prominent near the base of the last whorl.

Port Jackson, Austr. Dredged in 25 fathoms.

Described as a *Cronia* (*Purpura*), but appears to agree better with *Ocinebra*.

M. GRAVIDUS, Hinds. Pl. 36, fig. 423.

Five varicose, varices fimbriated by revolving ribs; canal rather long, recurved to the left. Whitish, banded with brown above. Length, .85 inch.

Cape Blanco, W. Coast of Africa; 60 fathoms.

Perhaps the young of some species of *Phyllonotus.*

*** *Group of M. tetragonus,* Brod. *Tropical.*

M. TETRAGONUS, Brod. Pl. 36, figs. 424, 425.

Shell quadrangular, four varicose; varices very prominent, thickened, scaly fimbriated, interstices transversely ribbed; canal short, much recurved. White. Length, 1 inch.

Andaman Islands (E. A. Smith); *Viti Isles* (*Polynesia*), (A. J. Garrett); *Bet Island, Torres Sts., Australia,* 11 fathoms (Brazier).

I agree with Reeve in considering *M. breviculus*, Sowb., (fig. 425), a variety of this species, the growth being much more pyramidal in some specimens than in others, and the varices sometimes five in number.

M. CYCLOSTOMA, Sowb. Pl. 36, fig. 426.

Ovate, gibbous, six varicose, a little shouldered, varices crossed by prominent ribs; spire and canal short. Whitish, more or less tinged with brown. Length, ·8 inch.

Red Sea, 11 fathoms; *Isle of Bohol, Phillipines.*

M. MUNDUS, Reeve. Pl. 36, fig. 427.

Five varicose, varices narrowly laciniated; spire produced; canal very short. Yellowish-white. Length, ·7 inch.

Isle of Zebu, Phillipines, Cuming.

M. NUCULA, Reeve. Pl. 36, fig. 420.

Six varicose, crossed by ribs which become more prominent on the varices; a coronal of short spines on the shoulder; canal and spire moderate. Whitish, mottled with brown. Length, ·75 inch.

Isle of Capul, Phillipines, Cuming.

Sowerby formerly considered this a variety of his *M. cyclostoma;* it may be so; but appears to me to be less crowded with ribs, and to differ in the coronal of short tubercles or spines.

M. NUCEUS, Mörch. Pl. 37, fig. 429.

Rhomboidal, thick, five to six varicose, varices thickened, fimbriated; with about ten revolving, scabrous ribs, alternately smaller; spire rather elevated; aperture small, oval; canal short. White, sometimes the varices chestnut-color. Length, 1 inch.

West Indies, Bermudas, Coast of S. Carolina (1 spec.).

At St. Thomas it is found under stones in one or two feet water (Krebs).

M. PUDICUS, Reeve. Pl. 37, fig. 431.

Seven varicose, shouldered; spire elevated; nodulose-spinose. White. Length, 1·25 inch.

St. Domingo.

Notwithstanding the shouldered whorls, I think this may prove to be the same as *M. nuceus.*

M. ASPER, A. Adams. Pl. 37, fig. 428.

Whorls six, aculeately frondose on the varices; white. Length, 30 mill.

Gulf of California (Adams).

So close to *M. pudicus* that I am inclined to think it will prove to be a synonym. The assigned locality is doubtful.

M. DENSUS, H. and A. Ad. Pl. 37, fig. 435.

Angulate, solid, smooth, lightly spirally lirate, varices eight. White. Length, 30 mill.

Habitat unknown.

Possibly this is a form of *M. pudicus*, Reeve, or *M. nuceus*, Mörch. It was described by Mr. A. Adams as *M. inornatus*, but as that name was pre-occupied by Recluz, Messrs. H. and A. Adams changed it to *densus*. Mr. Sowerby, not aware of this change, has recently substituted the name *Adamsi*—a name which is itself pre-occupied by Kobelt for *alabastrum*, Ad., not Reeve.

M. SOLIDUS, A. Adams. Pl. 37, fig. 430.

Shorter and thicker than *M. pudicus*, the fronds more rudimentary, the aperture smaller, canal more completely closed. White. Length, 28 mill.

Habitat unknown.

Very probably a mere variety of *M. nuceus* or *pudicus.*

M. JAMAICENSIS, Sowerby. Pl. 37, fig. 432.

Varices eight, distant, narrow, interstices deeply cancellated. Reddish-brown. Length, 20 mill.

Jamaica.

I have not seen this species; which is most readily distinguished from others of same form and sculpture by its color.

M. CASTUS, A. Ad. Pl. 37, fig. 433.

Varices seven, rounded, shell globose-oval; white. Length, 18 mill.

China.

Belongs to the *cyclostoma* group and appears to be distinguished by its shorter form and more numerous ribs.

M. INCISUS, Brod. Pl. 37, figs. 436, 437.

Five to seven varicose, varices thick, rounded. Shell white, crossed by chestnut-colored revolving ribs. Length, 1·25 to 1·5 inch.

St. Elena, W. Columbia, 8 fathoms, Cuming; *Catalina Isl., California,* W. M. Gabb.

Reeve's figure is somewhat suggestive of the preceding species; that of Sowerby (Conch., Ill.) is much better. One of the specimens obtained by the late Mr. Gabb, at Catalina Isl., is still larger than the latter figure, and corresponds to the figure of *M. gemma*, Sowb. (Thes. Conch.), fig. 437. It looks enough different, at first sight, to constitute a distinct species, but the differences appear to be due to the eroded or beach-worn condition of the *gemma* form.

M. MACULATUS, Reeve. Pl. 37, fig. 442.

Ovate, pyramidal, spire elevated; whorls well rounded, tuberculately varicose and finely ridged; aperture oval, small; canal short, closed. Yellowish, with a brown blotch on the shoulder between each varix; aperture and columella tinged with pink.

Length, ·75 inch.

Hab. unknown.

This species is perhaps wrongly placed in *Ocinebra;* it has some resemblance to *Tritonidea* (*Pisania*) and might, perhaps, be ranged with *M. cinereus* (*Fusus*), Say, in the genus *Urosalpinx*, which seems to occupy an intermediate position between *Ocinebra* and *Tritonidea.* Unfortunately, the animal and operculum are unknown.

*** *Group of M. lugubris. Distribution, Pacific; Japan; North and South America.*

M. LUGUBRIS, Brod. Pl. 37, figs. 438-440. Pl. 38, figs. 455, 456.

Six varicose, varices rather narrow, somewhat laminate, crossed by wide, rather flat ribs and intervening sulcations; spire turrited, spiny nodose; body whorl shouldered, the varices raised into curved spines on the shoulder; canal rather short, closed. Chestnut-brown, the sulcations usually darker.

Length, 1·25 inches.

Peurto Portrero, W. C. of Cent. Am., in coral rocks. *Magdalena Bay, Low. Cal.*; dredged from a sandy floor, 7 fathoms.—Hinds. *Guayaquil,* muddy floor, 21 fathoms.—Hinds.

I include with this species *M. calignosus*, Reeve, (fig. 455), *M. hamatus*, Hinds, (fig. 439), and *M. peritus*, Hinds, (fig. 438), the latter being the young. Its nearest affinities are with *M. erinaceus*, of Europe. *M. erinaceoides*, Val., from the Gulf of California has also been likened to *M. erinaceus*, and in all probability should be referred to *M. lugubris* instead of to *M. alveatus*, Kiener, with which Carpenter has likened it. Another synonym is *M. Barbarensis*, Gabb., which is thus described: Brown; whorls shouldered; varices five to nine, not very prominent except on the shoulder, where they are sometimes prolonged into a recurved spine; whole surface covered with strong revolving ribs, crossed by fine squamose plates; aperture sub-elliptical, lip with a broad varix and five or six internal dentations; canal closed, straight or a little recurved.

Length, ·77, lat. ·44 inches.

Catalina Isl., 40 fms., *Santa Barbara Channel*, 20 to 30 fms.

Also post-pliocene.

Through the kindness of Mr. R. E. C. Stearns I am enabled to give a figure from one of the types (fig. 440).

M. FOVEOLATUS, Hinds. Pl. 38, fig. 465.

Varices seven, simple. Dark brown, with two lighter bands.

Length, 1 inch.

Magdalena Bay, L. Cal.

This species has been referred to *Vitularia* by Kobelt, but the figure is a characteristic *Ocinebra*. The species has not been certainly recognized by any recent collectors.

M. SUBANGULATUS, Stearns. Pl. 38, fig. 466.

Varices seven to nine, crossed by irregular revolving liræ. There is a brown band composed of three brown lines; otherwise white. Lip with five or six tubercles within.

Length, ·89 inch.

San Miguel Isl. off southern coast of *Cal.*, (two specimens).

Resembles somewhat *M. foveolatus* above, and also recalls *Vitularia salebrosa*, King; especially the white variety of Reeve's monograph, which I have figured.

M. EXIGUUS, Brod. Pl. 37, fig. 451.

Varices five, frondose, fronds short; transversely ribbed, ribs prominent; spire short; canal medium, recurved; dirty white.

Length, ·37, breadth, ·25 inch.

Salango, W. Columbia, sandy bottom at 10 fathoms.

Evidently a very young shell. I give a figure from Sowerby, said to represent the species.

M. LAPPA, Brod. Pl. 37, fig. 434.

Light brown, the short spines of the varices darker in color.

Length, 1·25 inches.

St. Elena, W. Columbia; rocky bed at depth of 12 fathoms.

Here again I figure Sowerby's representation of the species; the figure in Reeve appears to me to be more like *M. vittatus*, Brod. Will not this shell prove to be the adult of *M. exiguus?*

M. RADICATUS, Hinds. Pl. 37, fig. 443.

Five varicose, compressly lacinated on the varices. Light brown or whitish. Length, ·8 inch.

San Blas, W. C. of Mexico, in mud at 11 fathoms. *Mazatlan.*

Carpenter describes a specimen from Mazatlan which he says is intermediate between *M. radicatus* and *M. lappa;* it is very likely that they should be united, as he has done.

M. FONTAINEI, Tryon. Pl. 35, figs. 384, 385.

Eight varicose, the varices raised into five or six short lamellar spines, crossed by revolving ridges; body shouldered; aperture oval, closed; outer lip bearing a tooth, and crenulate within; canal short, closed, direct.

Length, 1·3 inches.

Dredged near *Payta, Peru,* by M. Fontaine.

This is the *M. monoceros* of d'Orbigny, a name preoccupied by Sowerby for a Lower California species of the *Cerostoma* group.

M. CRASSILABRUM, Gray. Pl. 38, figs. 452, 453.

Pure white. Length, 1·5 inches.

Valparaiso, in crevices of rocks, at low water.—Cuming.

The generic position of this well-known shell has always been doubtful; its numerous laminated varices recall *Trophon,* from which it is distinguished by its thickly variced and dentate lip; it has also been referred to *Purpura.* I have arranged it with a group of purpuroid Murices having some relationship with *Cerostoma,* and inhabiting principally the same region, but differing in possessing numerous varices. The typical species of this group might possess sufficient distinction from *Ocinebra* to deserve a peculiar name, but the limits of such a group could only be arbitrarily defined.

M. JAPONICUS, Dunker. Pl. 37, figs. 445-448.

Dark brown, with five to six lamellar varices, crossed by distant revolving ribs; outer lip much thickened, dentate within; canal short; sub-umbilicate. Length, 2 inches.

Japan, Dr. Dunker and Dr. Lischke. *North China,* (*M. Talienwhanensis,* Crosse, figs. 445-447).

The type specimen of this species, and the only one known to Dr. Dunker, was much worn and did not present good characters; Dr. Lischke, however, well describes it (p. 31, Jap. Meeres Conch. Supp.) from numerous specimens.

M. INORNATUS, Recluz. Pl. 37, fig. 444.

Yellowish-brown, obscurely banded; slightly roseate within the aperture. Length, 1·25 inches.

Hakodadi, Corea.

The varices vary in number. Can this be a depauperate state of *M. Japonicus?*

M. TANTILLUS, A. Ad.

Small, ovately fusiform, white, with laciniated lamellæ widely cancellated with crispate liræ; whorls six, angulate in the middle; aperture narrow, sub-ovate; margin of lip thickened, widely reflected, sub-sinuate behind; canal very short.

Satanomosaki, Jap.; 55 fathoms.

Described as a *Trophon*, but the widely margined lip shows it to be a relative of *M. Japonicus*, etc. It may be the young of one of the preceding species. Not figured.

M. SCALARINUS, A. Ad.

Ovate, rimate, pallid fulvous, tinged with red; spire elate, acute, as long as the aperture; whorls five, with five or six elevated varices and revolving lamellose larger and intermediate crenulate smaller liræ; suture profound; aperture ovate, subpatulous, inner lip smooth, arcuate; outer lip externally variced; canal moderately open, inclined to the left.

Length, 1 inch, lat. ·25 inch.

M. MONACHUS, Crosse. Pl. 37, figs. 449, 450.

Chestnut-color, variegated with white; four varicose, varices white; obsoletely tuberculate between the varices.

Length, 1·8 inches.

China, Japan.

It is just possible that this may be a var. of *Japonicus;* on the other hand it recalls the genus or group *Vitularia.* The Japanese use it as food. Sowerby (Thes. Conch.) cites author, work and locality incorrectly for this species.

M. FALCATUS, Sowb. Pl. 38, figs. 457–459.

This has somewhat the appearance of *M. (Cerostoma) foliatus*, Gmel., but differs in the number of varices and in their hooked spinous prolongations from the shoulder of the whorls. Light yellowish-brown, sometimes tinted with darker color on the middle of the body. Length, 1·66 inches.

Japan.

M. aduncus, Sowb., (fig. 459), is a variety, and *M. acanthophorus*, A. Ad., (fig. 458), appears to be merely a depauperate specimen. The latter is thus described: Ovate-fusiform, five varicose, solid, whitish; whorls five, angulated in the middle, flattened above, transversely lirate; varices lamellate, crispate, terminating in strong triangular spines on the shoulder; aperture oblong, purplish within, narrowed in front, the lip thick, fimbriated, denticulate within; canal closed, reflected. Operculum purpuroid. Length, 1·75 inches.

Hakodadi, 5 fathoms; *Tsusaki*, (*Jap.*), 37 fathoms.

M. ENDERMONIS, Edg. Smith. Pl. 38, fig. 454.

Ovate, spire turrited; whorls six, with sloping shoulder above, and angulated periphery; varices seven, laciniate, uncinate above; crossed by unequal, scabrous lirations. Aperture ovate, purplish; lip thickened, fimbriate, denticulate within, with a prominent basal tooth; columella bluish-white, maculated with brown-purple in the middle; canal closed, short, slightly recurved.

Length, 1·35 inches.

Endermo Harbor, Yesso, Jap., 4 to 7 fathoms, sandy mud.

Some of the spiral lirations, that at the angle of the whorls and three or four others in the last whorl, are much larger than the rest, and with the varices produce a coarsely cancellated aspect. *M. Talienwhanensis*, Crosse, and *M. inornatus*, Recluz, are both allies of this species, but lack the labral tooth.

I have not seen a specimen.

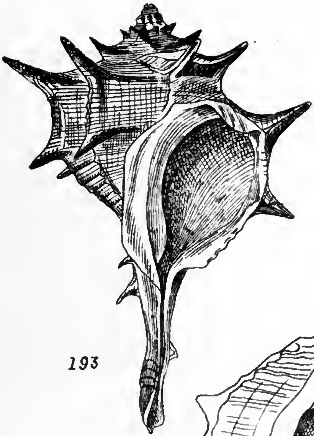
*** *Group of M. alveatus*, Kiener.

M. ALVEATUS, Kiener. Pl. 38, figs. 469, 467, 464.

Shell long and narrow; spire much elevated, of seven or eight convex whorls separated by deep sutures; varices three to eight, thick, fimbriated, crossing the sutures; six or eight revolving, narrow, scaly ribs, with intervening deep sulci; mouth small, oval; canal short. Whitish or yellowish. Length ·75 to 1·25 inches.

West Indies, 1 to 2 feet water, among madrepores.

The history of this species is somewhat involved: Kiener gave no habitat, but Panama has been assigned to it by most subsequent conchologists. I think that the species has been confounded with *M. erosus*, Brod., a Panama shell, which is certainly so close to this as to lead to grave doubts of its distinctness. A



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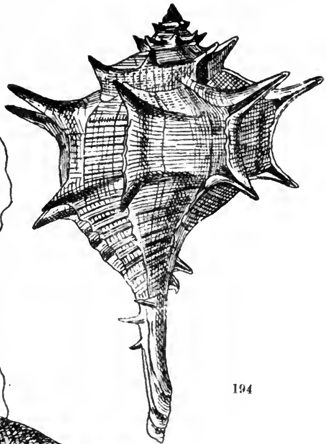

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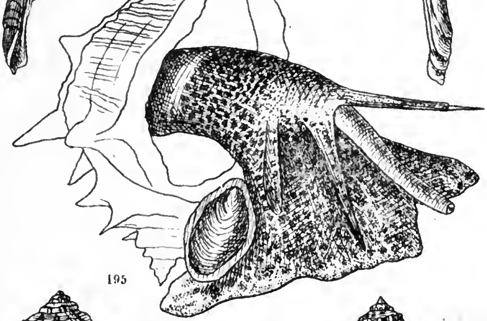

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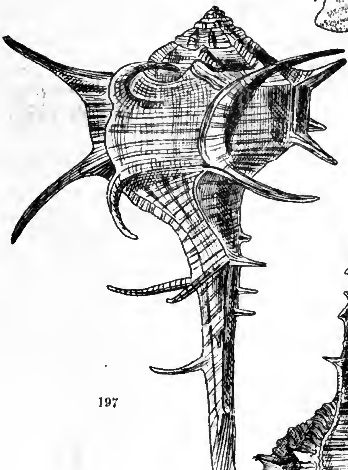

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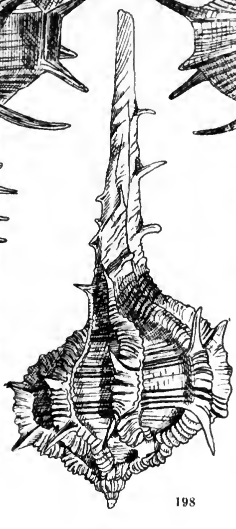

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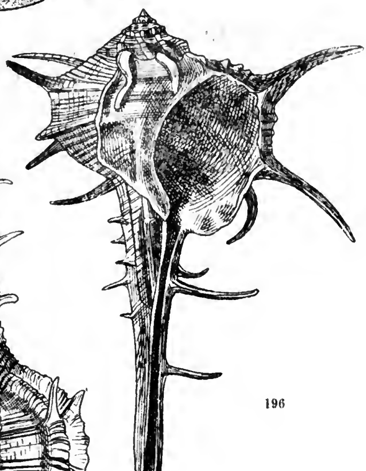

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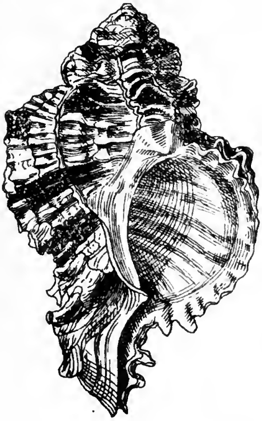

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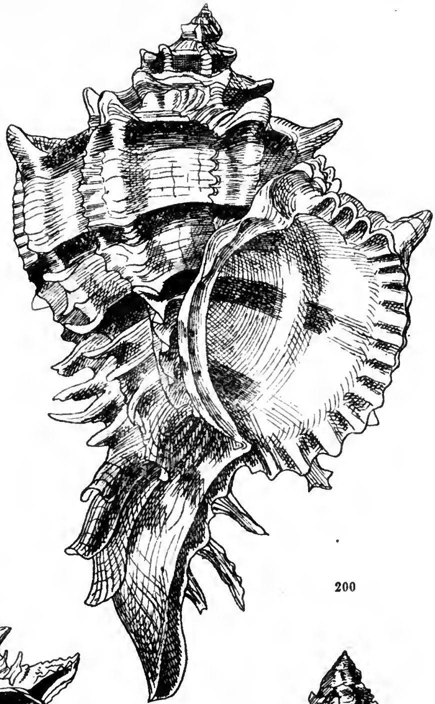

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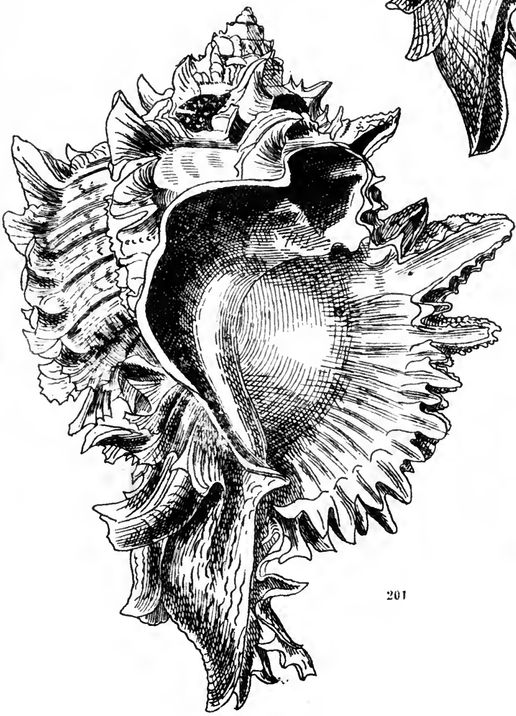

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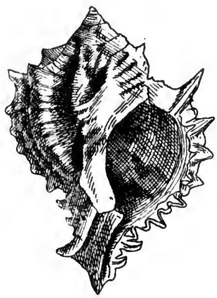

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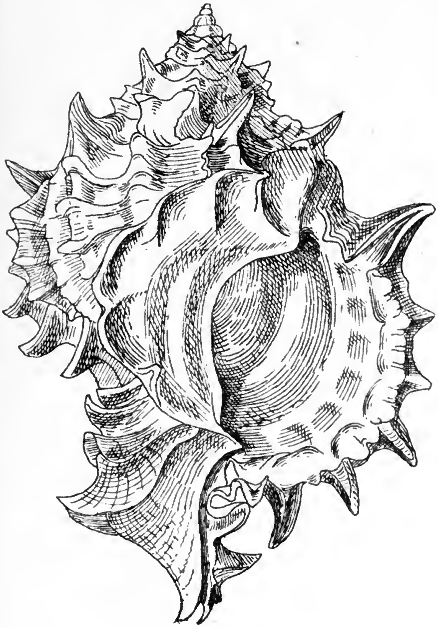

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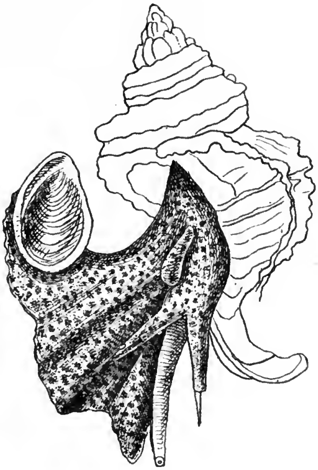

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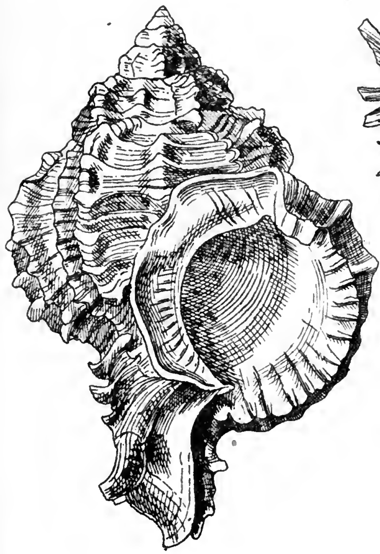

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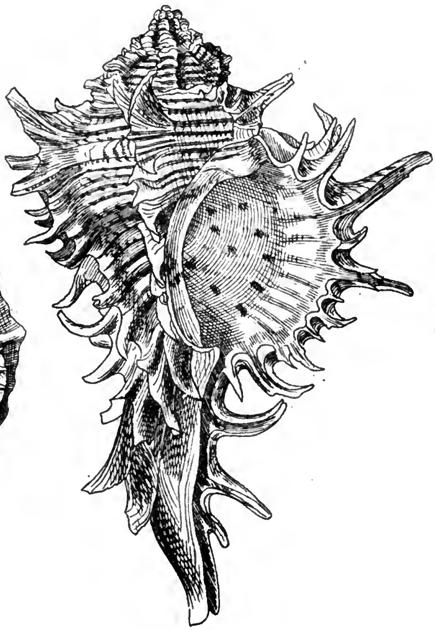

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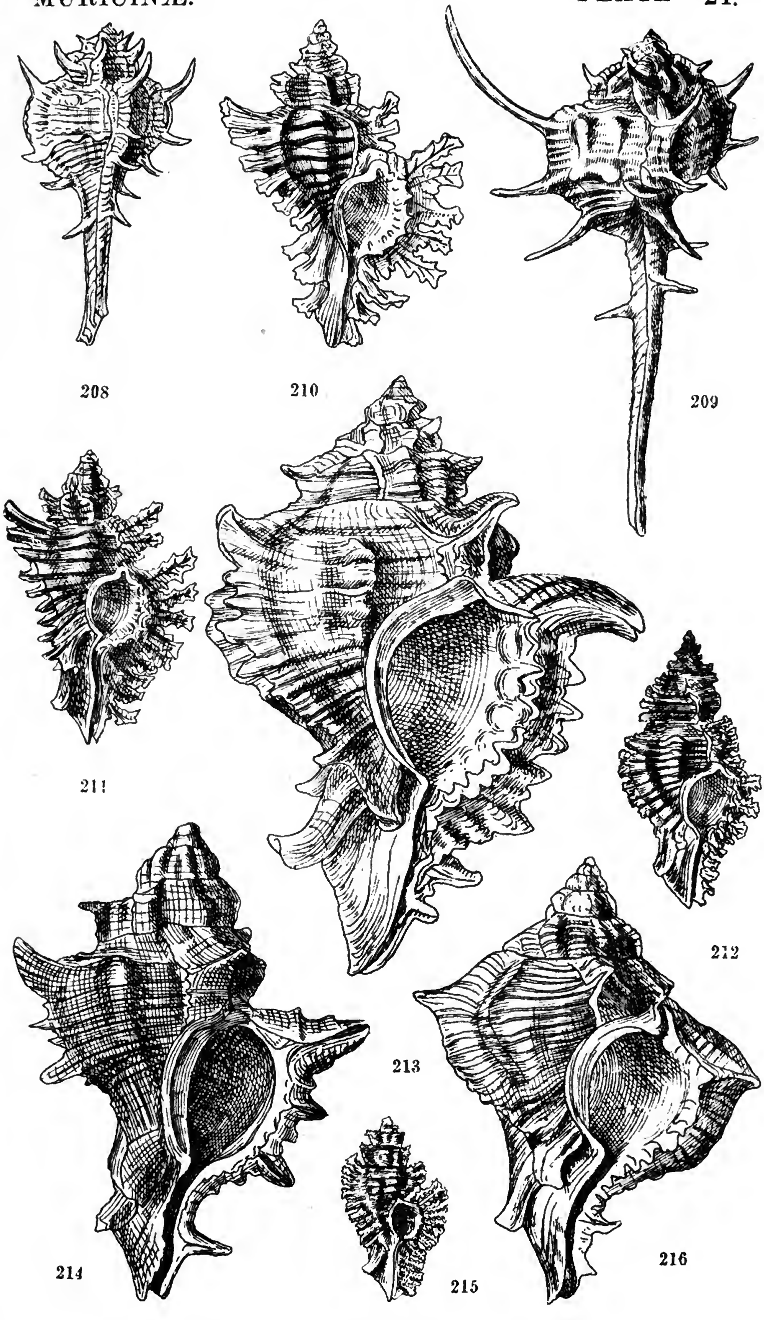
MURICINÆ. PLATE 24.



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MURICINÆ. PLATE 25.

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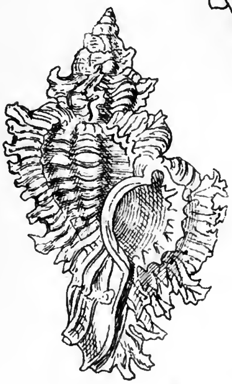

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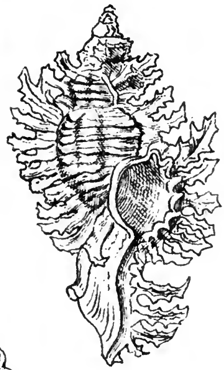

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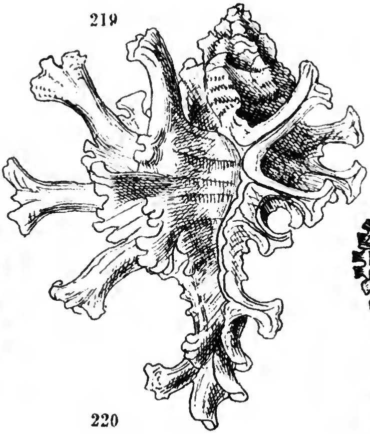

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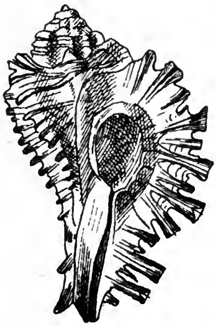

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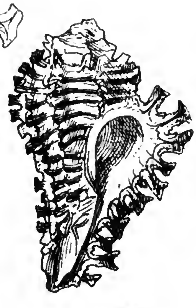

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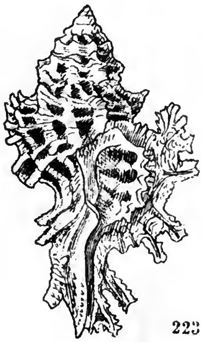

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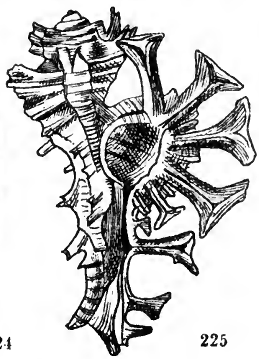

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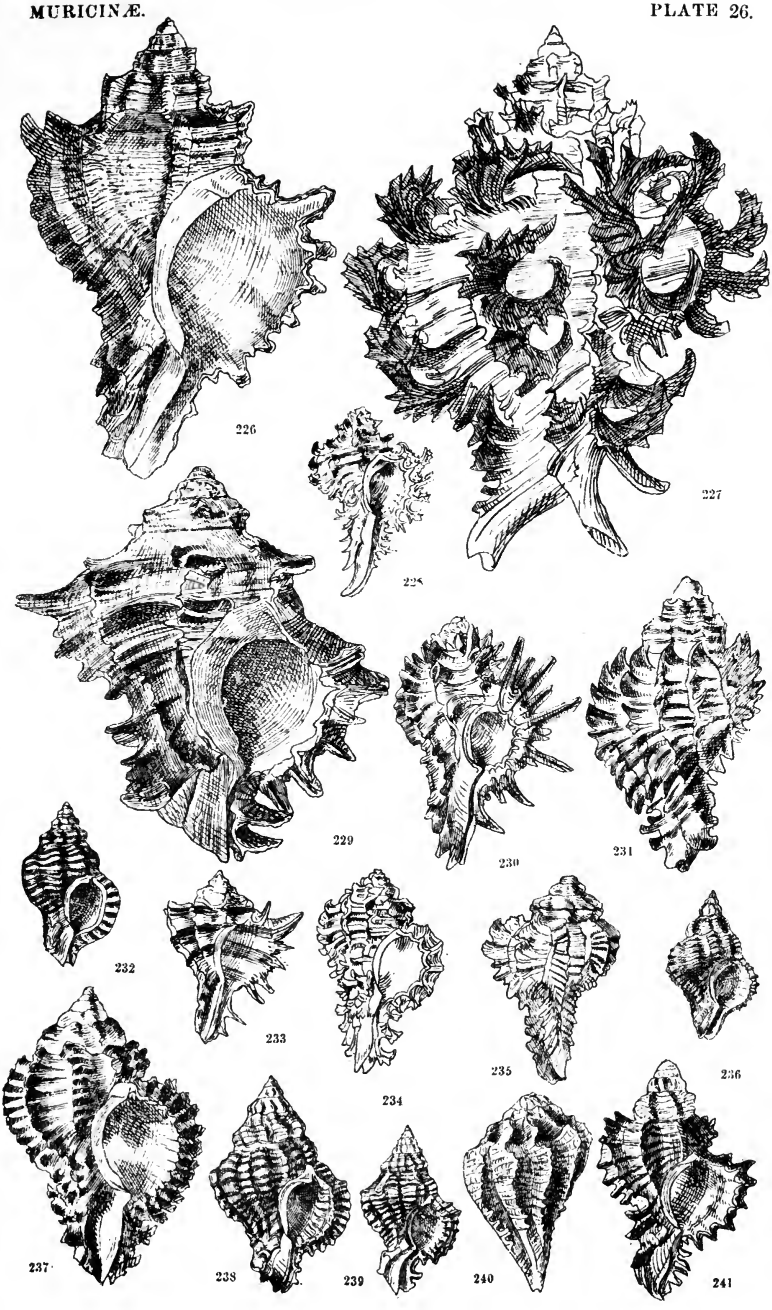
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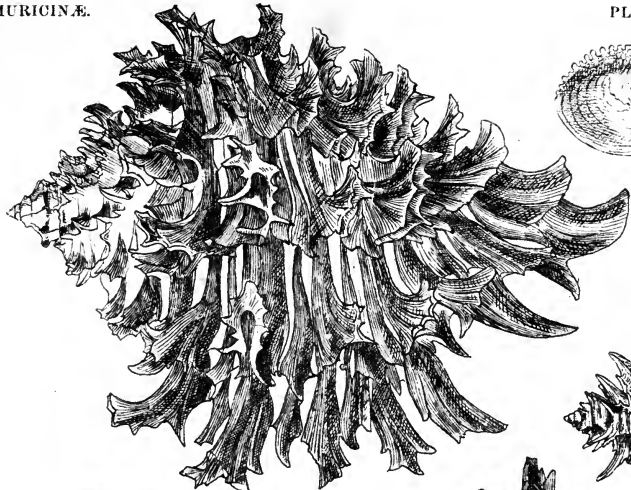

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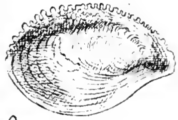

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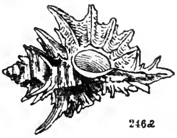

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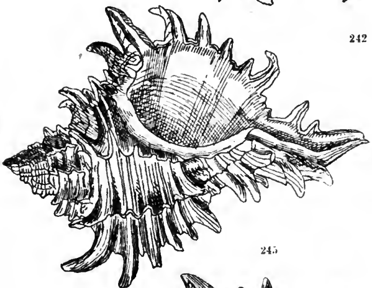

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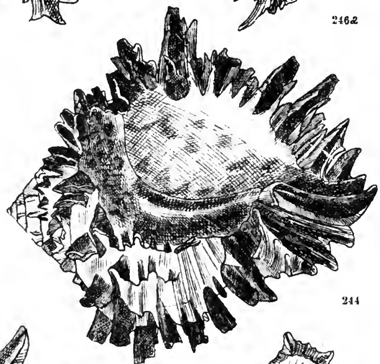

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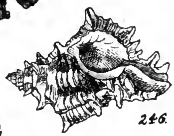

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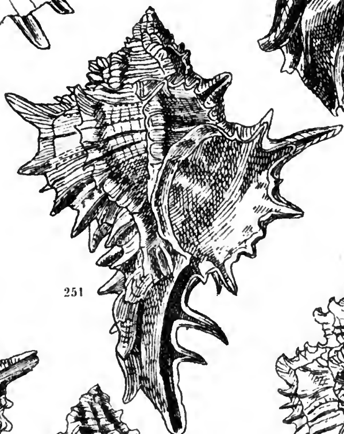

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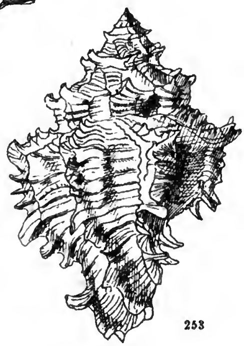

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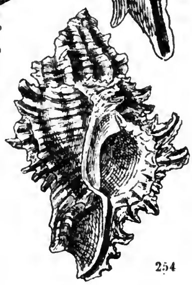

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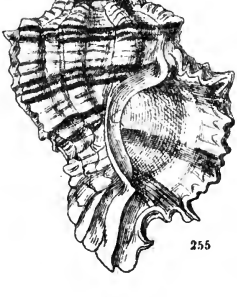

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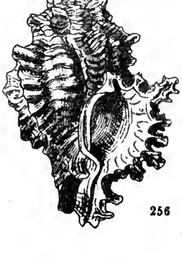

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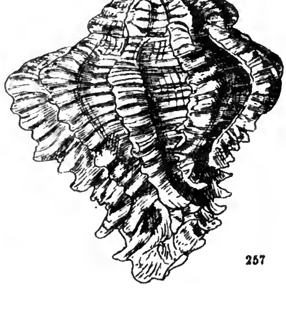

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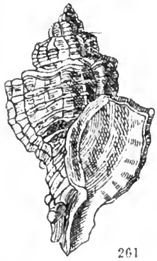
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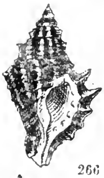
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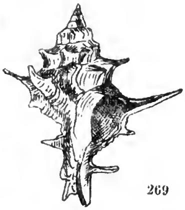
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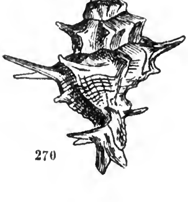
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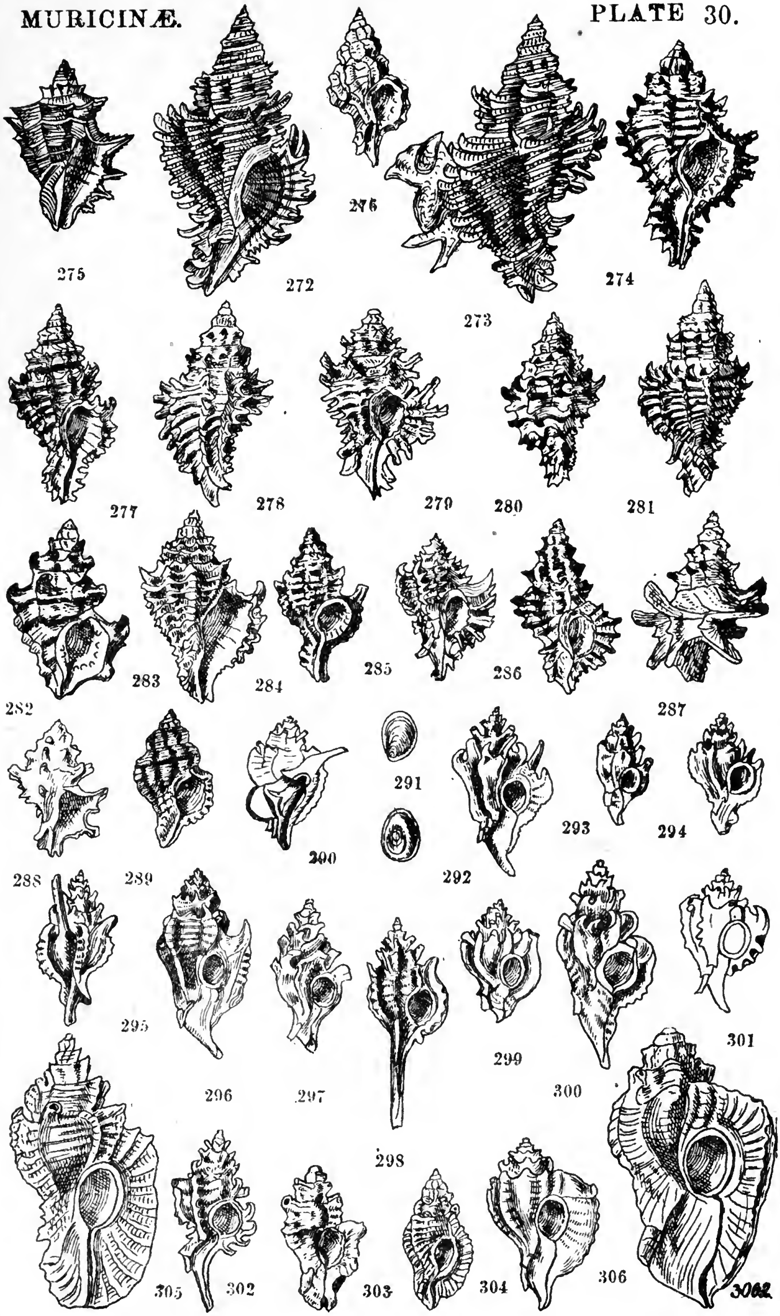
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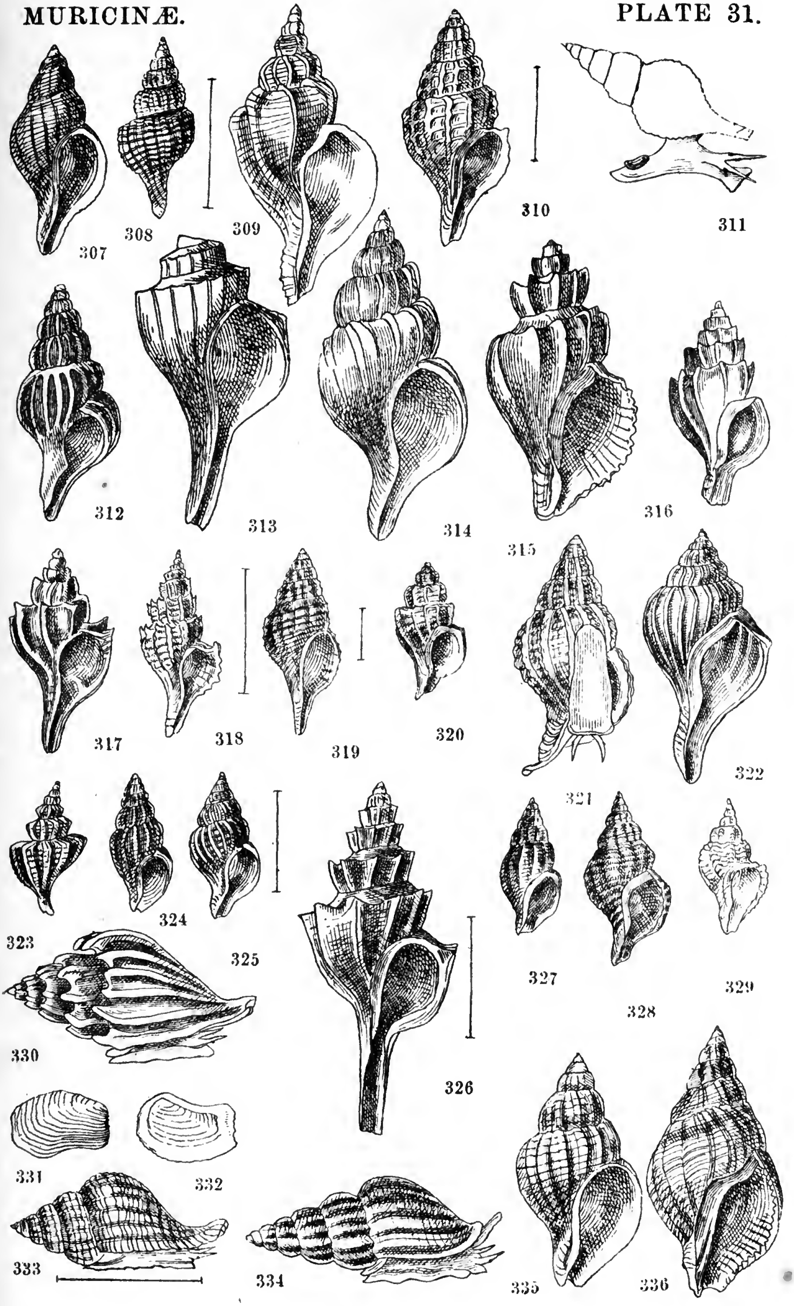
MURICINÆ. PLATE 31.



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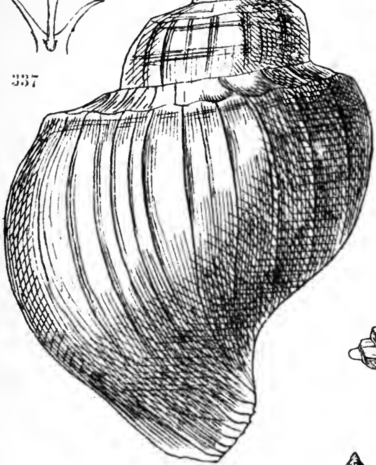

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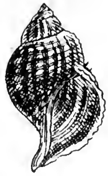

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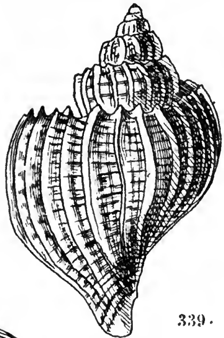

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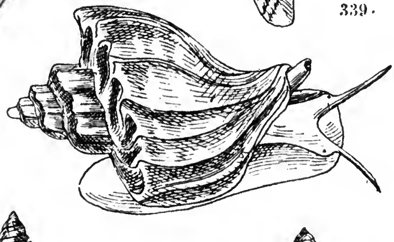

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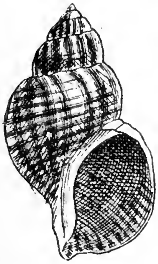

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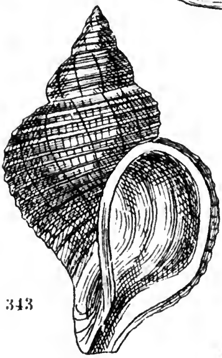

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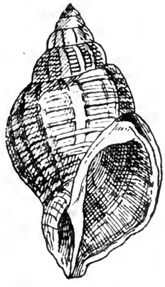

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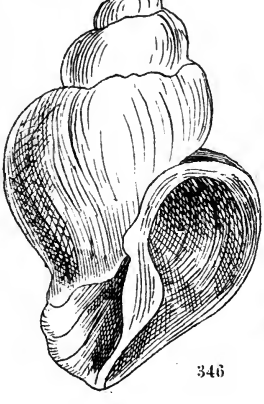

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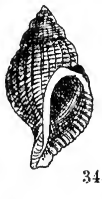

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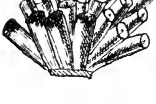

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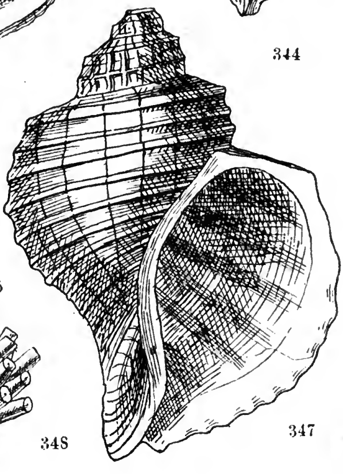

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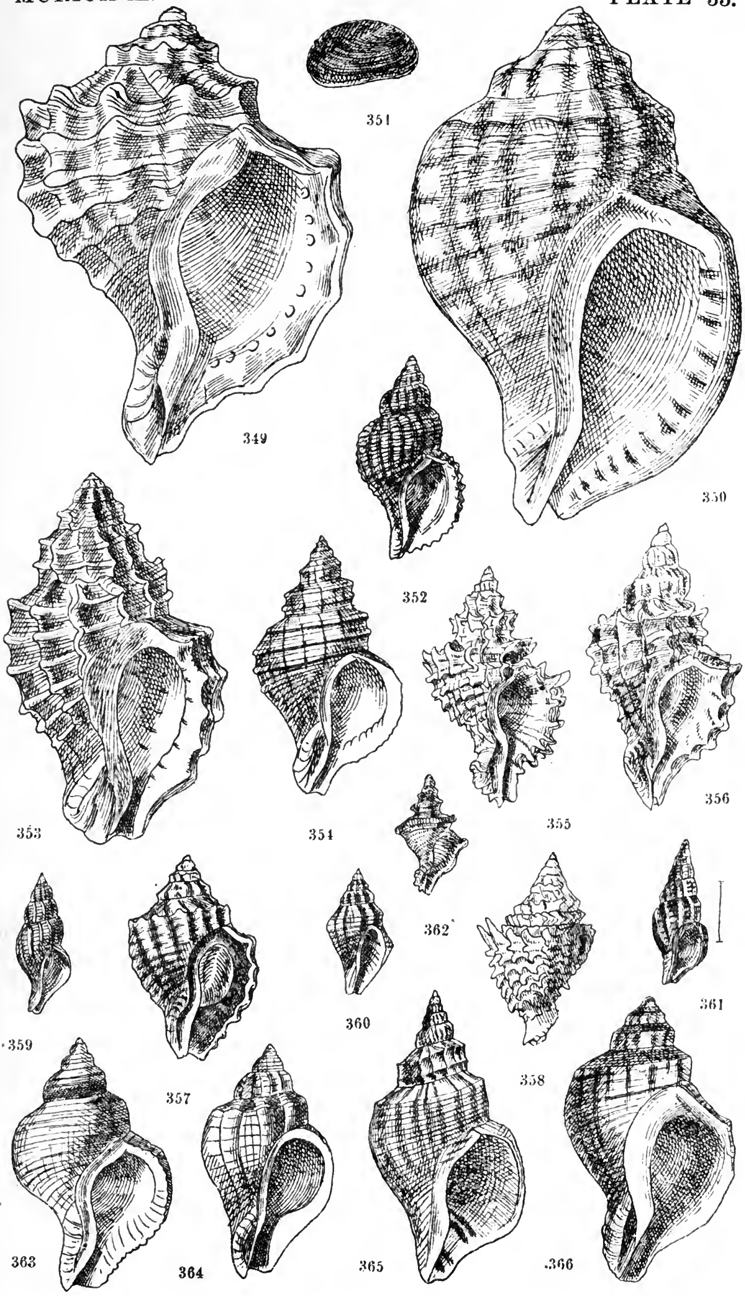
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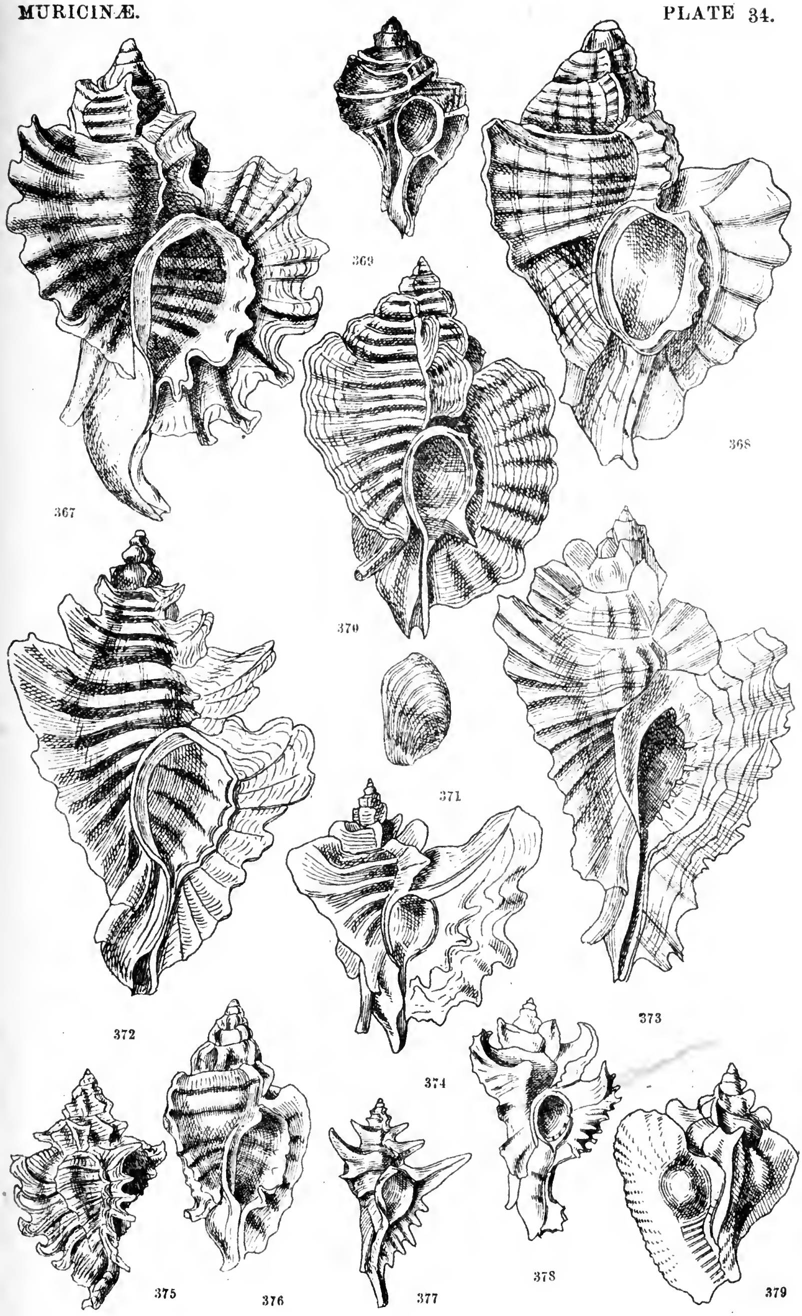
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large form, in which only three varices appear on the lower whorls, has been named *Triton Cantrainei* by Recluz (fig. 464), and C. B. Adams has called it *M. pauperculus*, and A. Adams, *obeliscus* (fig. 467).

M. EROSUS, Brod. Pl. 38, figs. 468, 460.

Dark colored in the pits between the ribs, or sometimes yellowish with a brown band. Rather narrower than the preceding species. Length, ·5 to 1 inch.

Panama, under stones at low water.

Sowerby figures this species in Conch. Ill., f. 16; Reeve also represents it by his f. 160.

M. KIENERI, Reeve. Pl. 38, fig. 461.

Yellowish or fulvous. Length, ·75 inch.

Habitat unknown.

Name proposed for *M. exiguus*, Kiener, preoccupied by Broderip. It is a very doubtful *Murex*.

M. GARRETTII, Pease.

Oblong-oval, solid, scabrous, dusky brown; whorls about six, somewhat angulated above, with spiral, transverse, reddish grooves and five varices; aperture round-oval, outer lip crenulated; canal short, subclosed, slightly oblique. Length, ·4 inch.

Shallow pools, rocky coasts of *Hawaii, Sandwich Is.*

Apparently rare. Name proposed instead of *M. exiguus*, Garrett, preoccupied by Broderip. I have not seen the species.

M. PEASEI, Tryon. Pl. 38, fig. 462.

Acutely ovate, thick, solid; spire slender, acute, short, less than half the length of the shell; last whorl with five prominent varices, which are squamose; interstices smooth; aperture oval, outer lip broadly varicose; canal very short, recurved, nearly closed. White, interstices flesh color, with a median brown band. Length, ·6 inch.

La Paz, L. California.

The above is the description of *Murex foveolatus*, Pease. I copy his figure, which does not agree at all with a specimen sent to me by him. The latter is too like *M. erosus*, Brod. Pease states that all the specimens except the one figured were covered with encrustations. I have much doubt of the distinctness of this species. There is a *Murex foveolatus*, Hinds (which is wrongly referred to *Vitularia*), so that I am compelled to give Mr. Pease's species a new name.

M. COCCINEUS, A. Adams. Pl. 38, fig. 463.

Shell ovate-fusiform, blush rose; spire produced, acuminate; whorls five, crossed by six, sharply nodose varices, spiny above; interstices with close, sharp revolving lines; aperture oval, pink, lip slightly lirate; canal short, sub-reflexed, scarcely closed. Length, ·3 inch.

St. Thomas, W. I.

The above description is slightly modified to agree with specimens before me from the original locality. One of these is figured.

M. PUMILUS, A. Adams. Pl. 38, fig. 470.

Shell rose-colored, ovate fusiform; spire elevated; whorls six, somewhat convex; varices five, crossed by alternately larger and smaller squamose revolving lines; outer lip lirate within; canal short, partially closed, slightly recurved. Length, ·85 inch.

China Seas; So. Austr. (Angas).

Sowerby makes *M. coccineus*, A. Ad., the young of this shell, and it certainly resembles it. I have not united them, because the present species is assigned to a very distant locality from *M. coccineus*—that of the latter being confirmed by specimens in the museum of the Philadelphia Academy of Natural Sciences.

The specific name was used many years ago by Broderip for a species which has never been identified; under the circumstances I think it scarcely necessary to change Mr. Adams' name.

*** *Group of M. Poulsoni.*

M. POULSONI, Nuttall. Pl. 38, fig. 475.

Whitish or yellowish, encircled by numerous, close, narrow, brown lines; aperture white or pink.

Length, 1·85 inches.

San Diego, Cal. to Pacific Coast of L. Cal.—W. M. Gabb.

I figure a fine specimen from the former locality.

M. CONTRACTUS, Reeve. Pl. 38, figs. 471–474.

Light brown, the revolving ribs sometimes darker in the interstices of the longitudinal plicæ; aperture white within. Operculum purpuroid. Length, 1·4 inches.

New Caledonia ; Philippines ; Viti Isles.

Very closely allied to *M. Poulsoni* but differs in the revolving lines of color being replaced by close sculpture; sometimes these revolving riblets become alternately larger. Reeve's *Bucc. funiculatum* (fig. 474), is certainly the same species, and I scarcely doubt the identity of his *B. concentricum*, (fig. 472), and *B. ligneum*, (fig. 473), the latter being a young shell with longer spire than usual.

M. LURIDUS, Midd. Pl. 38, figs. 481, 485.

Fusiform, spire elevated, canal short, open; whorls closely asperately lirate, the liræ crossing a few rounded ribs; aperture dentate within. Reddish or chocolate.

Length, ·35 to 1 inch.

Sitka to California.

The var. *aspera*, Baird, appears to me to be simply the fresh state of this species, specimens of which are generally waterworn. In the latter condition, when starved into a narrow, small form, Carpenter has distinguished them as var. *munda*.

M. INTERFOSSUS, Carpenter. Pl. 39, fig. 484.

Shell narrower and more shouldered than the last species, the lattice of revolving liræ and longitudinal ribs coarser and more elevated; canal short, closed. Length, ·4 to ·75 inch.

Sitka to California.

M. GRACILLIMUS, Stearns. Pl. 39, fig. 480.

Light brown, the revolving costæ sometimes white, spotted with red. Length, ·5 inch.

San Diego, Cal., to L. Cal.; Santa Catalina Is., common from low water to 30 fathoms.

M. CIRCUMTEXTUS, Stearns. Pl. 39, fig. 478, 494.

Whitish with brown blotches; yellowish to purplish within. Length, ·75 inch.

California.

I give in addition to the original figure, that of a larger specimen with coarser sculpture. This form is found abundantly at San Miguel and Santa Rosa Islands off the southern coast of California. Mr. Stearns furnishes me with this figure, (fig. 494).

M. Fricki, Crosse.

Elongately fusiform, longitudinally plicately varicose, the varices eight in number, compressed, short, laciniately foliated; whorls seven, spirally costate, two of the costæ ascending the spire; aperture small, oblong-ovate, columellar margin subarcuate; outer lip dilated, elegantly foliaceous, within denticulate; canal short, recurved. With a black-violet sutural, median and basal zone, which reappear within the aperture.

Length, 13, diam. maj. 5·5 mill.

California.

Not figured. I can only guess at the relationship of this species and prefer simply to record it, and await the publication of an authentic illustration.

M. Brazieri, Angas. Pl. 30, fig. 289.

Shell ovate, ventricose, shouldered; with five varices, crossed by five strong ribs, some of which are double; squamous, the varices nodulous; aperture dentate within. Light brown, brownish-purple on the columella and within the aperture.

Length, ·33 inch.

Near Pt. Jackson, N. S. Wales, Austr.; 20 fathoms.

M. Duthiersi, Vélain. Pl. 39, figs. 477, 483.

Yellowish or whitish, varices eight or nine, not much elevated; canal short, open. Length, ·3 inch.

Isles of St. Paul and Amsterdam, Ind. O.

I have ventured to unite with this species the same author's *M. Hermani*, (fig. 483), which appears to be founded on specimens in less perfect condition. The species does not appear to possess any well marked characteristics.

M. tritonidea, Vélain. Pl. 39, fig. 476.

Length, 4 to 5 mill.

Isle of St. Paul, Ind. O.

Described as a *Trophon*, but its characters do not correspond well with that genus.

Subgenus **Vitularia**, Swainson.

M. MILIARIS, Gmel. Pl. 35, figs. 393, 397.

Whitish or brownish; with irregular rounded ribs, which are sometimes tinged with chestnut, as though in interrupted revolving bands. Whole surface peculiarly scabrously mamillated.

Length, 2·5 inches.

W. Coast of Africa.

The ribs are more prominent and more rounded, and the form is more ventricose and proportionately shorter than in *V. salebrosa.* Reeve figures a young shell as *M. purpura*, Chemn.

V. SALEBROSA, King. Pl. 35, figs. 394, 396, 398

White or yellowish-brown, sometimes banded. The occasional varix much thickened, being composed of a number of parallel, close laminæ. Lip and columella tinged with yellow. Operculum diamond-shaped, with two short sides above and two long ones below, the angles rounded. Length 2·5–4 inches.

Mazatlan to Panama.

V. SANDWICHENSIS. Pease. Pl. 35, fig. 399.

Fusiformly ovate, rather thin, white, with about three transverse rows of brown spots on the varices; whorls five, sharply angulated, body-whorl angulated just below the suture; varices six, slightly oblique, wrinkled; aperture white, oblong-ovate, outer lip denticulated within; columella slightly arched; canal short.

Not hitherto figured. Represented in our collection only by a somewhat bleached specimen a half inch in length.

V. CANDIDA, H. and A. Adams.

Ovate, solid, white, spire produced, whorls convex, shouldered; varices thin, produced on the shoulder, often obsolete, interstices lirate; aperture ovate, lip thickened, sulcate within, margin denticulate. L. 35, lat. 18 mill.

New Zealand.

Said to be very variable in its characters. Not figured.

V. CRENIFER, Montrouzier. Pl. 35, fig. 395.

Yellowish-brown. L. 35, lat. 25 mill.

New Caledonia.

A single specimen obtained.

V. MONACHUS, Crosse.

This Japanese species which I have included in *Ocinebra* (*ante*, p. 127), has certain resemblances to *Vitularia* and may possibly belong to the group.

ADDENDA TO MUREX.

M. (TRIBULUS) TRYONI, Hidalgo. Pl. 70, fig. 427.

Varices three, compressed, those of the body-whorl with three short, sharp spines, on the spire a single spine upon each; a spine on the canal below each varix; canal moderate in length, straight; whorls seven, the two first smooth, the others with eight or nine very small, narrow longitudinal ribs crossed by numerous revolving lines forming tubercles at the intersections. Color whitish.

Length, 28 mill.

Lesser Antilles, at great depths.

For the above name and description, together with the specimen figured, I am indebted to Mr. J. G. Hidalgo, who obligingly forwarded them to me with the request that the publication thereof should be made in the "Manual." The shell, which is perhaps not adult, belongs to the same group as *M. recurvirostris*, but differs from all the other species in the great number and relatively little prominence of the riblets between the varices.

I am indebted to Mr. Hidalgo also for the following notes of locality:

M. BEAUI, Petit, M. CABRITII, Bernardi, M. HIDALGOI, Crosse, and M. PAZI, Crosse, have all been dredged together in the waters of the Lesser Antilles.

M. CAPUCINUS, Chemn. In describing this species I gave the locality Philippines as doubtful. It certainly is found there and exists in all the Madrid collections made at the islands by the employés of the Spanish administration. Mr. Hidalgo possesses specimens collected living at Zamboanga, Island of Mindanao.

Indeterminate Murices.

M. ACANTHOPHORUS, Monterosato. Named but not described. There is a *Phyllonotus acanthophorus*, A. Adams (described in Zool. Proc., 372, 1862), from Japan. Monterosato's species is from the Mediterranean.

M. CYCLOPUS, Benoit. MSS. Quoted by Monterosato as a Mediterranean species, but not characterized.

M. CINGULATUS, Lam. Hab.? This shell has not been identified. Sowerby thinks it a *Fusus*.

M. NANUS, ACUMINATUS, LÆVICOSTA, ALBICANS, AURANTIUS, DENTATUS; all described by Anton in his Verzeichniss, 1834, have never been identified. No localities of any of them are given. Not figured.

The following species are described by Mr. Arthur Adams in Zool. Proc., London, 1851–3. Neither distinctive characters nor dimensions are given in most of these descriptions, nor are they figured. I am unable to locate them positively in any of the subgeneric groups.

** With several varices.*

M. ARMATUS (*Gulf of California*), IOSTOMUS (*Philippines*).

** Shell plicate.*

M. EXCAVATUS, PAGODUS, SEROTINUS (*South Australia*, Angas). EXASPERATUS, DIADEMA (*Philippines*), NITENS (*Philippines*), UNIFASCIATUS (*Japan*).

M. PUMILUS, Brod.

Rhomboidal, five varicose, varices flattened, short, subrecurved, crenulate; dark brown, subfasciate with white; canal moderate, subrecurved; lip crenulate. L. 5 inches, lat. 3 inches.

Gallapagos Is., found under stones.

Probably a young shell.

M. OSTREARUM and M. CELLULOSA, Conrad. *Tampa Bay*, *Fla.*

I am unable to identify the very inadequate descriptions with any species; they are as follows:

M. CELLULOSA. Short-fusiform, with large, prominent revolving lines or costæ, the interstices with transverse wrinkled lines, largest on the varices, and giving the shell a cellular aspect; beak much curved; color cinereous; aperture small, obovate, purplish within. Inhabits oyster beds.

M. OSTREARUM. Fusiform, with revolving ribs alternated in size, and with longitudinal wrinkles; spire elevated, scalariform; base umbilicated; within livid. Occurs with the preceding.

Fossil Genera.

PTEROHYTIS, Conrad. Genus not characterized. The type has lamellar varices like *Cerostoma foliatum* but more numerous than in that group, and the outer lip has a tooth. I think it may be safely relegated to *Phyllonotus*, Swains.

P. UMBRIFER, Com. Pl. 70, fig. 429. Miocene, *Virginia*.

ODONTOPOLYS, Gabb. Resembles the subgenus *Pteronotus* in having three varices on each whorl but distinguished by the crenulations of the outer lip and by having two transverse plaits or folds on the middle of the columella.

O. COMPSORHYTIS, Gabb. Pl. 70, fig. 430. Eocene, *Wheelock*, *Texas*.

Genus **TYPHIS**, Montfort.

The ascending tube which is the distinguishing feature of the shells of this genus is occupied by an extension of the mantle margin of the animal.

The operculum is ovate, with apical nucleus, like that of Murex.

There are several European Eocene species.

This genus is monographed both by Sowerby and Reeve.

T. TETRAPTERUS, Bronn. Pl. 30, figs. 290–292.

Flesh color. Length, ·5 inch.

Confined to the Mediterranean, where it is widely distributed. Miocene to post-pliocene of Southern Europe.

T. ARCUATUS, Hinds. Pl. 30, figs. 293, 297.

The tubes are incurved so as to approach the preceding whorl. Somewhat smaller than the preceding, but not very dissimilar.

Cape of Good Hope, Japan, China.

T. Japonicus, A. Adams, is made a synonym in Sowb. Thes.

Conch., after comparison with the type of that species. *T. duplicatus*, Sowerby (fig. 297), does not offer any distinctive characters.

T. YATESII, Crosse. Pl. 30, fig. 294. Length, ·4 inch.

South Australia.

T. MONTFORTII, A. Adams. Pl. 30, fig. 295.

Rose color; the last tube much prolonged. Length, ·5 inch.

Japan.

Very closely allied to *T. Yatesii.*

T. NITENS, Hinds. Pl. 30, fig. 299.

Distinguished by its quadrangular form. Length, ·5 inch.

Straits of Macassar.

T. BELCHERI, Brod. Pl. 30, figs. 300, 301.

This may be regarded as the Atlantic analogue of the Mediterranean *T. tetrapterus.* It is a somewhat larger shell, with the variceal spines much incurved and a rather longer canal.

W. Coast of Africa, Brazil.

The latter locality is for *Murex Cleryi*, Petit (fig. 301), which, notwithstanding his attempt to distinguish it, I cannot consider essentially different.

T. QUADRATUS, Hinds. Pl. 30, fig. 296.

Chestnut-brown, the varices white; hooks and tubes short; canal rather short, bent, wide above. Length, ·7 inch.

W. Coast of Central America.

T. CLERYI, Sowerby. Pl. 30, fig. 302.

This Australian shell is figured by Sowerby in the Thesaurus and also in Conchologia Iconica as *T. Cleryi*, Petit—which is an error, as that species comes from South America and = *T. Belcheri*, Brod. The name being thus freed, I adopt it as of Sowerby, not Petit. It is distinguished from all the other species by its elegantly spinous varices.

New Zealand; off Sydney Head, Austrlia.

T. CUMINGII, Brod. Pl. 30, fig. 298.

The very long, slender, straight canal sufficiently distinguishes this species from all its congeners. Pale fulvous, with bands of darker color crossing the varices. Length, 1 inch.

Bay of Caraccas, Venezuela.

T. EXPANSIS, Sowb. Pl. 30, fig. 306.

The broad frill of the marginal varix is the principal feature. Length, ·85 inch.

Hab. unknown.

T. CANCELLATUS, Sowb. Pl. 30, fig. 303.

Shell obscurely cancellated, white; varices broadly foliated, hooked at the shoulder, the foliæ extending to the lower end of the short canal; tubes usually connate with the hooks of the varices. Length, ·5 inch.

Bahamas, St. Johns, W. I. (Krebs.)

T. GRANDIS, A. Adams. Pl. 30, fig. 306*a*.

Varices broad, fimbriate-lamellar. Length, 1·5 inches.

Gulf of California.

The largest species of the genus, and the type of a group of species peculiar to the West Coast of America.

T. PINNATUS, Brod. Pl. 30, figs. 304, 305.

Also from Gulf of California. I suspect it is the same species as the preceding. Von Martens acknowledges the identity of his *T. Jamrachi* with *fimbriatus*, A. Adams (fig. 305), which is evidently the adult state of *T. pinnatus*.

T. CORONATUS, Brod.

The only specimen known, which is not adult, is in the Cumingian Collection.

Bay of Caraccas, Venezuela.

T. TRIANGULARIS, A. Ad.

Fusiform, triangular, white, subcancellate; three pinnate varices, tubulate behind; interstices transversely lirate, with a median node; aperture oval, canal moderate, open, turned to the right.

Hab.? (Mus. Cuming.)

Said to resemble *Murex tripterus* in form. Not figured.

Genus **TROPHON**, Montf.

The typical *Trophon* has a fusiform shell, thin and white, the whorls with numerous, sharp, laminated varices, the interstices smooth, or spirally ribbed; canal open, usually turned to the left; no umbilicus; lip thin, smooth within. This group is essentially boreal in distribution. There is, however, another group of species inhabiting the southern temperate and antarctic zones, which, whilst possessing the main features of the type, the laminæ and the white color, present peculiar characters. These shells are usually broadly ovate, shouldered, umbilicate, the aperture dark colored within. They form a transition to *Siphonalia*, and might with almost equal propriety be included in that genus. It may be remarked here that Montfort's definition of the genus *Trophon* does not correspond so well with the typical group as now recognized, as it does with these Siphonalia-like shells.

Kobelt has catalogued the genus in Jahrbücher Deutsch. Mal. Gesell., vi, 168, 1879.

The name is a contraction of Trophonius, a mythological deity.

1. *Typical or Boreal Species.*

T. CRATICULATUS, Fab. Pl. 31, figs. 309, 310, 307, 320; Pl. 33, fig. 359.

Shell white, aperture white also. Length, 1·25–1·5 inches.

Greenland; Iceland; Gulf of St. Lawrence; Spitzbergen; Norway; Pacific Coast of N. America south to Puget's Sound.

Fossil: *England; California; Japan* (A. Ad.).

The name given by Fabricius as of Linnæus was supposed by Beck and others to be intended by Linnæus for another species of *Trophon*. and under this impression Beck changed the present specific name to *T. Fabricii*. The species of Linnæus is, however, a *Fusus;* so that it is proper to continue to use the specific name *craticulatus*, Fab. *T. Orpheus*, Gld. (fig. 310), is a shouldered var. of this species, and *T. squamulifer*, Carp. (fig. 320), appears to be the same form. I figure a specimen from Puget's Sound, which appears to unite the characters of *T. Orpheus* with the thickened lip and three revolving lines of *T. squamulifer*. *T. tenuisculptus*, Carp. (fig. 359), from the post-pliocene of Sta. Barbara, Cal., may also be the same species.

Amongst the synonyms of *T. craticulatus* I am much inclined to place

T. Heuglini, Mörch; which is thus described:

Narrowly fusiform, whitish; spire turreted with mamillary apex; the ribs are compressed, membranaceous, eight in number;

last whorl with six squamose revolving lines; lines of growth membranaceous, crowded, undulated. Length 22, lat. 10·5 mill.

Polar Sea.

T. Maltzani, Kobelt (fig. 307), is an Alaska form in which the varices are nearly entirely suppressed.

T. MURICATUS, Mont. Pl. 31, figs. 308, 311, 319.

Yellowish or flesh-color, sometimes white (var. *alba*).

Length, ·6 inch.

England; Ireland; Atlantic Coasts of France; Spain; Portugal; Mediterranean; 8–150 fathoms.

The ova-capsules are described by Jeffreys as about a line in diameter, with an oval orifice; they contain a purplish liquor, together with the fry. The animal is light yellow or whitish. Eaten by fishes—*Trigla Gurnardi* and *Peristedion cataphractum*. It has also been taken, on a single occasion, from a fish caught on the Massachusetts coast.

T. BARVICENSIS, Johnst. Pl. 31, fig. 318.

Shell and animal white. The shell is broader, proportionally, than *T. muricatus*; it is also a little more shouldered, and has fewer ribs, which are more laminar and prominent.

Length, ·6–·9 inch.

North British; Norway; Mediterranean; 8–200 fathoms.

Creeps like *Lachesis*, foot upwards, on the surface of the water. An ova-capsule was found by Mr. Jeffreys in a valve of *Leda minuta:* it is very thin, semitransparent, and marked with delicate, close-set, microscopic, concentric lines; orifice oval The species bears the Roman name of Berwick-on-Tweed.

So far the Mediterranean specimens have only been obtained at considerable depths.

T. CLATHRATUS, Linn. Pl. 31, figs. 312, 314, 316, 317, 322, 325.

Most authors separate this into two species, distinguished by size and number of ribs. *T. truncatus*, Ström. (fig 325), is about ·6 inch long, with twenty ribs on the body-whorl; whilst *T. clathratus*, L. (fig. 312), has fourteen ribs when the same size, and grows, moreover, to much greater dimensions. I have no doubt that the British specimens are all small and correspond uniformly to the description of *T. truncatus*, but specimens from Arctic American localities vary all the way in size from the *T. clathratus* or large form (equivalent to *T. lyratus*, Lam., fig. 312, and *T. scalariformis*, Gld., fig. 314), to the small shells corresponding to *T. truncatus*; and the ribs vary greatly in number, not only on different specimens, but even on different whorls of the same species. *Murex Bamffius* of Montagu is a synonym of the English type. A scalariform variety, with excavated sutures, shouldered whorls, coronated with spines more or less, has been called *T. Gunneri* by Lovén, and *T. multicostatus* (fig. 316). by Escholtz. Provisionally, I allow the *T. truncatus* to stand as a variety.

Inhabits from *Spitzbergen ; Norway ; Great Britain ; Iceland ; Arctic America, south to Massachusetts ; Newfoundland ; W. Coast of America, to Vancouver's Island ; Japan.* Depth, 5–500 fms.

It is a usual post-glacial fossil of N. Europe, and the variety occurs in the older pliocene at Messina. Post-pliocene, Santa Barbara, Cal. The Icelanders call it "St. Peders-snekke," or St. Peter's snail; I know not why.

Dr. Jeffreys separated the large and small forms in his British Conchology, but has more recently thought fit to unite them.

Fusus candelabrum, Ad. and Reeve (fig. 317), is indistinguishable from the shouldered carinate form of Gould's *Fusus scalariformis*. It is reported from Japan, by A. Adams.

T. Muriciformis, Dall. Pl. 31, fig. 313.

Very like *Busycon carica* in form.

Length (apex broken off), 40 mill.

Behring's Sts., Dall; *Victoria, Vancouver's I.* (young), Richardson.

Large and peculiar as is this shell, I very much doubt its distinctness from *T. clathratus*. Kobelt has changed the name to *T. Dalli*, on account of *Eupleura muriciforme*, Brod., which he has included in *Trophon*.

T. clavatus, Sars. Pl. 31, fig. 326.

This is a smaller shell, with the whorls somewhat more shouldered, the ribs fewer, more prominent and more spinose on the shoulders, and the canal straighter than *T. Muriciformis*. It is very like that species; but appears to be more closely related to *T. Barvicensis*, of which it may prove to be a variety.

T. TRIANGULATUS, Carpenter.

Small, thin, white, wide behind, narrow before; two nuclear and four normal whorls, the latter shouldered; rapidly narrowed to the front, with long, arcuated canal; varices about seven, acutely laminated, forming open, radiated, somewhat curved spines around the shoulder; there is an obsolete angle or line on the periphery. Length, ·35 inch.

Catalina Isl., Cal., 60 fms.

Said to be related to *T. muricatus*, Hinds.

I have not seen this species. Mr. Stearns writes me that a specimen in the California State collection, about 1 inch long, and so labelled, is the young of *Chorus Belcheri*, Hinds.

T. SUPPOSITUS, Gld.

Shell pyriform, turreted, thin, dirty white, with remote, erect laminæ; whorls six, convex, shouldered, the last bulbous, protracted in front into a thin, recurved canal. Aperture ovate, three-fifths the length of the shell, columella porcellanous.

Length 30 mill., diam. 15 mill.; length of aperture, 20 mill.

Hab.?

I know nothing of this species; the description does not distinguish it from *T. clathratus*.

T. CONCINNUS, A. Ad.

Ovately fusiform, solid, cinereous; decussated by nodulous concentric lines and thin longitudinal plicæ; whorls five, subangulated in the middle; spire acutely conical; aperture narrow, ovate, narrowed in front into a contorted canal; columella arcuated, smooth.

Japan, 35 fathoms.

This little, neatly-sculptured species resembles in some particulars *T. crispus* of Gould; but the transverse liræ are nodulous and crowded, and the longitudinal laciniated plicæ are close together, whereas in *T. crispus* the whorls are finely cancellated. The above is a copy of the original description; I do not know the species.

2. *Antarctic or Southern Forms.*

T. LIRATUS, Couthouy. Pl. 31, fig. 333.

Animal and shell pale yellow; operculum fusoid. Shell fusiform, polished, with traces of a thin epidermis; the whorls are crossed by about twenty close-set, angular ridges, and the interstices have deep-cut revolving striæ. Aperture white, clouded with purple; columella with a purplish callus; lip simple, but bordered with the last angular ridge. Length, ·75 inch.

Dredged at *Orange Harbor* (*Terra del Fuego*), 15 fathoms, Couthouy.
Castle Point, Manchuria, Japan, 20 fathoms, A. Adams.

It is not probable that both these localities are correct. The external appearance of the shell is somewhat like a *Urosalpinx*.

T. CRISPUS, Gould. Pl. 31, figs. 321, 323, 328, 329; Pl. 70. fig. 437.

Animal yellow. Shell ashy, polished and purplish within; lip evasive, deeply furrowed within. Length, 1 inch.

Dredged at *Orange Harbor*, 16 fathoms.

Arthur Adams quotes this species also from Japan—probably an error in identification. Animal very timid; when fully pro truded, the head is not advanced beyond the foot. A scalariform monstrosity occurs.

Murex pallidus, Brod. (fig. 329), from Falkland Islands, appears to be the young of this species; *Fusus fasciculatus*, Hombr. (fig 328), and *F. fimbriatus*, Gay (Pl. 70, fig. 437), are also the same species.

T. LACINIATUS, Martyn. Pl. 31, figs. 330–332.

Shell whitish, chestnut within the aperture; animal yellow. Length, 1·5–2 inches.

Magellan's Sts., Falkland Isles.

I do not hesitate to unite with this species *T. antarcticus*, Phil. The single specimen on which the description is based is said to be narrower, the lamellar spines on the shoulder shorter, etc. I have before me specimens which answer well to this description, as well as intermediate forms.

The aperture in this species, as well as in the related *T. Geversianus* and *T. xanthostoma*, being very wide, a modification of the form of the operculum occurs, in a lateral growth from the initial point, which causes the latter to appear as if on the outer side instead of the lower extremity, simulating the Purpuroid operculum. I very much doubt whether these Southern American and New Zealand species really belong to *Trophon*, but am not prepared to give them any other position at present.

T. Geversianus, Pallas. Pl. 32, figs. 337–347; Pl. 70, figs. 433, 435.

Typically, this species is broad ovate, shouldered, with numerous frill-like varices and elevated, rounded, revolving ribs; umbilicus widely exposed, aperture chestnut within.

Length, 2·5 to 3 inches.

Magellan's Straits to Chili.

With this typical form must be united *Murex Patagonicus*, d'Orb. (fig. 340). This author has described a much heavier shell, round shouldered, without varices, under the name of *M. varians* (figs. 346, 348), although suspecting it to be the same as *Geversianus*. Gray considers it the same, and I think there is no doubt of it, as I have before me intermediate forms, among which are vars. *calva* (fig. 338) and *lirata* (fig. 347) of Kobelt. Then there is a smaller form called *Philippianus*, Dunker (fig. 343), which I figure. This may be considered a variety. *Fusus intermedius*, Gay (Pl. 70, fig. 433) is another variety. *Fusus decolor*, Phil. (fig. 342), is founded on worn specimens of var. *Philippianus*, Dunker. I think *F. albidus* Phil. (341), is also this variety. *T. albolabratus*, E. A. Smith (Pl. 70, fig. 435), from Kerguelen's Island is said to differ from *T. Philippianus* in the whorls being more rounded above, the penultimate whorl is larger and more elevated; body-whorl more inflated below the middle, not prolonged into such an elongated cauda; the aperture rather larger, longitudinal lamellæ more prominent and not nearly so numerous. Long. 40 mill., diam. 18 mill.

It is a narrower shell than any of those quoted above, and may be distinct, but I doubt it.

T. MURICIFORMIS, King.

Ovately-fusiform, cinereous; whorls tumid, cancellated; aperture dark chestnut; margin of lip crenulate.

Length 1 inch, diam. ·55 inch.

Straits of Magellan.

I cannot identify this species. Very probably it is a variety of *T. Geversianus.*

T. CORRUGATUS, Reeve. Pl. 33, fig. 352.

Closely latticed; pale fulvous white. Length, 1·25 inches.

Habitat?

A very doubtful form. It may = *T. muriciformis* above, and Philippi (Abbild. III) has identified it with his *Fusus albidus*, which is a synonym of *T. Geversianus.* On the other hand Hutton thinks that his *T. plebeius*, of New Zealand, may be the same.

T. LOEBBECKEI, Kobelt. Pl. 31, fig. 335.

Very like the preceding, but not so closely ribbed.

Length, 32 mill.

Habitat unknown.

It may belong to the genus *Urosalpinx.*

T. PLEBEIUS, Hutton.

Small, fusiform; whorls convex, striated spirally, and finely plicate longitudinally; mouth oval, angular, lip striated in adult individuals; canal short, slightly inclined to the left. Purpureous, the salient parts darker; within brownish purple.

Length, ·8 inch.

New Zealand.

Trophon inferus, Hutton is said to resemble the above, but much larger, with shorter canal and more irregular ribs.

Length, 1·1 inches.

They are probably identical. Hutton thinks that possibly *Fusus corrugatus*, Reeve (= *Trophon*) is the same. Not figured.

T. GLOCKERI, Anton.

Only known through a short description; no locality. Is probably a *Trophon.*

T. PLUMBEUS, Gld. Pl. 31, figs. 334, 324, 327; Pl. 70, fig. 432.

This is figured in the Wilkes Exped. Mollusca as *Fusus plumbeus*, Phil. The latter, however, is a *Euthria*, from the Northwest Coast of North America, whilst the mollusk figured by Gould is a *Trophon*, and probably from Orange Harbor (Terra del Fuego). The animal is yellow like others of the genus, and the operculum has its nucleus terminal. "The animal secretes abundantly a sap-green viscous fluid."—Couthouy. *Fusus roseus*, Hombr. (fig. 327), appears to be the same species.

T. BUCCINEUS, Gray. Pl. 39, fig. 490.

No description or locality is given but an excellent figure, which I copy. The shell is allied to *T. plumbeus*, is light chocolate-brown, deeper within the aperture, and a little exceeds an inch in length.

T. XANTHOSTOMA, Brod. Pl. 33, figs. 349, 350.

Perfect specimens have the varices beautifully fimbriated by the crossing of six or eight prominent revolving ribs, whilst the interstices of the latter are crowded with incised revolving lines, and crossed with raised growth-striæ. The adult is very rarely in this perfect condition. It much resembles forms of *T. Geversianus*, but may be distinguished by the following characters: the shell is much heavier, the lamellæ are broader, the shoulder of the whorl is more sloping, the aperture is inclined to pink within, and the lip is frequently margined inside and slightly dentate. Like *T. Geversianus*, this species varies much in the proportions of the shell. It has characters in common with *Siphonalia*. Reeve (who figures it as a *Purpura*) remarks upon its variability and the difficulty of assigning it permanently to any genus. I figure *Fusus fusiformis*, Potiez et Michaud (Pl. 70, fig. 432), which is certainly the same species.

Dredged in gravel and sand, 7 to 25 fathoms; harbor of *Valparaiso, Chili*.

T. HORRIDUS, Brod. and Sowb. Pl. 33, figs. 356, 353.

Only differs from *T. xanthostoma* by its elongated spire, and is probably a variety of that species. The type is young, and does not exhibit the internal denticles of the outer lip, but an older stage (*M. Boivinii*, Kiener, fig. 353) has these well developed.

St. Elena, Panama. In sandy mud, 8–12 fathoms, Broderip.

Troschel includes it in the enumeration of the Tschudi collection from Peru, and figures the operculum, which is muricoid.*

T. WAHLBERGI, Krauss. Pl. 31, fig. 315.

Length, 1·33 inches.

Natal Coast, So. Africa.

T. DUODECIMUS, Gray.

Ovate, fusiform, pale yellow, longitudinally costate; spire conical, acute; whorls rather rounded; last whorl about half the length of the shell, with twelve concentric rounded ribs and a central white band, with some spiral ridges in front crossing the varices, and closer over the short, open canal.

New Zealand.

I do not know this species: Hutton, in his catalogue of New Zealand shells, confesses his inability to determine it.

T. STANGERI, Gray. Pl. 33, figs. 363, 365.

"Small, ovate, fusiform; brown; regularly and closely concentrically striated; spire acute, rather shorter than the body-whorl; the upper whorl with two, and the body-whorl one (what?); with eight continued, distant, spiral ribs, the hinder ones farthest apart. and most raised; the mouth dark brown; the canal short, open; axis ·75 inch."

New Zealand.

To this species Hutton refers the *Murex liratus* of his catalogue (not of Gmel.) as well as his *Fusus varius*. Dr. von Martens has identified the *liratus* with *T. ambiguus*, Philippi (fig. 365), and Hutton thinks *Fusus cretaceus*, Reeve (fig. 363), may be the same. Both these species are very closely allied to *T. xanthostoma*, Brod., from Chili.

T. SPIRATUS, Adams. Pl. 33, fig. 354.

Very like *T. cretaceus*, Reeve, and may be the young of that species. Lip slightly striate within; operculum with terminal nucleus. Length 46, diam. 23 mill.

New Zealand.

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* Archiv. für Naturg., i, 1852.

T. CORONATUS, Adams.

Ovately fusiform, thin, cretaceous, white; spire moderate; whorls angulate behind; varices distant, laciniated, produced into squamiform spines on the shoulder; interstices smooth; last whorl ventricose, produced into a long rostrum, which is recurved at the extremity; aperture ovate; lip smooth, simple; canal open.

L. 45, lat. 17 mill. *New Zealand.*

Not figured.

T. PETTERDI, Brazier. Pl. 33, fig. 361.

Color dirty white, light yellowish within the aperture.

Length, 8·5 mill. *Tasmania.*

An aberrant form, which might as well be placed in *Muricidea* as here. *T. clathratus*, Woods, is the same species according to Von Martens (Zool. Rec., 152, 1875); and I think *Murex scalarinus*, A. Adams, will prove to be the same or an allied species. If the same, it will have priority. It is not figured, and no locality is given. Sowerby has figured in error for this species a little shell which much resembles a slim variety of *Murex aciculatus*, Lam.

T. BRAZIERI, Woods.

Ovately fusiform, attenuate at both ends, sordid white; spire subturreted, almost acute, mamillate; whorls seven, with rib-like varices (six distant ones on the body), smooth or finely striate: aperture ovate, chestnut-colored, indistinctly brown-banded; outer lip thin; columella subtuberculate anteriorly; canal sub-elongate, recurved. L. 10, lat. 5 mill. *Tasmania.*

Not figured.

T. GOLDSTEINI, Woods.

Abbreviately fusiform, lamellosely varicose, sordid white, spire subturreted; whorls eight, convex, angulate and coronate above, girdled with distant, subraised liræ (in last whorl four, the two towards the base between the varices obsolete), liræ not passing over the varices, which are anteriorly squamose and flexuous; aperture ovate, enamelled and chestnut-brown banded within; outer lip varicose; columella twisted; canal twisted and flexuous.

L. 16, lat. 8 mill. *Tasmania.*

Not figured.

T. AUSTRALIS, Woods.

Ovate, acuminate at each end, sordidly greenish; whorls six, convex, angular above; obsoletely ribbed lengthwise, and finely transversely lirate; ribs on last whorl ten, vanishing anteriorly; spire acute; aperture ovate, outer lip thin; columella flattened; canal somewhat long and slightly recurved.

L. 16, lat. 9 mill.

Tasmania.

Not figured.

This and the preceding species may be young specimens of *Urosalpinx.*

T. FIMBRIATUS, Hinds. Pl. 33, fig. 355.

Light brown, sometimes obscurely banded, aperture white, sulcate within; shell rather solid. Length, 1·5 inch.

Straits of Macassar; 11 fathoms in sand and gravel; *Formosa.*

Generic relationships doubtful. Reeve changed the name to *luculentus*, in his monograph of *Murex*, because Lamarck has described a *Murex fimbriatus*: as a *Trophon*, however, Hinds' name will stand, and consequently that of Reeve becomes a synonym to it. *Murex lamelliferus*, Dkr., from Formosa, appears to be the same species.

T. SQUAMEUS, Dunker.

Ovate-fusiform, acute; whorls eight, convex, angulate, and flat-shouldered above the angle, the last whorl two-thirds of the total length; longitudinally plicate, crossed by imbricately squamous revolving riblets; lip crenulate, sulcate within; canal open, sub-umbilicate. Yellowish white, with interrupted chestnut bands. Length, 1 inch.

Manilla.

An unfigured species said by its author to resemble *T. fimbriatus.*

T. CARDUUS, Brod. Pl. 33, fig. 358.

Very like *T. fimbriatus*, but differs somewhat in the ornamentation of the spire. Dredged by Mr. Cuming from a coral reef, twelve miles from shore, at a depth of 25 fathoms, at Pacosmayo Peru.

T. CRASSUS, A. Ad. Pl. 33, fig. 364.

Yellowish brown, violet within the aperture. Length, 1·35 in.

Hakodadi, Japan.

This is an aberrant form, removed by its solidity, its usually internally dentate lip, etc., from the typical *Trophons.*

T. incomptus, Gould, is suspected by Mr. Adams to be the same species: the description applies pretty well to the figure of *T. crassus*, and it comes from the same locality. Gould says that in young shells the laminæ are quite prominent, with small spines at the angles.

T. FLINDERSI, Ads. and Angas. Pl. 33, fig. 357.

Cinereous, margin of aperture purplish. Length, 1·25 inches.

York's Peninsula; S. Australia.

Described as a Trophon-like species of *Purpura;* but the operculum of the figure is decidedly muricoid and not purpuroid, I therefore place it in *Trophon.*

I add descriptions of two species of *Purpura* by Tenison-Woods: they have not been figured, and the operculum is not mentioned, but as they are compared with *T. Flindersi*, as possibly mere varieties of it, they may belong in *Trophon* rather than in *Purpura.*

P. LITTORINOIDES, Tenison-Woods.

"Acuminately ovate, greenish white, spire produced, acuminate, mamillate; whorls six, angulate and bicarinate above with transverse rounded liræ (equaling the interstices in width), and cancellated with scaly imbricate lamellæ; aperture acutely ovate, stained deep blackish purple within; inner lip somewhat flattened and partly enamelled, blackish purple; outer lip slightly crenulate.* Length 15 mill., diam. 8 mill.

South Australia.

"This shell approaches in habit the *P. Flindersi* of Ads. and Angas, but it is much smaller and more like a *Littorina*, while the other resembles a *Trophon.*"

* Since the above was written, *P. littorinoides* has been found at various localities in Victoria. "Some specimens had a Nassa-like mouth, that is, teeth on the outer lip."

P. PROPINQUA, Tenison-Woods.

"This shell so closely resembles *P. littorinoides*, that no better description can be given than to say that it is broader, shorter, with fewer whorls, and the spiral liræ become six stout corrugated ribs with a corrugated one at the angle. The aperture is fulvous. It is intermediate between the species just mentioned, and Mr. Angas' *P. Flindersi.* The difference may be due to climate. Future observers must solve the question of the specific distinction of these three shells which are different enough at their various stations, many hundred miles apart, but may possibly graduate one into another as they are traced north or south.

"Length 13, diam. 8 mill."

N. W. Coast Australia; extremely abundant on rocks at low water.

T. GYRATUS, Hinds. Pl. 33, fig. 362.

Brownish white. Length, ·75 inch.

Straits of Macassar; in coarse sand, 17 fms.

Described as a *Trophon*, and by Reeve and Kobelt placed in *Murex.* I figure it here, but think it may prove a young *Siphonalia.* Operculum unknown.

T. UNICARINATUS, Phil.

Shell minute, violaceous, oblong-fusiform, smooth; whorls carinate above, forming a shoulder; canal open, equaling and confluent with the aperture. Length, 3·5 lines.

Straits of Magellan.

This may possibly be the young of one of the numerous varieties of *T. Geversianus.* It was described as a *Fusus*, which of course it is not. Not figured.

Genus **UROSALPINX**, Stimpson.

Shell elongated oval, or short fusiform, longitudinally ribbed or undulated and spirally striated; aperture with a short canal; outer lip dentate and lirate within. Operculum somewhat like that of *Purpura*, semicordate, with the nucleus at the outer edge a little below the middle. Lingual dentition nearly like that of *Trophon*, the lateral teeth having an elongated base of attachment; but the rhachidian tooth has numerous minute denticles between the principal ones, corresponding to ridges on the surface of the tooth, as in the *Murices*. Ova-capsules oblong, shouldered, widest near the summit, compressed, carinated on either side peduncle short; base of attachment very small; aperture median at the summit.

It differs from *Trophon* in its operculum, and from *Ocinebra* in its smoother shell, want of distinct varices, and open canal.

I think the genus as defined above will include a natural group of species such as I have ventured to refer to it. It is possible that several species which I have preferred to place in *Ocinebra*, such as *M. liratus*, A. Ad., and *M. maculatus*, Reeve, may really belong here: for the present they cannot be definitely placed, the operculum and animal being unknown. Kobelt has monographed *Urosalpinx* as a subgenus of *Trophon*.

The fossil genus *Scalaspira*, Conrad, is certainly closely allied to, if not identical with *Urosalpinx*; if the latter, it has priority: it would scarcely be advisable, however, to reject Stimpson's well-characterized genus in favor of one having no diagnosis, and only known by its type.

Scalaspira strumosa, Conr. Pl. 70, fig. 431. Miocene, *Virginia*.

U. cinerea, Say. Pl. 39, figs. 493, 489, 487.

Usually light brown or yellowish, rarely with several revolving, indistinct, rufous bands. Within the aperture varying from light flesh-color to dark salmon, chocolate or purple.

Length, 1·35 inches.

Maine to Florida.

Animal small, foot scarcely covering the aperture, very little dilated at the front angles, cream-colored, margined with lemon color beneath, punctured with light drab above; siphon merely surpassing the tip of the canal; head scarcely protruded; tentacula nearly united at origin; eyes black, at the outer upper third of tentacula, which third is a mere filament, contractile. Motions sluggish. Littoral.

The eggs of *Urosalpinx cinerea* are contained in small transparent membranous parchment-like vases, each of which is attached by an expanded foot to some solid substance, usually the under surface of an overhanging rock, a little above low-tide mark. Each female deposits from ten or twelve to more than a hundred of these vases, the process of laying occupying several weeks. The vases are generally attached in more or less regular rows, covering sometimes an area of three or four square inches. In shape and size they are like the egg-cases of *Purpura*, but without the slight reddish tinge of the latter. They are flattened vertically, and their edges are marked by keel-like ridges. Owing to the lengthened period of oviposition, eggs and embryos in all stages of development are to be found in the various vases of a group, and the young escape from the first-laid vases before the female has finished laying. Unlike the vases of *Purpura*, each of which contains several hundred eggs, those of *Urosalpinx* contain only from six to twenty, ten or twelve being the usual number. All of these normally undergo development, and give rise to embryos. Occasionally a partially segmented egg or more advanced embryo becomes abortive and breaks up into separate cells, each of which remains alive for some time, and often swims actively by the motion of its cilia. These cosmellæ and the yolk of the aborted eggs are drawn into the digestive cavities of other embryos, but this method of furnishing the young with food is exceptional and accidental, although normal in the Purpuræ.*

Reeve (Monog. Fusus) has figured *Eupleura Tampaensis*, Conrad, in mistake for this species. *Fusus recurvus*, Koch (fig. 487), appears to be a small specimen of *U. cinerea*.

U. Floridana, Conrad. Pl. 39, fig. 486.

Distinguished from *U. cinerea* mainly by its shouldered whorls, the ribs forming nodulous projections at the angles. Cinereous, not banded; purple within. Length, 1·25 inches.

Florida.

U. Mexicana, Reeve. Pl. 39, fig. 482.

" A neatly sculptured species, distinguished by the light yellowish color of the ridges upon a purple-brown ground."

Length, ·9 inch.

Mexico.

This may prove to be identical with *U. Floridana*, and if so, will have priority over that species.

* W. K. Brooks, in "Scientific Results, Chesapeake Zoological Laboratory," 121, 1879.

U. Morrisi, Dunker.

Solid, ovate-fusiform, with acute apex; the convex whorls have about ten ribs crossed by revolving liræ; aperture sulcate within; cauda short, subrimate; canal open, a little incurved, white, with three fuscus bands. Length 1·3 inches, lat. ·7 inch.

Habitat?

Has not been figured. Is said to be distinguished from *U. cinerea*, Say, by its greater size, more tumid whorls, more profound sutures and distinct sculpture. Described as a *Trophon*, but evidently belongs to *Urosalpinx*.

U. cancellina, Phil. Pl. 39, fig. 492.

Longer and narrower than *U. cinerea*, Say, the ribs and revolving liræ both more numerous, the former sixteen, the latter twenty-four in number on the body. Dirty white, violet within.
Length, 1·5 inches.

Magellan's Straits.

U. Wahlbergi, Krauss. Pl. 31, fig. 336.

A solid, whitish species, most nearly allied to *U. cancellina*, Phil. Length, 1·5 inches.

Cape of Good Hope.

U. Birileffi, Lischke. Pl. 33, fig. 360.

Solid, subturreted fusiform; yellowish brown to chestnut, sometimes mottled; whorls seven, convex, shouldered; imbricated costulæ cross eight or nine longitudinal ribs; lip crenulate, thickened and dentate within; aperture violet or reddish.
Length, 1 inch.

Japan.

U. ficula, Reeve. Pl. 39, fig. 479.

Somewhat pyriform, spire rather short, whorls longitudinally ribbed, ribs somewhat distant, obtusely keeled round the upper part, corded with raised lines, alternately smaller. Light brown, lines reddish brown. Length, ·9 inch.

Manilla? (Cuming.)

Very close to *U. Paivæ*, Crosse, and very closely allied to *U. Birileffi*, above.

U. INNOTABILIS, E. A. Smith. Pl. 70, fig. 439.

Light brown, with two interrupted darker bands; aperture white within, the outer lip with about six teeth.

Length, 20 mill.

Japan.

U. PAIVÆ, Crosse. Pl. 39, figs. 495, 499.

Ash-gray to cinereous, whitish or purple within the aperture.

Length, 1 inch.

So. Australia; under stones at low-water.

U. Hanleyi, Angas (fig. 499), is founded on elate specimens of this species. It is not readily distinguished from *U. Floridana*, Conrad. Von Martens considers *Fusus corticatus*, Hutton, a synonym of *U. Paivæ.*

U. FUSIFORMIS, A. Adams. Pl. 39, fig. 498.

A yellowish brown shell, thirty millimetres in length. No locality. Described as a *Murex*, but appears to be a *Urosalpinx*, and remarkably similar to *U. Floridana*, Conrad, besides being very like *U. Paivæ*, Crosse.

U. ASSISI, Woods.

Ovately fusiform, grayish olive; whorls six, convex, angular above, elegantly ribbed and peculiarly thickly striate lengthwise, with very fine lamellose striæ; transversely conspicuously lirate, liræ alternating and passing over the ribs; suture impressed; ribs elevated, narrow, eleven in last whorl; aperture ovate, outer lip thin, acute, canal long-oblique, purple within.

Length, 12 mill.

N. Coast of Tasmania.

In form resembling *T. Paivæ*, Crosse, and *T. Hanleyi*, Ang., but easily distinguished by its long canal and peculiar lamellose striations.

The above is Woods' description. I doubt its distinctness from *U. Paivæ*, Crosse. It is probably a young shell.

U. UMBILICATA, Woods.

Ovate, yellow or pale chestnut, solid, spire raised; whorls five to six, angulate above and concave, conspicuously plicate lengthwise (eight in the last whorl), and transversely thickly lirate, liræ alternating large and small, the larger flattened, squamately imbricated over the plaits; squamæ behind the columella valid, raised and canaliculate; at the sutures, the plaits and liræ obsolete; outer lip crenulate outside and toothed within; columella lip expanded, umbilicus margined with rounded, imbricated scales. Length 27, lat. 15 mill.

E. Coast Tasmania; rather uncommon.

At one time I considered this a Tasmanian var. of *T. Hanleyi*, Ang. (= *Paivæ*, Cr.), but a comparison of many specimens shows me that the present is an entirely different shell, very much more scabrous. The umbilicus and its margin are also peculiar and distinct.

The above is the original description. Not figured.

U. DUBIA, Hutton.

Oval, fusiform, thick; whorls of the spire seven, convex, with coarse spiral ribs; the spiral whorls only furnished with longitudinal ribs; mouth oval; canal very short. Covered with a persistent greenish brown epidermis; dark purple within the aperture. Length ·7 inch, lat. ·4 inch.

New Zealand.

Wider than *U. Paivæ*, the canal much shorter; distinguished also by the absence of ribs on the body-whorl. Not figured.

U. PLEBEIA, Hutton. U. BRAZIERI, Woods. U. AUSTRALIS, Woods. U. INFERA, Hutton. U. GOLDSTEINI, Woods.

Kobelt includes these in his catalogue of *Urosalpinx*, which he makes a subgenus of *Trophon*. I have described them under *Trophon*.

U. TRITONIFORMIS, Bl. Pl. 39, figs. 491, 488, 496.

Brownish, the nodules sometimes nearly black; bluish or purplish within, sometimes banded. Length ·75–1·25 inches.

Philippines; Australia; Tasmania.

Readily distinguished by its small size and long, turriculated spire. I have before me a similar form said to come from Ceylon.

Dunker redescribed this species making for it a new genus, *Adamsia typica*, and H. and A. Adams have adopted it as a subgenus of the pisanoid genus *Cominella:* it is, however, a true

Urosalpinx, judging from its operculum, which is purpuroid. A more shouldered variety has been described by Adams and Angas as *Adamsia Adelaidæ* (fig. 488), and again by the latter as *Purpura neglecta* (fig. 496). Rev. E. Tenison-Woods has proposed the generic name *Agnewia* for this shell, that of *Adamsia* being preoccupied by E. Forbes in *Anthozoa.* Tasmanian specimens are banded with purple or chestnut.

Genus **EUPLEURA**, H. and A. Ad.

Stimpson has shown (Am. Jour. Conch., i, 58, 1865), that *Ranella caudata*, Say, has the dentition of the *Muricidæ* (instead of that of the *Ranellidæ*). The tongue of no other species of *Eupleura*, however, has been examined, and it was, perhaps, unadvisable to separate this group so widely from its former congenerers on the evidence of a single character in a single species. I can readily place *Eupleura* in the *Muricidæ*, however, because I think that in its conchological characters it forms a passage between *Murex* and *Ranella*, as I believe *Ocinebra* to form a passage between *Murex* and *Purpura*, *Urosalpinx* between *Murex* and *Fusus*, etc. Kobelt, who has recently monographed the *Muricidæ*, considers *Urosalpinx* and *Eupleura* both subgenera of *Trophon.*

E. CAUDATA, Say. Pl. 39, fig. 503.

Color varying from nearly white to dark brown, livid within. Animal has a light yellow foot; siphon, head and tentacles nearly white. Length, ·6–1·2 inches.

Narragansett Bay, Mass., to Georgia and Florida.

Generally, the southern specimens are largest. The two lateral varices characteristic of *Ranella* are sometimes scarcely more developed than the intermediate ribs. Operculum purpuroid.

E. TAMPAENSIS, Conrad. Pl. 39, fig. 497.

This is a more robust species than the preceding, the longitudinal ribs are more elevated and sharper, and the revolving ribs coarser and more distinct. The canal is much shorter; teeth within the lip smaller and more numerous. Aperture dark chestnut within. Length, 1 inch.

W. Coast of Florida.

May possibly prove to be an extreme form of *E. caudata.* The lateral varices are not distinguishable from the others.

E. Muriciformis, Brod. Pl. 39, figs. 502, 501, 504, 505.

This appears to be the Pacific Coast analogue of *E. caudata*. Its distribution is from Southern California to Central America; and it is largest and finest from the southern localities, attaining a length of 1·75 inches, whereas northern specimens are stunted and do not exceed ·75 inch. Mr. W. W. Calkins has collected a few specimens of this species near Cedar Keys, Florida, part of them on the pretty little coral *Oculina diffusa*: these he submitted to me and I have no doubt that they are the same species; there is also a specimen labeled Florida in the Swift collection.*

Ranella triquetra (fig. 505), and *R. plicata*, Reeve (fig. 504), appear to be forms of this species, and an extreme form is *R. pectinata*, Hinds. *R. clathrata*, Gray, has been also referred here: it has not been figured, and the description will not permit us to assign it definitely.

E. nitida, Brod. Pl. 39, fig. 500.

Dark brown or purple, sometimes banded; varices laminate. Length, ·6–1 inch.

Panama, W. Columbia.

E. pulchra, Gray.

Whitish, brown or violet. Length, 1·5–2·25 inches.

Japan; Philippines.

It is very doubtful whether this beautiful species belongs to this group, to which it is assigned by H. and A. Adams. I mention it here, but will include it in *Ranella*, in Vol. III.

Genus **PURPURA**, Brug.

Subgenera.

Purpura (typical). Shell oblong-oval, last whorl large; spire generally short; aperture ovate, large, with an oblique channel or groove at the fore-part; columella flattened; outer lip simple.

Purpurella. Aperture contracted; outer lip strongly dentate within; columella flattened, with one or two distinct spiral ridges upon its centre.

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* Mr. R. E. C. Stearns, in "Science News," supposes Mr. Calkins' shell to be a variety of *E. caudata*. I can only repeat that the specimens sent me are undoubtedly *E. Muriciformis*.

Tribulus. Spire depressed, whorls simple, the last ventricose; aperture wide; columella arcuated; inner lip excavated, corrugated at the fore-part.

Thalessa. Spire elevated, whorls spinose, angulated at the upper part; aperture moderate; columella rounded, tubercular in front; outer lip nodulous internally.

Stramonita. Spire elevated, whorls simple or nodulous; aperture moderate, produced anteriorly; columella rounded, simple in front.

Trochia. Whorls separated by a deep groove; inner lip thickened, convex, striated; aperture with a very short canal.

Polytropa. Spire acuminate, whorls foliated or tuberculose; inner lip flattened; canal small, oblique; aperture narrowed at the fore-part.

Cronia. Shell ovate; spire acuminated; aperture moderate; inner lip callous at the upper part; columella straight, simple anteriorly.

Genus **PURPURA**, Brug.

For the dentition of *P. patula*, L., see Pl. 42, fig. 1. The same plate contains figures of the lingual armature of representatives of the different subgeneric groups.

The animal does not differ essentially from that of Murex in its general external and anatomical characters. The eyes are usually placed near the tips of the tentacles, the siphon is short, and the foot not large.

About forty tertiary species have been described.

P. patula, Linn. Pl. 43, figs. 19–22.

Brown, the ribs and nodules darker; the much excavated columella light chocolate-color, with a darker margin or semilunate portion posteriorly; grooves within the outer lip dark chocolate. Adults attain 4 inches in length.

Gulf of California to Panama; Isle of Bourbon (Deshayes); *Philippines* (Cuming); *West Indies.*

There can be no doubt of the very extensive distribution of this species in tropical and subtropical latitudes. Dr. Gould has distinguished the Pacific specimens by characters derived from depauperate or immature shells, under the name of *P. pansa;* but well-developed forms do not differ from those of the West Indies. In young individuals the revolving ribs and tubercles are much sharper than in adults. This species does not inhabit the Mediterranean, although so stated by several authors.

? Martyn

P. HAUSTRUM, Montf. Pl. 43, fig. 25.

Exteriorly various shades of chocolate; within the aperture bluish white, more or less tinged with chocolate. Substance of shell thin. Length, 2–3·5 inches.

Australia; New Zealand.

P. PERSICA, Linn. Pl. 43, figs. 24, 23.

Brown, with narrow revolving zones of white alternating with dark chocolate; aperture bluish or pinkish, with interrupted narrow revolving brown lines upon the interior of the outer lip.

Length, 3–4 inches.

Philippines.

P. inerma, Reeve (fig. 23), does not differ, and *P. Rudolphii*, Chemn., is so close that its identity may be suspected.

P. RUDOLPHII, Chemn. Pl. 44, fig. 26.

Shell heavier than *P. persica*, with usually higher spire; two or three of the revolving zones develop tubercles; whorls somewhat shouldered; outer lip less dilated and thicker than in *P. persica;* columella straighter and less patulous.

Length, 2–3 inches.

Philippines.

P. CHOCOLATUM, Duclos. Pl. 44, figs. 27–29.

The substance of the shell is uniformly thin; color uniform chocolate, the columella tinged with orange, the interior bluish or yellowish. In some young specimens the whorls are rounded, without angles or tubercles, whilst others, of same size, have the shoulder and tubercles equally developed with the adult.

Length, 3·5 inch.

Peru.

D'Orbigny found clusters of eggs (fig. 28) in May. He says that the mollusk is very active in its movements, and that, judging from the quantity of shells found in the vicinity of the ancient tombs at Arica, it must have been a favorite article of diet with the aborigines.

P. LEFEVREI, Lesson.

Said to belong to the Patula-group. Has not been figured or identified.

Pacific O.

Subgenus **Purpurella**, Dall.

A section of the shell shows that the projections upon the centre of the columella are not mere tubercles, but regular spiral ridges extending through nearly all the whorls.

P. COLUMELLARIS, Lam. Pl. 44, figs. 41, 35.

Dark brown; interior flesh color, the lips tinged with orange. Length, 1·5–3 inches.

Mazatlan; Gallapagos Isles. (Cuming.)

Carpenter remarks that, different as normal specimens of this shell are from *P. patula*, the labial callosity gradually vanishes in some specimens, whilst the labral teeth are scarcely developed, and the resemblance of the two species is then so great that they can only be separated by a balance of characters. The series of specimens before me confirm this view, and afford abundant evidence of a common derivation however distinct they may be typically. *P. semi-imbricata*, Lam., a species which has not been identified, is perhaps equivalent to this species.

P. leucostoma, Desh. (fig. 35), does not present any well-marked distinctive characters; it is quite young, being only 14 mill. in length, and the coloration varies from the specimen figured to that of *P. columellaris*.

Subgenus **Tribulus**, Klein.

P. PLANOSPIRA, Lam. Pl. 45, fig. 32.

Pale yellowish brown; interior white, the revolving ribs within the outer lip, and the basal ribs of the columella yellowish red. The singular deep excavation of the middle of the columella is crossed by an oblique black rib. Length, 1·5–2·5 inches.

Gallapagos Isles; Lower California.

P. APERTA, Blainv. Plate 44, fig. 30.

White, or yellowish white; more or less stained with orange upon the columellar tubercles and the teeth of the lip.

Length, 1·5–3 inches.

W. Co. Central America. (Cuming.) *Sandwich Isles.*

Pease remarks that the species is peculiar to the latter locality.

Subgenus **Thalessa**, H. and A. Adams.

P. HIPPOCASTANEUM, Lam. Pl. 45, figs. 42, 43, 36 to 41; Pl. 46, fig. 45.

Yellowish or whitish, more or less mottled or stained with dark chocolate, which is sometimes disposed in bands between the spinose revolving ribs; internally whitish with darker revolving bands. Sometimes the surface is nearly covered with black, and a broad band margins the outer lip. Length, 1·5–3 inches.

Philippines; Zanzibar; Paumotus; Central Pacific; Bay of Muscat; Indian Ocean.

The description of Linnæus' *P. hippocastaneum* is too indefinite, and his references include other species; so that I am compelled to cite Lamarck.

P. bituberculαris, Lam. (fig. 36), is merely a black variety, in which the outer lip is generally broadly margined with black; it has no distinctive characters in the tuberculation.

A similar form from the Red Sea has been called *P. Savignyi* (fig. 45) by Deshayes.

P. distinguenda, Dunker (fig. 37), is a depauperate form of the black variety, the whorls merely nodulous instead of spinose. In *P. intermedia*, Kiener (fig. 41), even the nodules have almost disappeared and are principally indicated by white spots upon the otherwise dark surface; *P. ocellata*, Kiener (fig. 38), is the young of this form. It may be convenient to designate *P. intermedia* as a variety. Another variety is *P. alveolata*, Reeve, which I have also figured (fig. 40). It is whitish or brownish, the tubercles darker; interior yellowish, mottled with brown.

Length, 1·25 inches.

Panama. (Cuming.) *Formosa; Japan and Swan River.* (E. A. Smith.)

P. TUMULOSA, Reeve. Pl. 46, figs. 44, 48, 49; Pl. 45, figs. 33, 34; Pl. 47, fig. 65.

Revolving ribs rounded, raised into round nodules superiorly; outer lip thin, not dentate within. Color varying from very light brown to dark chocolate, more or less mottled with white, especially the tubercles. Length, 1–2 inches.

Zanzibar?; Japan.

The adult specimen (*P. Bronni*), which I figure from Lischke (fig. 33), is remarkable for the confluence of the tubercles into greatly raised rounded ribs on the body-whorl. *P. clavigera*, Küster (fig. 49), is a depauperate form. Reeve's locality, "Zanzibar," for *P. tumulosa* is probably an error.

P. PICA, Blainv. Pl. 46, figs. 46, 47, 52, 53.

Shell whitish, banded with dark chocolate; bands appearing within the margin of outer lip and on columella; interior of outer lip with close, narrow, raised, brown revolving lines.

Length, 1·25–2·5 inches.

China Sea; Philippines; Central Pacific Ocean.

Broader, more ventricose, with shorter, stouter, and more direct spines than *P. hippocastaneum*. The want of teeth and development of raised revolving ribs within the outer lip are good distinguishing characters. *P. cuspidata*, Ad. and Reeve (fig. 47), is the young.

P. ARMIGERA, Chemn. Pl. 46, figs. 50, 51.

White, generally with light brown bands between the rows of tubercles; aperture yellowish or pink within.

Length, 2–3·5 inches.

Philippines; Paumotus, etc.

P. affinis, Reeve (fig. 51), is the young. The animal is described fully in Gould's Moll. Wilkes' Exped., p. 245.

P. TRISERIALIS, Blainv. Pl. 47, fig. 54.

White, with revolving bands composed of brown squares; yellowish white within. Length, ·75–1·5 inches.

Acapulco; Mazatlan.

P. DELTOIDEA, Lam. Pl. 47, figs. 55, 58.

Light brown or whitish, with dark chestnut bands, which sometimes appear also on the inside of the outer lip; columella pink. Length, ·75–2 inches.

West Indies; Florida.

Very closely allied to *P. triserialis;* the bands are not broken up into squares of color, but are continuous and much darker; the color of the columella is also different.

P. albocincta, Küster (fig. 58), appears to be founded on a worn, immature specimen of this species.

P. MELONES, Duclos. Pl. 47, fig. 56.

Dark chestnut, variegated with white, especially upon the periphery and inferior portion of the body; columella tinged with pink; outer lip frequently black-bordered.

Length, 1·5–2 inches.

Pacific Coast of Central America.

The want of nodules or spines disagrees with the character of the group; yet the relationship of this species with *P. deltoidea* is tolerably close. Sometimes the body-whorl is, in adults, constricted around the middle. Mörch describes the animal in Mal. Blatt., vii, 99.

P. TRIANGULARIS, Blainv. Pl. 47, fig. 57.

White; more or less stained with light brown externally.

Length, 1 inch.

Mazatlan to Panama.

Something like *P. triserialis*, but differs in the equal development of the second row of revolving tubercles.

P. MANCINELLA, Linn. Pl. 47, figs. 59–61, 63, 64.

Shell yellowish, the tubercles frequently tinged with red; aperture varying from white (*P. echinata*) to deep yellow; in the latter with the raised interior revolving lines darker colored (typical).

Length, 1·5–2·5 inches.

Bay of Muscat; Singapore; Fiji Isles; W. Coast Central America; Peru; Japan; Australia.

The more elevated and more sharply tubercled forms, white without and within, are called *P. echinata* (fig. 63), and might continue to be so designated as a variety, but the intermediate gradations are very complete. *P. ægrota*, Reeve (fig. 64), said to inhabit the waters of Japan and Australia, is one of these intermediate forms.

P. LUTEOMARGINATA, Montrouzier. Pl. 47, fig. 62.

Yellowish white, the nodules chocolate; margin of lip and columella tinged with orange. Length, 1·6 inches.

New Caledonia.

This may be a mere variety of the preceding species, but has relationships with *P. bimaculata* also.

P. Lischkei, Küster. Pl. 48, fig. 68.

Light brown with four whitish subnodulous revolving ribs, lineated with chestnut-brown; aperture tinged with orange.

Length, 1·6 inches.

Habitat unknown.

Has very much the appearance of a depauperate variety of *P. luteomarginata*. If identical, *P. Lischkei* will have priority.

P. bimaculata, Jonas. Pl. 48, fig. 67.

White, the rounded nodules black; a black spot at the base of the columella and a similar one at the base of the outer lip.

Length, 2 inches.

Zanzibar.

P. neritoidea, Linn. Pl. 48, figs. 72, 73, 69.

Whitish, externally more or less penciled with brown revolving lines; two or more round black spots on the middle of the columella. Length, 2 inches.

Cape Verde Is.; Ascension Isl.

The type is tuberculate, but the variety *Ascensionis*, Quoy (figs. 69, 73), is smooth; both have the characteristic black spots on the columella.

P. bufo, Lam. Pl. 48, figs. 66, 67, 71.

Yellowish white with brown revolving lines; interior of aperture flesh-color, sometimes showing revolving brown lines like the exterior. Substance of adults very thick, not banded within.

Length, 1·5–2·5 inches.

Philippines, on rocks at low water.

Varies from nearly smooth, only some slight tubercles on the shoulder, to forms having several revolving rows of tubercles.

P. multilineata, Küster (fig. 71), is the young of this species; I also figure a young shell with well-developed tubercles, from Kiener (fig. 70).

P. Trinitatensis, Guppy.

Solid, ovate, yellowish, subrimate; with numerous spiral ridges crossed by fine imbricating striæ; four spiral rows of obtuse, elongated tubercles, the superior one forming the angle of the body-whorl; mouth pink within, often with two or three more or less interrupted spiral red or chestnut revolving lines, obsoletely striate, denticulate on the lip. Length, 40 mill.

Gulf of Paria, Trinidad, W. I.

Said to resemble *P. mancinella*, but with a sharper spire and more decided striation. It has not been figured, nor have I seen it.

P. COCCINEA, Anton.

P. BICONICA, Anton,

Both said to belong to the *P. armigera* group; not figured, nor identified by subsequent writers. No locality given.

Subgenus **Stramonita**, Schum.

P. CONSUL, Lam. Pl. 49, figs. 74, 79.

Yellowish, usually with narrow brown revolving lines; aperture orange color. Length, 2·5–5 inches.

Philippines.

Reeve has attempted to show distinctive characters in a large form with short tubercles, and has called it *P. gigantea* (fig. 79). I have before me a series which completely connects this form, however, with the sharply tuberculate *P. Consul.*

P. LUTEOSTOMA, Chemn. Pl. 49, figs. 77, 78, 81.

Yellowish brown, mottled or longitudinally waved with dark chocolate; aperture yellow or orange within, sometimes banded with brown lines. Length, 1·5–2·25 inches.

Loo Choo; Japan.

The undulatory character of the tubercles reminds one of *P. hippocastaneum;* it is distinguished from that species, however, by its yellow mouth and thin outer lip.

P. Capensis, Petit, said to have been collected by M. Verreaux, at Cape of Good Hope, is evidently the same species; the figure which I copy, does not agree well in coloring with the description.

P. RUSTICA, Lam. Pl. 49, figs. 75, 76.

White, marbled with purplish brown or red; aperture flesh-color or yellowish. Length, 1·6–2 inches.

Philippines (Cuming); *Insl. Apiana, Polynesia* (Pease).

P. marmorata, Pease (fig. 76), appears to be the same species.

P. HÆMASTOMA, Linn.

I cannot separate the numerous species which are referred to the hæmastomoid group; they appear to be at best mere names for geographical groups, which, whilst usually presenting some slight peculiarities, invariably connect themselves with the parent form. As might be expected under these circumstances, the various monographers in endeavoring to recognize a number of these species, differ among themselves quite as much as do the shells under consideration; I will not attempt to disentangle all this synonymy, but will proceed to designate by name a certain number of *forms* (I cannot call them varieties, much less species).

Hæmastoma (typical). Pl. 49, figs. 80, 84; pl. 50, fig. 87.

This has two rows of tubercles and an orange-colored mouth. It is principally Mediterranean and West African, but recurs in the West Indies and W. Coast of Mexico also. A smoother state from Barcelona has been called *P. Barcinonensis* by M. Hidalgo (fig. 84). Sometimes the spire is drawn out, becoming babylonic; this elate form is represented by a figure in d'Orbigny's Mollusca of the Canary Isles (fig. 87); it occurs also upon the Gulf Coast of the United States.

Undata, Lam. Pl. 49, fig. 82; Pl. 50, figs. 100, 103; Pl. 51, fig. 109.

By common consent, the usual W. Indian manifestation of *P. hæmastoma* bears this name, although the form which it characterizes is equally common on the W. Coast of America, and in the East Indies. The shell is generally smaller, less tuberculated, the pattern of painting more defined (undulated or striped), the mouth white or fasciated within instead of orange color. *P. Forbesii*, Dunker (fig. 100), from Guinea, W. Africa, belongs to this form.

Floridana, Conrad. Pl. 49, figs. 83, 85; Pl. 50, figs. 86, 90, 94.

This is a still less tuberculate form, with yet more distinct painting, and *P. fasciata*, Reeve (fig. 90), is a depauperate or worn state of the same. It is West Indian, but Conrad includes in his species a var. of *hæmastoma* figured by Dunker, from Guinea, W. Coast Africa (fig. 83). Another figure of *hæmastoma* in the same work is cited by Conrad as the type of his *P. nebulosa* (fig. 94); *P. Nuttalli*, Conrad (fig. 109), from Fayal, is again the same form. *P. viverratoides*, d'Orb. (fig. 103), from the Canary Islands, is so completely dissimilar to the typical *hæmastoma* that it is no wonder it was described and figured as a distinct species; yet it is only a variation of the *Floridana* type—a variation which is quite abundant among West Indian specimens of the latter, and it is connected with *hæmastoma* by an unbroken series of gradations.

Biserialis, Blainv. Pl. 50, figs. 97, 99, 102.*

In some of the shells thus named the aperture is white, but usually it is orange-colored, with an unmistakable recurrence to the typical *P. hæmastoma*. It occurs from Southern California to Panama very plentifully. Other names of this group are *unifascialis*, Lam. (fig. 102), *hæmatura*, Val., *macrostoma*, Küster (fig. 99), *Consul*, Mke. (non Lam.).

Bicostalis, Lam. Pl. 50, figs. 91, 93.

P. P. Carpenter proposes that this name be reserved for the East Indian forms; its normal type as well as a specimen devoid of tubercles and almost without shoulder, are well represented by Reeve's figures (which I have copied), although the originals of these are from West Columbia.

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* Sinusigera.

Mr. Arthur Adams has identified a *Cheletropis* with *Purpura biserialis*, of which he supposes it to be the larval state (see *ante*, p. 52). The following species of *Cheletropis* (= *Sinusigera*) have been described:

S. cancellata, Orb. (Figured in Keferstein.) Pl. 8, figs. 101, 102.
S. microscopica, Gray (= *Huxleyi*, Forbes). Pl. 50, fig. 88.
S. glabra, A. Ad.
S. trochoides, A. Ad.
S. vitrea, A. Ad.
S. crenilabris, Garrett. Pl. 50, fig. 89.

The arms, four in number, are arranged in a cruciform manner around the head. There are two tentacles, and the eyes, well formed, are situated on the outer side of their bases. Respiratory siphon short, being a simple fold of the mantle. Foot large and very mobile, furnished with a small, thin operculum; unprovided with a float.

Blainvillei, Desh. Pl. 50, figs. 104, 95, 92.

Usually uniform chocolate color exteriorly; the aperture bordered with chocolate, bluish within. Shoulder and tubercles very slight, shell rather thin. Peruvian. To this form belong *P. Callaoensis*. Blainv. (non Gray), *P. Delessertiana*, d'Orb. (fig. 95), *P. Peruviana*, Souleyet (fig. 92), and *P. Janelli*, Kiener, (fig. 98).

P. LINEATA, Lam. Pl. 50, fig. 106.

Yellowish, with orange-colored revolving ribs, which are slightly nodulous on the shoulder; interior yellow, with columella and lip tinged with orange; substance of shell rather thin.

Length, 1·5 inches.

Habitat unknown.

I have not seen this species; it may be an extreme variety of *P. hæmastoma*, or possibly the young of *P. Consul.*

P. CRUENTATA, Gmel. Pl. 50, fig. 105.

A thin spirally ribbed shell; ashy gray with chestnut blotches, orange-colored within. Length, 1·8 inches.

Habitat unknown.

My figure is from Küster. who alone has attempted to identify it; evidently belongs to the *hæmastoma* group.

P. FASCIATA, Dunker.

The description indicates a shell of the hæmastomoid group, and applies very well to forms of *P. hæmastoma*. Unfortunately the specimen is not figured. Locality unknown.

Subgenus **Trochia**, Swains.

P. CINGULATA, Linn. Pl. 51, figs. 108, 110, 111, 114–117.

The prominent revolving ribs, excavated at their sides, distinguish this species from all that precede it. Color white or gray; tops of ribs and interior of aperture usually brown.

Length, 1·5 inches.

Cape of Good Hope.

Reeve has proposed to restrict this species to those having only three revolving ribs, and he describes a form with five ribs as *P. spiralis* (fig. 114); but I have before me a series including specimens with from one to eight ribs, and in some of which the ribs become obsolete and replaced by deep striæ; even the shoulder of the whorls disappears in other specimens, and then we have the form the young of which is described by Krauss as *P. cribrosa* (fig. 111). The normal development of ribs strikingly resembles the fossil *Rapana* (*Ecphora*) *quadricostata*, Say, of the United States.

P. SUCCINCTA, Martyn. Pl. 51, figs. 118–120, 107, 125, 113.

Shell white, encircled by about eight strong revolving ribs, the sides of which are deeply excavated; crossed by rugose growth-lines. Sometimes the interstices of the ribs are filled with elevated revolving striæ, and occasionally the tops of the ribs are incisely striate. The whole ornamentation is sometimes obsolete. Length, 1·5–3 inches.

Australia; New Zealand; Cape of Good Hope.

This is a more gibbose species than *P cingulata*, varieties of which it somewhat resembles; the clathrate appearance of its initial whorls is a distinguishing character. Its metropolis appears to be South Australia, where it is common on rocks, at low water. Sometimes the clathrated growth continues beyond the early whorls, and in this state the shell has received the name of *P. squamosa*, Lam. (fig. 113). This name may be retained as a variety, from Abyssinia and Cape of Good Hope.

Subgenus **Polytropa,** Swains.

P. SCOBINA, Quoy. Pl. 51, figs. 123, 112, 121, 122, 124; Pl. 52, figs. 126–130, 132, 133.

Shell very variable, ranging from quite smooth to cancellate; sometimes with revolving costæ, which are occasionally tuberculate. Color whitish, more or less tinged or flamed with chocolate, brown or yellow. Aperture narrow or wide; sometimes in the narrower forms obsoletely toothed within the outer lip; deep chocolate or violet within. Length, ·75–1·5 inches.

New Zealand; Cape of Good Hope.

Large, smooth specimens of this mollusk are referred by Küster to *P. versicolor* of Gmelin, which would have priority if it could be made out with certainty; but the figure in Martini referred to by Gmelin is very unsatisfactory. Besides the type, I figure a number of forms to which different names have been attached. These include *P. rugosa*, Quoy (fig. 112), which does not differ much; *P. tristis*, Dunker (fig. 124), and *P. albomarginata*, Desh. (fig. 121), which is a depauperate state of *tristis*; *P. Quoyi*, Reeve (fig. 122), an extreme ribbed form, together with an intermediate state figured by Kiener and Küster.

Dr. Gould was the first (in Moll. Wilkes' Exped.) to notice the variation from costate to smooth forms in the New Zealand specimens, and the latter becomes usual in those from the Cape. I figure of these *P. cataracta*, Reeve (fig. 132), as of Chemnitz, *P. lagenaria*, Duclos (fig. 128), *P. dubia*, Krauss (fig. 127), *P. versicolor*, Wood (fig. 133), according to Küster; the last connecting with the ribbed form. *P. Zeyheri*, Krauss, appears to be founded on a young shell.

P. HARPA, Conr. Pl. 52, fig. 145.

Chocolate, the revolving ridges maculate with white; bluish within, columella and lip-dentations tinged with chocolate, with narrow revolving bands of the same color. Length, 1–1·25 inches.

Sandwich Isles.

A rather constant species in sculpture and coloration, and apparently of limited distribution.

P. LAPILLUS, Linn.

Shell usually whitish or orange-brown or chocolate-colored; with sometimes one to several white revolving bands. Obsoletely ribbed, conspicuously ribbed, or covered with revolving striæ; surface smooth, or imbricated or lamellate by the crossing of the growth-lines upon the revolving ribs. Lip at the rest period in the adults usually much thickened within and dentate.

Length, 1–2·5 inches.

Boreal Seas; North Europe to North Africa (not Mediterranean); Northern Atlantic Shores of the United States to Greenland; (Siberia to Japan; Behring's Straits to California.?)

The quantity and variety of material before me, embracing a rich series of forms from many localities, together with the comparison of the numerous descriptions and figures that have been published, induce me to include under this, the oldest name, a very large number of nominal species. As in the case of *P. hæmastoma*, I have considered it preferable to retain some of these names as indicating growth modifications and localities: those who take a less conservative view than myself will thus have the names and descriptions at hand to designate these several forms as varieties or species, or even genera, if it so please them. I have also endeavored to illustrate a few of the transition forms.

P. lapillus, Linn. Pl. 52, figs. 131, 134, 135, 137–144, 146, 147; Pl. 53, figs. 148–151. *Typical.* The metropolis of this form is Northern Europe, the North American specimens, as well as those from Southern Europe and North Africa, being stunted in comparison of size and ornamentation. Its fossil distribution ascends as far back as the Red Crag of England. It lives gregarious on rocks and stones within the tides, where it preys on mussels, limpets, and barnacles. It is especially fond of oysters, and is considered a destructive enemy by the cultivators of the bivalve. A single reversed, as well as a scalaroid specimen are recorded by Mr. Gwyn Jeffreys. He says that "this mollusk has a shambling gait and sedentary habits, and seems to be always eating or digesting its food. Lister, however, observed it early in the morning, at the commencement of June, otherwise engaged, viz., in perpetuating its species on a dry rock after the tide had receded. It is very destructive to mussel-beds, and is said by Linné to eat the dead fish left in fishermen's nets. I have seen it busily feeding on *Balanus balanoïdes*, its strong proboscis being inserted between the opercular walls of the barnacle. According to Mr. Osler, it also devours Littorinæ, Trochi, Naticæ, and even its own kind. From what I have observed of the mode by which it perforates the shell of a mussel, I am inclined to agree with Mr. A. Hancock, that it uses its tongue. I cut off the end of the proboscis of a *Purpura*, while it was attacking a mussel; the part thus lopped still remains in the hole, with the front of the tongue exposed. The hole is shaped like an inverted cone, and exhibits under the microscope extremely fine scratch-like striæ, as if caused by the rasping action of the lingual apparatus. I believe the movement to be rotatory, because the sides of the hole are quite even. The process is an extremely slow one. Mr. Osler states that, after watching for some hours a *Purpura* attached to a Limpet, he found the perforation incomplete; and Mr. Spence Bate and Mr. Bretherton noticed that it took two days to get through the shell of a moderate-sized mussel.* It does not appear that the prey is destroyed by any poisonous secretion of the whelk, after it has gained access to the interior. The proboscis is at first thrust into the hole which it had drilled, and the whelk eats in that way; but when, from the death of the mussel or limpet, the former gapes or the latter separates from the rock, the *Purpura* devours the remainder by the natural opening.

"According to Mr. Peach, it deposits its spawn all the year round, but more actively from January to April. Spawn which he collected in January, 1843, was hatched four months afterwards; he took forty-seven fry from a single capsule. They soon began to assume the peculiar habit of their parents, by getting out of the water, where they would remain for hours, answering to the period of the ebb and flow of the tide." †

This is one of the species which furnished the dye known as Tyrian Purple to the ancients (see *ante*. p. 43). Mr. Jeffreys remarks that the liquor contained in the egg-capsules is also purpuriferous, and that it tastes like the strongest pepper. The male *P. lapillus* is longer and more slender than the female, and has a fine, tapering spire, with a plicated but not tubercular throat. In aged specimens the throat has not unfrequently a succession of tubercular rows, forming internal varices. Occasionally the shell is truncated or the first whorls broken and deserted. In brackish water they are smaller and thinner. They are called *horsewinkles* in Ireland. ‡

Like all other predacious and voracious beasts the *Purpura* meets with retribution occasionally; here is an instance:

Mr. Henry Crowther, whilst collecting in the shore pools at Whitby, England, "noticed a commotion amongst the mollusks

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* M. Bouchard-Chantereaux observes that the shells of *Purpura lapillus*, found on the Boulonnais (France) coast are thinner and smaller in those situations where they are subject to the influence of brackish or fresh water. It is very fond of *Mytilus edulus*, *Mactra*, *Donax*, etc., the shells of which it bores through in from three to five minutes, preserving perfect immobility during the operation and protecting the tongue from contact with the sea water by applying the two anterior lobes of its foot closely around its mouth. After boring the shell of its victim, the mantle is torn away, and the viscera only devoured.—*Jour. de Conch.*, p. 124, 1879.

† Brit. Conch., iv, 279.

‡ Jeffreys, *ibid.*

which was of too brisk a nature for their well-known and characteristic slowness. When the obscuring sands which they had thrown up in the fray had settled, we saw that the shells were principally in possession of hermit crabs, which, under this guise, were attacking a *Purpura lapillus* and dragging it from its shell. We caught the whole school at once and transferred them to a collecting-bag; the shells occupied were *Nassa pygmæa*, *Trochus cinereus*, *Littorina littorea*, three sizes, and a *P. lapillus*, the sheik of the party, for he was taken red-handed. We presume to think that if their object had not been frustrated, there would have been ere long a mutual exchange of crab's clothing."*

Varieties *major*, *minor*, and *imbricata* are enumerated by European naturalists. I give figures of the first (fig. 135), and third (fig. 131), of these varieties from Forbes and Hanley, besides a young shell (fig. 139) and several adults from Küster and Kiener. The variety *major*, of Europe is very suggestive of *P. crispata*, of the Pacific coast of North America, and differs quite as much from extreme depauperate forms as does the latter (so-called) species from *P. ostrina*.

P. saxicola, Val. Pl. ~~88~~ 53, figs. 152–154*a*.

This is normally the *lapillus* of the W. Coast of N. America, extending from the California Islands northward to Sitka, and recurring in Japan. Towards the south it becomes shorter, wider, usually thinner, darker colored, tuberculate, assuming the successive forms of *ostrina* and *emarginata*, whilst towards the north it seems to run into *lima*, *septentrionalis*, *crispata*, etc.—generally larger, heavier, smooth or lamellate forms, with the outer lip thickened and toothed internally. The type of *P. Freycineti*, Desh. (fig. 153), is a young shell of large size, very like *saxicola;* but there is considerable variation in the forms that have been referred to *Freycineti*. *P. ostrina*, Gould (fig. 154*a*), is a small form of the *saxicola* type, characterized by short spire, gibbous whorls, smooth or spirally ribbed, color usually dark chocolate, the ribs white. *P. fuscata*, Forbes (fig. 154*a*), is similar in ornamentation and color, but the spire is longer.

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* *The Naturalist*, 1878–79.

P. emarginata, Desh. Pl. 53, fig. 155.

When the revolving ribs of *saxicola* or *ostrina* become broken up into nodules, the result is *P. emarginata*, Desh., which is typically a very distinct looking shell, but connected by minute gradations with the smoothest *ostrina*. It is a southern form. *P. Conradi*, Nuttall MSS., is referred to it by P. P. Carpenter.

P. LIMA, Mart. Pl. 53, figs. 159, 156–158, 161.

This is another form in which the typical variation from *lapillus* is very great; its characteristic appearance is due to a considerable number of narrow, elevated revolving ribs, which are alternately larger. The shell is usually so thin that the external ribs form corresponding sulcations within the aperture. The suture is frequently channelled, color light brown, more or less banded and clouded with a deeper tint. Extends from California northward to Alaska, and merges into *fuscata* and *Freycinetti* on the one hand, and into *saxicola* on the other. *P. canaliculata*, Duclos (fig. 156), *P. attenuata*, Reeve (fig. 158), *P. analoga*, Forbes (fig. 157) and *P. decemcostata*, Midd. (fig. 161), are synonymous.

P. CRISPATA, Chemn. Pl. 53, fig. 160; Pl. 54, figs. 163–166, 168.

This variety is well known under this name, but the work containing the description only contains binomial phrases, as in this case, accidentally. *Murex plicatus*, Martyn (fig. 165), is the earliest binomial designation, and *Buccinum lamellosum*, Gmelin, refers to the same shell, as do also *Murex lactuca* (fig. 163), and *M. ferruginea* (fig. 164), of Esch. It is a very thick shell with long spire, the whorls more or less angulated by the usually obsolete revolving ribs. At its southern limit on both the Californian and Asiatic coast, it is comparatively smooth (*P. rupestris*, Val. (fig. 160), *septentrionalis*, Rve. (fig. 166), *Freycinetti*, Lisch. (fig. 168), whilst at its northern limit the growth-lines are occasionally developed into the lamellæ which characterize its most luxurious state. Outer lip very much thickened within and dentate. Yellowish to reddish brown, with frequently a central white band. Loves oysters, and has accompanied these bivalves transplanted from Puget's Sound to Oakland, Cal. The smoother form much resembles the var. *major* of the European *lapillus*.

Dr. P. P. Carpenter was the first who attempted to classify the *lapillus* group of the West Coast of North America; he separates them as follows:

" *P. saxicola*, Val. Some varieties run into the New England form of *P. lapillus* sufficiently nearly to justify the identification; but the bulk of the specimens are easily distinguished by the excavated columella. They pass by insensible gradations to *P. ostrina*, Gould, which is a rare and extreme variety. Many of the shells called *P. Freycinetii* by Midd., are certainly referable to this species. Some forms pass towards the true *P. Freycinetii*, Desh., while others are equally close to the very different *P. emarginata*, Desh.

" Var. *fuscata*, Forbes.

" Var. *emarginata*, Desh.

" Var. *ostrina*, Gld.

" *P. canaliculata*, Ducl. = *decemcostata*, Midd., *attenuata*, Rve., *analoga*, Forbes.

" *P. crispata*, Chemn. = *plicata*, Mart., *lactuca*, Esch., *septentrionalis*, Rve., etc."

E. von Martens (Mal. Blatt., xix, 86, 1872) does not hesitate to refer all these forms to *P. lima*, Martyn, but does not speak of their relationship to *lapillus* except as "N. W. American species of Purpura of the *lapillus* group."

Doubtful Species referred to Polytropa.

P. EXILIS, Dunker.

Narrowly ovate, yellowish, whorls four, with a number of revolving riblets and striæ, decussated by narrow growth-lines; body-whorl double the length of the spire, with three revolving costulæ, next whorl bicarinate, upper one unicarinate; aperture ovate; columella sinuous; labrum thickened, crenulate.

Length 7 mill., diam. 3 mill.

Upolu.

Not figured. Evidently a young shell, and appears to be related to *P. hæmastoma*.

P. BICONICA, Hutton.

Shell small, widely fusiform; spire short and pointed; last whorl wide above and narrowed below, with spiral ribs and slight transverse plicæ. Whitish, shaded with dark brown; within, dark purplish brown, with white teeth inside the lip.

Length ·4, diam. ·28 inch.

New Zealand.

Not figured. The name has been already used by Anton. I am not able to identify it.

P. RETIARIA, Hutton.

Shell oval-fusiform; whorls carinated, with four or five spiral ribs in front of the carinæ, and a small one behind it on the last whorl, crossed by transverse plicæ at regular intervals, forming a series of squares on the surface. Whole shell covered with delicate transverse foliations. Aperture oval; columella curved; canal short and slightly bent. Grayish white; purplish within. Length ·9, diam. ·5 inch.

New Zealand.

P. DUMASI, Vélain. Pl. 54, figs. 162, 167, 170, 172.

A polymorphous species; whitish or pale rosaceous.

Length, ·75–1·2 inches.

Isle of St Paul, Indian Ocean.

The type is so close to *P. patens*, Hombr., that I suspect them to be identical; in which case the latter name will take precedence. Mr. Vélain has selected from the numerous forms of this species the following named varieties:

Var. *multistriata*, fig. 172.

Var. *semicostata*, fig. 170.

Var. *cincta*, fig. 162.

P. PATENS, Hombr. et Jacq. Pl. 54, fig. 171.

Light gray, cinereous within. Length, 21 mill.
Probably = *P. Dumasi.* *New Zealand.*

P. VARIABILIS, Desh.

Chocolate; violaceous within; lips crenulated.

Length, 1·3 inches.

Isle of Bourbon.

Allied to *P. patens*, Jacq., evidently.

P. Magellani, Vélain. Pl. 54, figs. 169, 173.

Grayish purple, flecked with brown. Length 1·4 inches.

Isles of St. Paul and Amsterdam, Ind. O.

M. Vélain recognizes the close relationship of this species with those of the genera *Pisania* and *Euthria*, but states that both the operculum and lingual dentition are those of *Purpura*.

P. squamata, Hutton.

Shell sharply oval; spire long; whorls narrow, spirally striate and noduled, with numerous fine, foliaceous, transverse imbrications; outer lip crenulated and striated within; columella with a plication. Color brownish white; purplish within, with columella and border of lip white or yellowish. Length ·75, diam. ·45 inch.

Not figured. *New Zealand.*

Doubtful Purpuræ.

P. littorinoides, Tenison-Woods.

P. propinqua, Tenison-Woods.

The above being possibly synonymous with *Purpura Flindersi*, Ad. and Ang., which appears to be a *Trophon*, are described under that genus.

P. calvitoma, Nuttall.

P. argus, Duclos; P. turbo, Duclos.

MSS. names appearing in Jay's Catalogue.

P. avenacea, P. aterrima, P. bicolor, Lesson.

These are all very shortly and indefinitely characterized, and have not been recognized by subsequent authors. They may be young shells.

P. nodulifer, Menke.

Mörch does not find this in the Menke collection, to which it once appertained. Not identified.

P. nux, Reeve = Murex Edwardsi, Payr.

P. quadridentata, Dufo. *Mahé, Seychelles Isles.*

P. dentata, Menke. *St. Vincent, Cape Verde Isles.*

P. minuta, Anton.

P. incisa, Phil.

Subgenus **Cronia**, H. & A. Ad.

P. AMYGDALA, Kiener. Pl. 55, fig. 174.

Orange or cream-color; the principal revolving ribs lighter in tint; frequently brown-tinged at base; cream-color within the aperture. Length, 1–1·4 inches.

Australia.

This species is, in its typical state, thickly covered over its entire surface with small, arched scales, covering its close ribs; I am much inclined to think, however, that *P. aurantiaca* is merely a smooth state of the same species.

P. AURANTIACA, Hombr. Pl. 55, fig. 175.

Orange-colored, more or less tinted with brown; sometimes white-banded. Length, 35 mill.

Isl. of Hogoleu.

Probably a smooth var. of *P. amygdala*.

P. BUCCINEA, Desh. Pl. 55, fig. 176.

Brown; larger revolving ribs articulated with white and darker brown; aperture cream-colored to light brown.

Length, 1·25–1·75 inches.

New Guinea.

The distinguishing characteristic of this species is an obtuse angle or protruberance upon the very centre of the columella; this might put it along with *P. columellaris* in Mr. Dall's subgenus *Purpurella*: but the angle is not persistent in some of the fully grown specimens. Except the angle and the narrower form of the shell, this species closely approximates to vars. of *P. amygdala*. Küster adopts the name *flammea* as of Chemnitz, but this author was not binomial, and the identification of the species is surely an error.

P. CASTANEA, Krauss. Pl. 55, fig. 177.

Chestnut-brown; purple within. Length, ·6 inch.

Cape of Good Hope.

A young shell which perhaps belongs to this group.

P. ALBA, Hombr. and Jacq. Pl. 55, fig. 178.

White, externally and internally. Length, 1 inch.

Isle of Manganeva.

This is also a young shell, the generic position of which is very doubtful.

P. ANOMALA, Angas. P. 121, Pl. 36, fig. 422.

This is described as a *Cronia*, but does not resemble the group at all; it is so like *Ocinebra* that I have preferred to place it there.

P. AVELLANA, Reeve. Pl. 55, fig. 179.

Shell smooth, distantly plicately ribbed; white, mottled with chocolate-color; lip thickened and dentate within. Length, 1 in.

N. Coast of Australia.

Described as a *Buccinum*, with simple lip. H. and A. Adams included it in the genus *Clavella;* its really thickened, dentate lip (per specimen before me) and longitudinal ribs, together with its form, show it to belong rather with *Cronia.*

Genus **PURPUROIDEA**, Lycett.

This fossil genus has been confounded with *Purpurina*, d'Orb.: its typical forms appear to be true Purpuræ, and the species I figure has some resemblance to the recent *P. chocolatum;* whereas the species of *Purpurina* are nearly related, apparently, to *Cancellaria.*

P. NODULATA, Lycett. Pl. 55, fig. 180. Oolite.

Genus **LYSIS**, Gabb.

Founded on *L. duplicata*, a cretaceous fossil from California, and supposed by its author to be nearly related to *Stomatia.* I have examined authentic specimens in our museum, and do not hesitate to refer it to the Purpuræ.

L. DUPLICOSTA, Gabb. Pl. 55, figs. 182, 183. Cretaceous,

California.

Genus **JOPAS**, H. and A. Adams.

J. SERTUM, Brug. Pl. 55, figs. 181, 188–190.

Shell varying from smooth or finely striate, to a form covered with small revolving ribs, which are sometimes decussated and rendered granulate by growth-lines. Chestnut-brown, more or less undulately marked with yellowish white, and having an interrupted white band on the periphery. Sometimes purplish red, with the band and maculations light purple. Aperture whitish or cream-color, the lip margin and columella brown or blackish. Length, 1·5–2·25 inches.

Red Sea to Paumotus Isles.

Mr. W. H. Pease was the first to show the variability of this species, and to add to its synonymy *I. francolina*, Brug (fig. 190), and *J. situla* (fig. 188), which simply represent different stages of sculpture and coloration. I have before me a specimen from Rarotonga, nearly 3 inches in length, and very ponderous.

Genus **VEXILLA**, Swains.

V. TÆNIATA, Powis. Pl. 55, figs. 184, 185.

Brownish or chocolate, encircled by six or eight narrow, whitish bands and numerous close striæ. Animal bilobed in front.

Length, ·75–1 inch.

Philippines to Paumotus ; Sandwich Isles.

V. VEXILLUM, Chemn. Pl. 55, fig. 186.

Smooth ; yellowish, with six or eight narrow, brown, revolving bands. Length, ·75–1 inch.

Philippines ; Sandwich Isles.

It is not unlikely that *V. tæniata* will eventually prove to be a variety of this species. D'Orbigny includes this species among the mollusks of Cuba, and says that the East Indies is a locality given in error ; it is scarcely necessary to remark that he is him self mistaken ; the mollusk is not West Indian.

Subgenus **Usilla**, H. Adams.

Founded on *V. fusco-nigra*, Pease, which differs from the typical *Vexilla* in the spire being acuminate, and the aperture somewhat contracted or narrowed.

Pease (Am. Jour. Conch., iv, 115) adopts the subgenus, and adds to it *Purpura leucostoma*, Desh., and *Planaxis cingulata*, Gould. I very much doubt whether the group will stand, as the little specimen of Pease's species before me is very suggestive of *Pisania*, and Deshayes' species is a true *Purpura*, and evidently very closely allied to, and as I believe = *P. columellaris*. The opercula of Pease's and Gould's species are unfortunately undescribed.

V. FUSCO-NIGRA, Pease. Pl. 55, fig. 187.

Abbreviately fusiform, ventricose, solid ; spire moderately produced, acute, and less than half the length of the shell ; whorls six, convex, furnished with close, transverse, granular ribs ;

suture impressed; body-whorl large, ventricose, and marked with coarse, remote, revolving impressed lines, and fine longitudinal striæ and wrinkles; canal short, slightly recurved; aperture oblong-ovate; outer lip thick, somewhat dilated, and furnished with six or seven intra-marginal tubercular teeth, sinuated at its junction with the body-whorl; columella-lip smooth, flattened, slightly callous above. Color black or brownish black, impressed lines on body-whorl light chocolate-color; lip purplish-brown; teeth white or bluish.

Animal. Foot oblong, truncated in front, rounded behind; tentacles cylindrically tapering. Eyes lateral and sessile, at about two-thirds of the length of the tentacles; siphon long. Color dark greenish slate, closely punctured with black and white; tentacles zoned with brown, tips white.

Sandwich Isles (Pease); *Solomon's Isles* (Brazier).

V. CINGULATA, Gould.

Shell small, thick, ovate-turreted, smooth, brownish red alternately zoned with yellow, striæ intercurrent; whorls seven, somewhat convex, the apical granular, the last large; aperture narrowly ovate; lip oblique, with seven teeth, and fasciated within; columella excavated, red. Length 12, diam. 6 mill.

Ousima, Japan, under stones at low water.

Described as a *Planaxis*, which it may well be, and as likely to be a *Pisania* as a *Vexilla*.

Genus **RICINULA**, Lam.

H. and A. Adams restrict the typical group to those species having spinose or tubercular whorls, with digitate outer lip; and they practically include in it a few species distinguished for size. The teeth within the outer lip are generally disposed into an upper and a middle compound tooth, besides single, inferiorly placed ones. The subgenus *Sistrum* has usually a longer spire, the shell is smaller, more fusiform, the teeth within the outer lip not grouped, but single. This separation has its conveniences, and I adopt it: nevertheless the characters, as in so many other groups, only serve well for the recognition of some of the forms; others must be arbitrarily placed. The dividing line between *Sistrum* and *Engina*, *Latirus* and some *Pisanoid* forms is very difficult to trace, and I have seen worn specimens of either of those genera which might be readily referred to the others; on this account some species originally described under *Sistrum* I have been able to refer definitely to other groups; whilst others, from insufficiency of diagnosis, illustration or specimens are retained, but with doubt. The genus is essentially Polynesian in distribution, frequenting coral reefs.

R. HYSTRIX, Linn. Pl. 56, fig. 195.

The surface varies from nodulous to spinose; in very large specimens the shell is sometimes umbilicate. Yellowish brown; the interior of aperture rich rose-color.

Length, 1·5–2·5 inches.

Sandwich Isles; Fiji Isles; Paumotus.

In this, the largest species, the teeth have but little disposition towards grouping.

Var. REEVEANA, Crosse. Pl. 56, fig. 196.

The surface is nine-varicose instead of seven-varicose as in *R. clathrata*, Lam. The interior of the aperture is violet-purple. I do not find the distinction in the number of varices to hold good, as I have before me specimens of the latter with as many as ten varices. The interior of the aperture is less rugose upon lip and columella, and wants, besides, the brown markings of *clathrata*.

Marquesas Isles.

Var. SPECIOSA, Dunker. Pl. 56, fig. 194.

Small, rugosely tuberculose, the tubercles prominently arranged in revolving series; columella strongly four-plicate.

Length, ·83 inch.

Rarotonga, Paumotus.

This is a well marked variety, distinguished by its small size, very deep rose-purple interior, columellar plaits, etc. It was first figured by Reeve as var. of *R. clathrata*, Lam., and then described by Dunker. Subsequently, the latter finding Reeve's figure cited as the young in Crosse's description of *Reeveana*, abandoned his species as synonymous with that of Crosse. I consider the two to be well distinguished varieties, diverging in opposite directions from the type.

Var. CLATHRATA, Lam. Pl. 56, figs. 197, 198.

Brownish white externally, violet within; the lip and columella whitish, stained and marked with brown.

Length, 1·25–1·75 inches.

Central Pacific, on coral reefs.

Var. LAURENTIANA, Petit. Pl. 56, fig. 192.

This shell, of which only a single individual is known, has the exterior surface covered with a parasitic growth, which obscures its color. Within the mouth it is rose-colored, and the lip and columella are yellowish brown. Length, ·8 inch.

Locality unknown.

Most nearly related to var. *speciosa*, Dunker.

R. IODOSTOMA, Lesson. Pl. 56, fig. 199.

Surface not tuberculate, light brownish with incised revolving lines, and four or five dark chocolate bands. Columella with three or four plications; teeth of outer lip grouped; aperture rosy violet within. Length, 1–1·75 inches.

Tahiti; Sts. Macassar; New Zealand.

Very closely allied to *R. horrida;* but distinguished by its colored bands and absence of tubercles.

R. HORRIDA, Lam. Pl. 56, figs. 201, 202.

Usually white or very light brown; the tubercles or short spines black; interior deep violet. Length, 1–1·75 inches.

Philippines to Sandwich Isles.

R. RICINUS, Linn. Pl. 56, fig. 200; pl. 57, figs. 204, 206, 212.

White or yellowish brown; the tubercles or spines black; aperture white, the lip sometimes tinged with yellow.

Length, ·75–1·25 inches.

Red Sea; Benguela, Natal, Guinea, Japan, Philippines, New Zealand, Polynesia.

Var. ELEGANS, Brod. Pl. 56, fig. 193.

Varies from the type in the external surface being uniform white, and the lips of the aperture encircled by a narrow brown band. Length, ·5–·75 inch. *Paumotus Isles.*

Mr. Pease remarks of this var. that its variation from the type is parallel to that of *R. lobata* from *R. digitata.*

R. DIGITATA, Lam. Pl. 56, fig. 191; pl. 57, fig. 203.

Shell whitish externally, columella, lip and interior of aperture orange-color. Length, 1–1·5 inches.

Central Pacific Isles.

Var. LOBATA, Blainv. Pl. 57, fig. 205.

Columella and lip dark chocolate-color.

R. BICONICA, Blainv. Pl. 57, figs. 208–211.

A revolving row of tubercles forms a shoulder on the body-whorl, and there is another median (and sometimes an inferior) row of less developed tubercles; these are usually white, but sometimes dark brown; interspaces covered by brown revolving ribs; more or less longitudinally plicate; aperture light violet within; two upper teeth of lip grouped together.

Length, ·75 inch.

Philippines.

PURPURA RUFOSTOMA, Lesson.

This is evidently a *Ricinula*, but the description does not suffice for the recognition of the species. It is from the Gambier Isles, and has never been figured.

Subgenus **Sistrum**, Montf.

R. MORUS, Lam. Pl. 57, figs. 213, 214.

Usually white (sometimes orange-colored), the nodules black (sometimes uncolored); interior light violet. Length, ·6–1 inch.

Polynesia.

Var. ASPERUS, Lam. Pl. 57, figs. 215, 216.

The longitudinal ribs which, in the type are scarcely apparent, here become more pronounced, causing the tubercles to be narrower and sharper.

Philippines.

Var. STRIATUS, Pease. Pl. 57, fig. 217.

A depauperate form, with the longitudinal ribs almost continuous and developed at the expense of the tubercles.

Length, ·7 inch.

Paumotus.

R. TUBERCULATUS, Blainv. Pl. 57, figs. 218, 220.

Very variable in outline, some specimens being much shouldered, with short spire, others ovate with longer spire. Closely allied at first sight to *R. morus* but dark olive-brown, the tubercles darker or black, and surface closely covered with revolving striæ instead of the single small rib between each row of tubercles as in *R. morus*. The aperture is dark brown or black, the teeth and columella partially white. Length, ·75–1 inch.

Japan; Philippines to Sandwich Isles.

The external resemblance of this species to *Purpura musiva*, Kiener, is very great; the genuine purpuroid aperture of the latter will serve to distinguish them.

The animal is described by Gould in the Mollusca of Wilkes' Exped. as being deep grass-green; with the mantle, locomotive disk and tentacles light sea-green finely dotted with white.

R. ANAXERES, Duclos. Pl. 57, fig. 219.

The coloration is the reverse of that of *R. tuberculatus;* that is, the shell is dark and the nodules light—frequently nearly white. Length, ·4–·5 inch.

Natal; Solomon's Isles; Australia; Paumotus.

Is possibly not adult, and is related in sculpture to *R. morus*, but otherwise more closely to *R. tuberculatus*.

R. MARGINATRA, Blainv. Pl. 57, figs. 221, 222, 225–229.

Shell very variable in outline, cancellated by revolving and longitudinal ribs, by which the surface is broken up into tubercles; most prominent as revolving series and usually incisely cut by revolving striæ which, in the interstices of the nodular series become scabrous. Brownish, the nodules usually darker. Aperture bluish within, with revolving raised chocolate lines which terminate in four or five white or fulvous tubercles upon the thickened lip; lip and columella stained with chocolate.

Length, ·75–1 inch. *Australia; Central Polynesia.*

The type (fig. 225) is a young shell; the adult is *Purpura marginalbum*, Blainv. (figs. 221, 226). I cannot distinguish *P. cancellata*, Kiener (fig. 227) nor *Ricinula fusca*, Küster (fig. 222). Pease acknowledges the difficulty of separating his *Sistrum affine* (fig. 228), and von Martens has already considered it a synonym; I add *S. squamosum*, Pease (fig. 229), from the perfect concordance of description, figure, and type specimens. Dr. Gould has described, but not figured a *S. parvulum* collected at Simon's Bay by Stimpson. He distinguishes it from *R. tuberculatus*, but I cannot find any characters by which to separate it from this species.

R. OCHROSTOMA, Blainv. Pl. 57, figs. 230, 223, 224; Pl. 58, figs. 231–234.

White; the aperture also, usually white, but sometimes cream-color or yellowish. Length, ·75–1·5 inches.

Australia; Philippines to Paumotus Isles.

Varies much in the development of the tubercles, longitudinal ribs and revolving striæ, and has consequently received a number of names. The *R. ochrostoma* and its var. *rufonotata* of P. P. Carpenter, are stated by Mr. Pease to belong to the genus *Engina*.*

Var. HEPTAGONALIS, Reeve. Pl. 58, figs. 235–240.

Whitish; more or less stained with brown; sometimes with a central and inferior band; yellowish within the aperture.

The distinguishing feature of the several species described by Reeve, which I write here as a variety is, that the longitudinal ribs are not well developed and the nodules therefore constitute revolving series. The type is said to have been collected by Cuming at Panama—a very doubtful locality, as yet unverified by subsequent collectors; Küster figures a specimen from Natal, also somewhat doubtful; the *R. eburnea* of the latter author is founded on a specimen said to come from the Indian Ocean.

R. CHAIDEA, Duclos. Pl. 58, figs. 241, 247.

White, without and within. Length, ·65 inch.

Philippines; Australia; New Caledonia.

May be only a depauperate var. of the preceding, but the short ventricose form is very characteristic.

S. rugulosum, Pease (fig. 247), from Howland's Island, appears to be the same species not adult.

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* Am. Jour. Conch., iv, 116.

R. MUTICA, Lam. Pl. 58, fig. 246.

Brownish black; lip margined with dark chocolate, teeth white; columella and interior white or bluish. Length, ·65 inch.

Mozambique; Mauritius.

Very distinct in form and coloring.

R. DUMOSA, Conr. Pl. 58, figs. 245, 243, 249.

Yellowish externally; purple, violet or light chocolate within. Length, ·65–·8 inch. *Sandwich Isles; Marquesas.*

There can be no doubt of the identity of Reeve's *R. porphyrostoma* with this species, which is well figured in connection with the original description, and has nine years' priority.

Murex Liénardi, Crosse (fig. 249), from Mauritius has been referred to *R. fiscellum*, Chemn., by Nevill (Jour. Asiatic Soc., 83, 1875); I am inclined to consider it very close to, if not identical with *R. dumosa.*

R. IOSTOMA, Reeve. Pl. 58, fig. 248.

The nodules of the revolving ribs are tinged with black; the violet aperture is not contracted; otherwise this species is closely related to *R. dumosa.* Length, 1 inch.

Hab. unknown.

R. CANCELLATA, Quoy. Pl. 58, figs. 242, 250.

Externally whitish or grayish; aperture yellowish or orange-brown. Length, ·75–1·25 inches. *Philippines to Sandwich Isles.*

Readily distinguished by the deep-pitted, square interstices formed by the crossing of the longitudinal and revolving ribs.

R. FISCELLUM, Chemn. Pl. 58, figs. 251–257.

White, yellowish or chocolate, the longitudinal ribs and the pit-like depressions (defined by the crossing of the revolving ribs) frequently tinged with brownish or blackish; violaceous within the aperture. Length, ·6–1 inch. *Philippines to Sandwich Isles.*

The spire is much shorter and the whorls more shouldered than in *R. cancellata.* The color of the aperture is different. There are fewer longitudinal ribs, and the revolving ribs are compound, composed of a bundle of smaller ones. The species has been confounded especially with *R. undata* (= *margariticola*) by some of the monographers, and considerable confusion of synonymy has thereby resulted.

Var. FUSCO-NIGRA, Dunker (Pl. 59, fig. 258).

Shorter and stouter than the type; internally chocolate-colored. Length, 17 mill.

Kingsmill Isl.

No figure of this form having been given hitherto, I am able to give one from a specimen forming part of the original lot.

R. UNDATA, Chemn. Pl. 59, figs. 259–268, 270, 271.

Shell shouldered, with rounded longitudinal ribs, crossed by close, scabrous, revolving, raised lines. Brown or blackish; aperture light chocolate or violaceous within.

Length, ·75–1.5 inches.

Tranquebar; Natal; China; Japan; Australia; Polynesia to Paumotus Isles.

I adopt the above name with some hesitation, as Chemnitz is not a consistently binomial author; it is undoubtedly prior to any other name for the species, whilst its rejection would involve the necessity of adopting either *margariticola*, Brod., or *muricina*, Bl., both published in the same year, 1832. Frequently the revolving ribs are broken up by the longitudinal elevations into long, bead-like tubercles, which are not scabrous, and in this state it somewhat resembles *R. concatenata*, Lam. *Purpura reticulata*, of Quoy (fig. 264), and *P. humilis*, of Crosse and Fischer (fig. 265), both appear to me to be young shells of this beaded form.

Var. ALBOVARIA, Küster. Pl. 59, fig. 271.

Shell banded.

R. ADELAIDENSIS, Crosse. Pl. 59, fig. 273.

Whitish or yellowish, the aperture violaceous.

Length, ·75 inch.

Australia.

I suspect that this will prove a variety of the preceding species.

R. CONCATENATA, Lam. Pl. 59, fig. 269.

Whitish, yellowish or gray; the bead-like revolving tubercles generally dark colored; aperture sometimes orange or violet within, frequently white. Length, 1–1·25 inches.

Philippines; Australia.

R. NODULOSA, Adams. Pl. 59, fig. 275.

Chocolate or lead-color, the nodules black; interior chocolate, the teeth white. Length, ·6 inch.

West Indies; Brazil.

Mr. Hidalgo in his work on the Mollusks of the "Viaje al Pacifico," has described Brazilian specimens with great doubt as a variety of *R. tuberculata*, Blainv. He has sent me specimens which are certainly the same as authentic types of *R. nodulosa;* the species is much smaller and different in shape from *R. tuberculata*, but the details of sculpture and color are curiously alike.

R FERRUGINEA, Reeve. Pl. 59, fig. 277.

Blackish, sometimes obscurely white-banded, the nodules black; aperture bluish or chocolate within. Length, ·6–·8 inch.

Guaymas, Cape St. Lucas.

A large, thinner species than the preceding, with rather thin outer lip, and more spinous tubercles. Has been confounded with *R. carbonaria*, Reeve, which is an *Engina.*

R. JUGOSA, C. B. Ad.

The description of this species is so very close to *R. ferruginea*, that I suspect them to be identical, although P. P. Carpenter thinks, from an examination of the single type specimen, that it is either an *Engina* or a *Peristernia*. The type is white-banded and the "inner lip is excavated, with a few wrinkles above and granules below; canal moderately long. This species is much like a *Murex*." Length ·94 inch, diameter ·47 inch.

Panama.

R. SIDEREA, Reeve. Pl. 59, figs. 276, 278.

White, irregularly marked with reddish brown square spots. Obsoletely nodosely ribbed, with revolving striæ.

Length, ·85 inch.

Philippines.

Found on coral reefs and under stones at low water. Does not appear to be closely related to any of the species. It looks something like a *Columbella*. I copy a figure (fig. 278) from Von Martens' "Vorderasiatische Conchylien," which is referred to this species: I doubt it.

R. FUNICULATA, Reeve. Pl. 59, fig. 272.

Bluish-white, ridges and tubercles black; violaceous within. Length, ·7 inch.

Hab. unknown.

R. PARVA, Reeve. Pl. 59, fig. 274.

Whitish; nodules orange-color and black in alternate rows. Length, ·3–·6 inch.

Philippines.

It is doubtful whether this species belongs here or in *Peristernia.* I have not seen authentic or undoubted specimens.

R. SCABRA, Koch.

Ovate fusiform, nodulous by decussating ribs and striæ; with three brown-black zones; aperture as long as the spire, coarctate, with six equal teeth within the outer lip.

Hab. unknown.

I do not know this species; it has not been identified or figured by subsequent authors.

R. LIVIDA, Reeve. Pl. 59, fig. 281.

Chocolate-brown, variegated with darker color. Length, 1 inch.

Isle of Negros, Philippines.

Very like Reeve's *Buc. bimucronatum* (which is a syn. of *R. ochrostoma*), the principal difference being, that in this species, the rib forming the shoulder forms a single angle, instead of being double as in the latter. It is possibly a mere variety.

R. CHRYSOSTOMA, Desh. Pl. 59, figs. 283, 279, 280.

Light brown or yellowish; orange or violet within the aperture. Length, ·75 inch.

Ceylon, Seychelles, Mauritius, Polynesia.

Reeve has figured a different species (= *R. biconica*) under this name. I think that *R. ozenneana*, Crosse (fig. 279), and *Murex Crossei*, Liénard (fig. 280), are merely varieties of the same specific form, but I am unable to include (as Messrs. G. and H. Nevill have done) *Latirus gibbus*, Pease; the latter appears to be a true Turbinelloid species.

R. MUSIVA, Kiener. Pl. 59, fig. 284.

Characterized by the revolving nodules being in alternate series of color, brown and black. Length, 1 inch.

Philippines.

Doubtful or Undetermined Ricinulæ.

PURPURA COSTIFERA and P. COSTA-STRIATA, Dufo.

Mahé, Seychelles Isles.

P. VIOLACEA, Lesson.

Close to *P. cancellata*, Kiener (= *R. marginatra*, Bl.); small, longitudinally and transversely costate, cancellate; aperture oblique, dentate within, violaceous; canal distinct; columella smooth.

Gambier and Marquesas Isles.

R. PAPILLOSA, Phil.

Hab. unknown.

R. VENTRICOSULA, Nevill. Pl. 59, fig. 282.

White stained with pale brown. Length, ·23 inch.

Ceylon.

Evidently a young shell; the columella shows plications, which would indicate affinities with the Turbinellidæ, the outer lip, however, bears four internal teeth.

The following species, described as Ricinulæ, are referred to other genera.

To the genus *Engina*:—

R. forticostata, *crocostoma*, *lineata*, *zonata*, *lauta*, *histrio*, *carbonaria*, *trifasciata*, *mendicaria*, of Reeve.

Purpura alveolata and *turbinella*, of Kiener.

Sistrum ochrostoma (not Bl.), var. *rufonotatum*, Carpenter, = *Buc. pulchrum*, Rve.

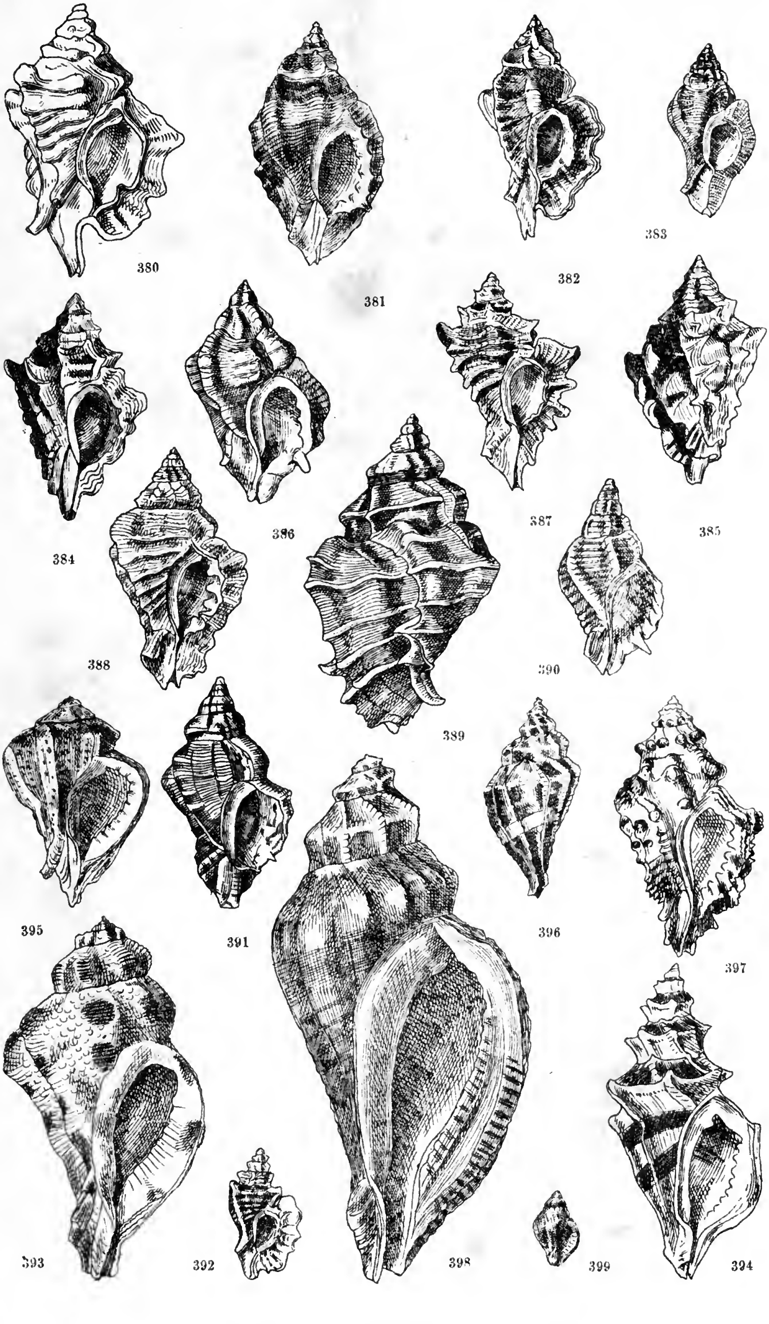
To *Urosalpinx*. *P. tritoniformis*, Blainv.

To *Turbinellidæ*:—

R. deformis, *rosea*, *rutila*, *bella*, *recurva*, *eximia*, *contracta*, *concinna*, *astricta*, *armillata*, *acuminata*, *pulchra*, of Reeve.

R. Reeveana, C. B. Ad.

Purpura bucciniformis, Kiener.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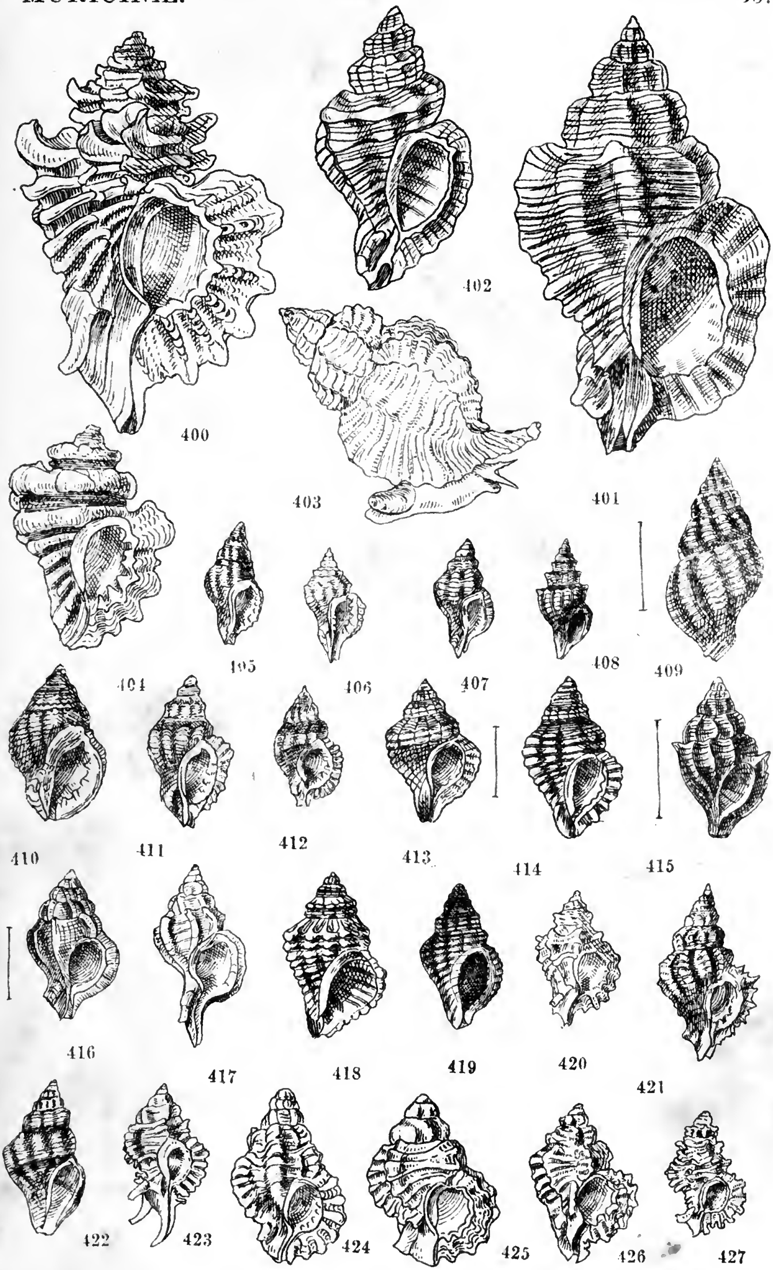
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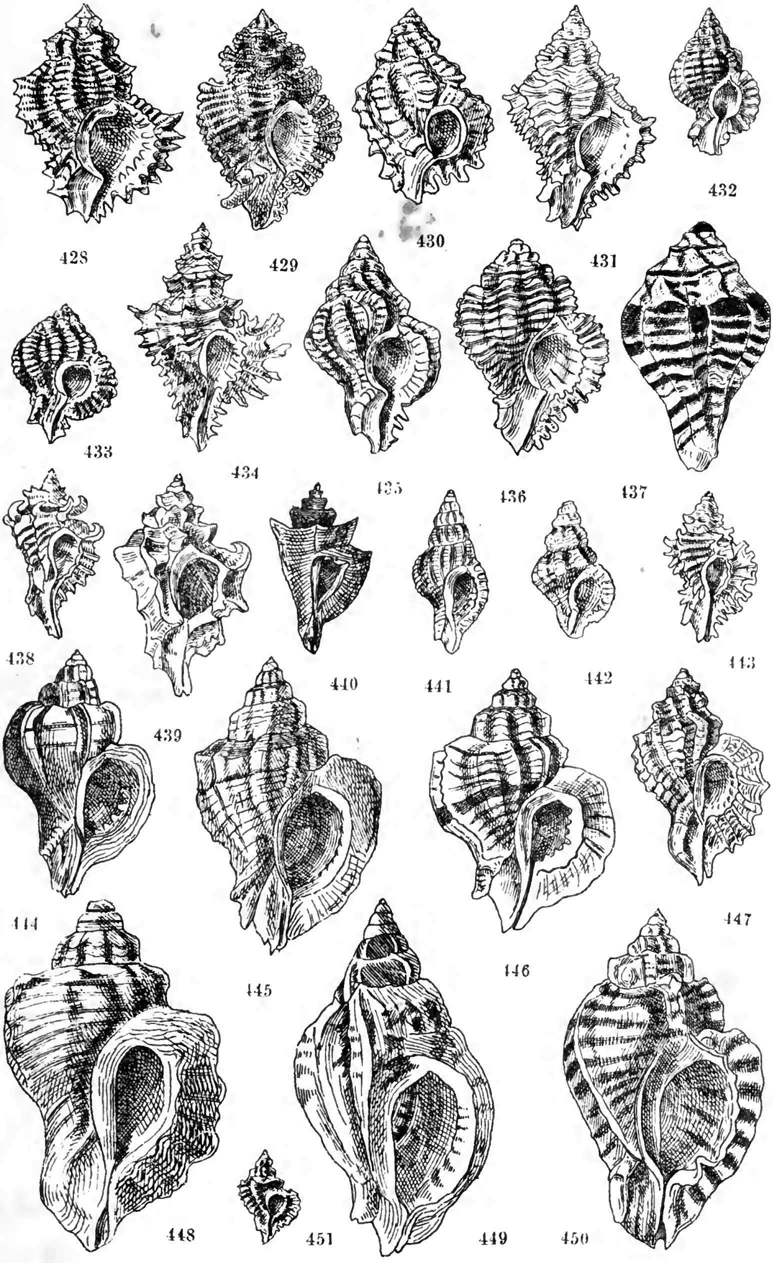
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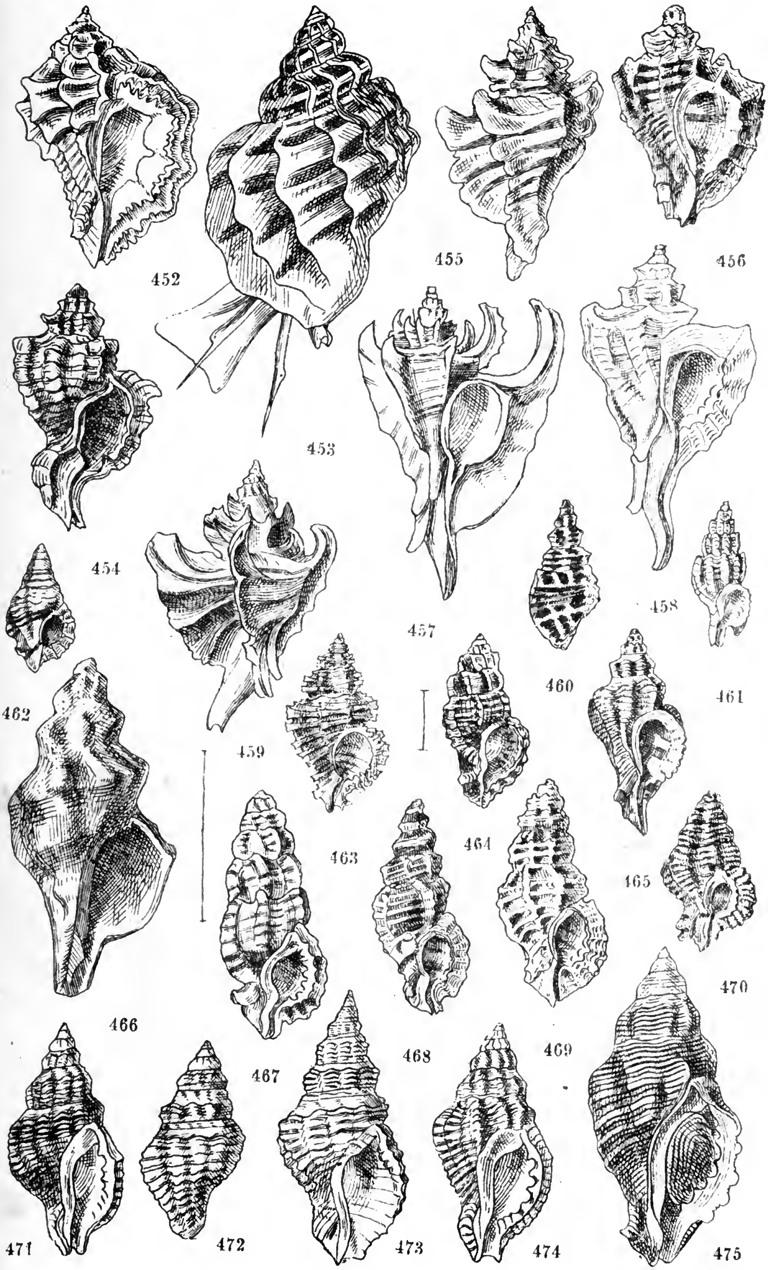
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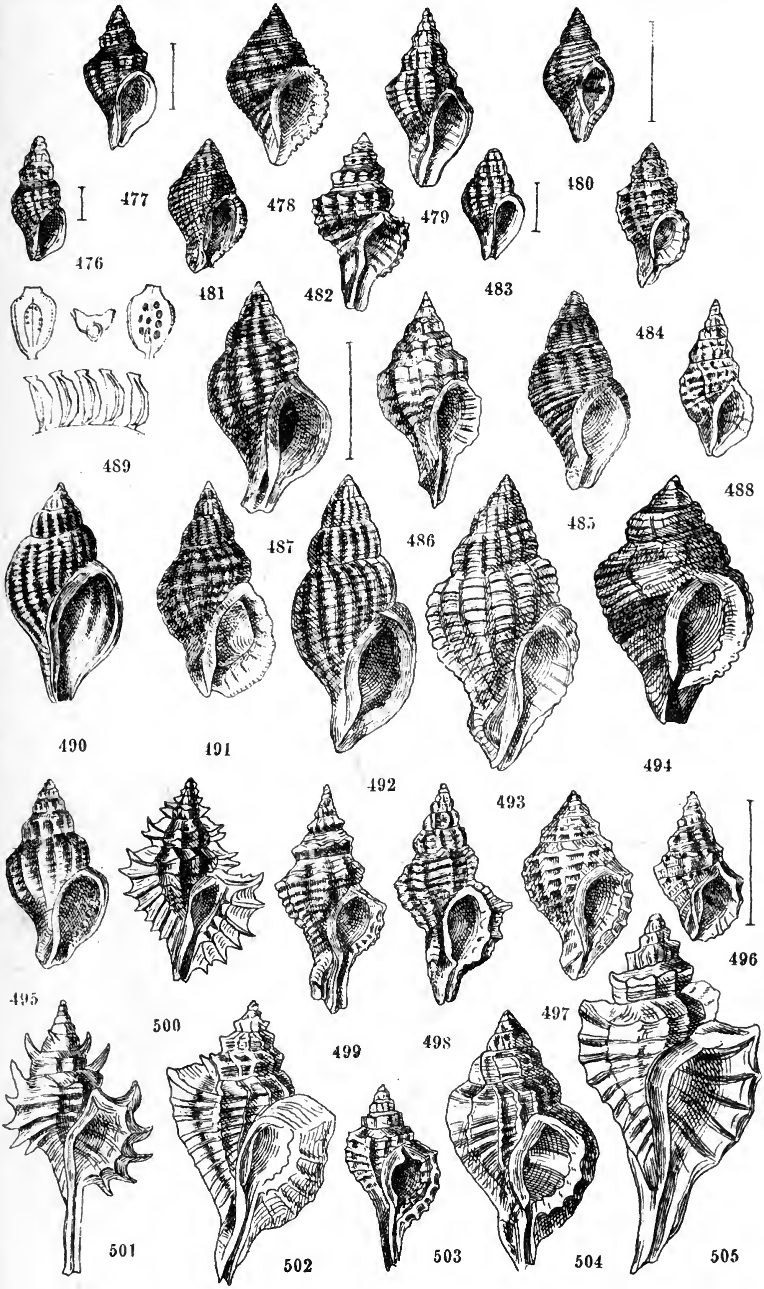
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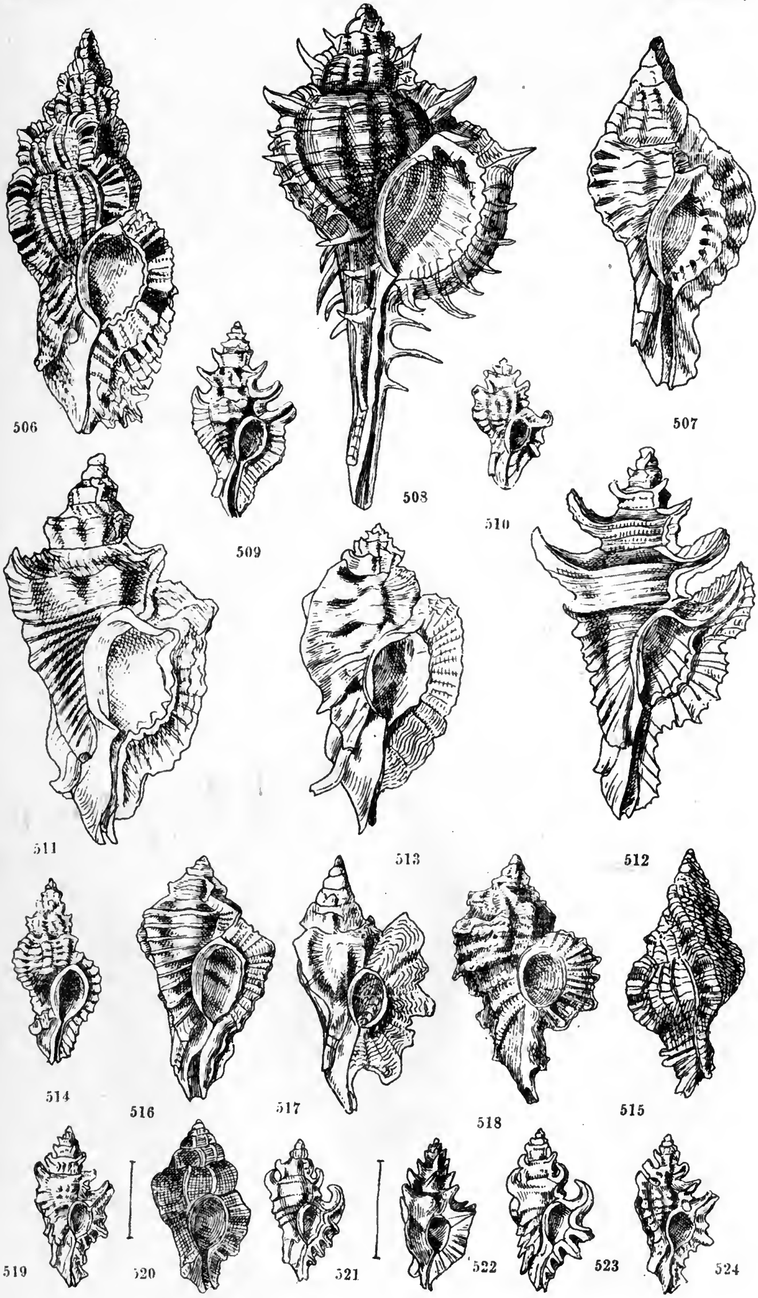
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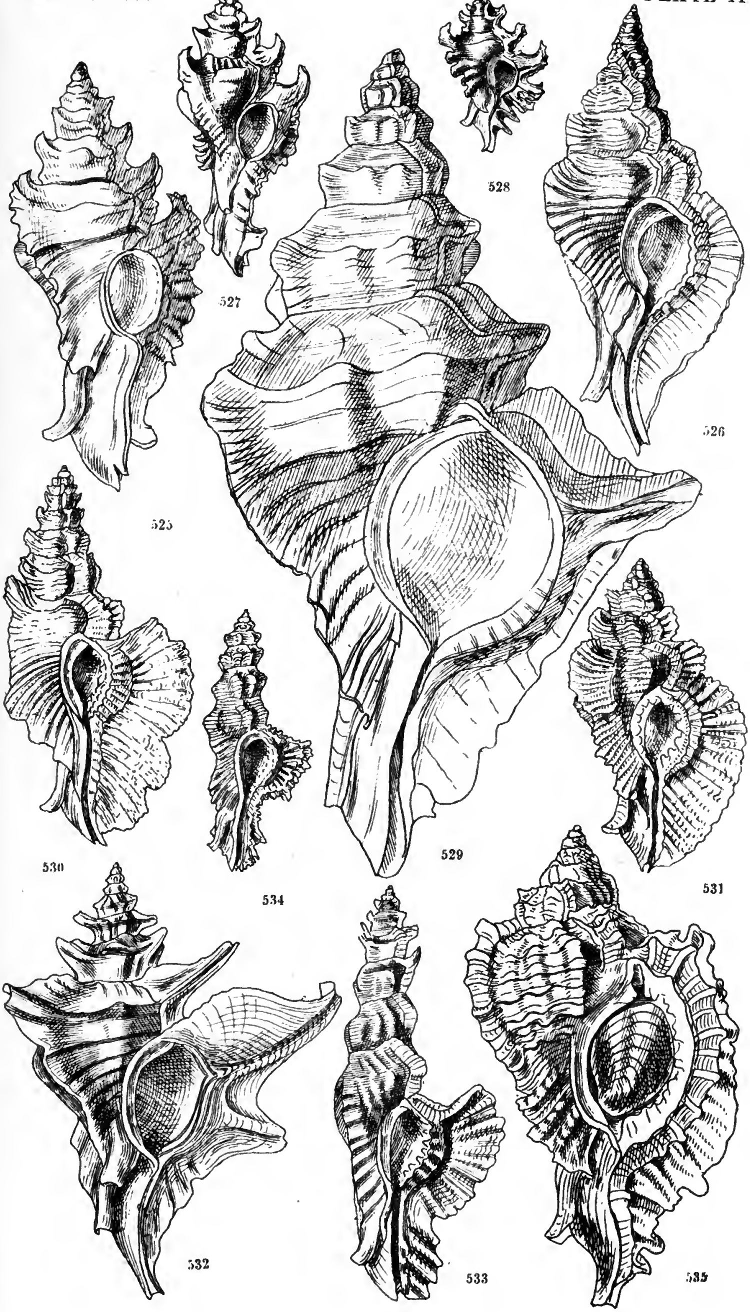
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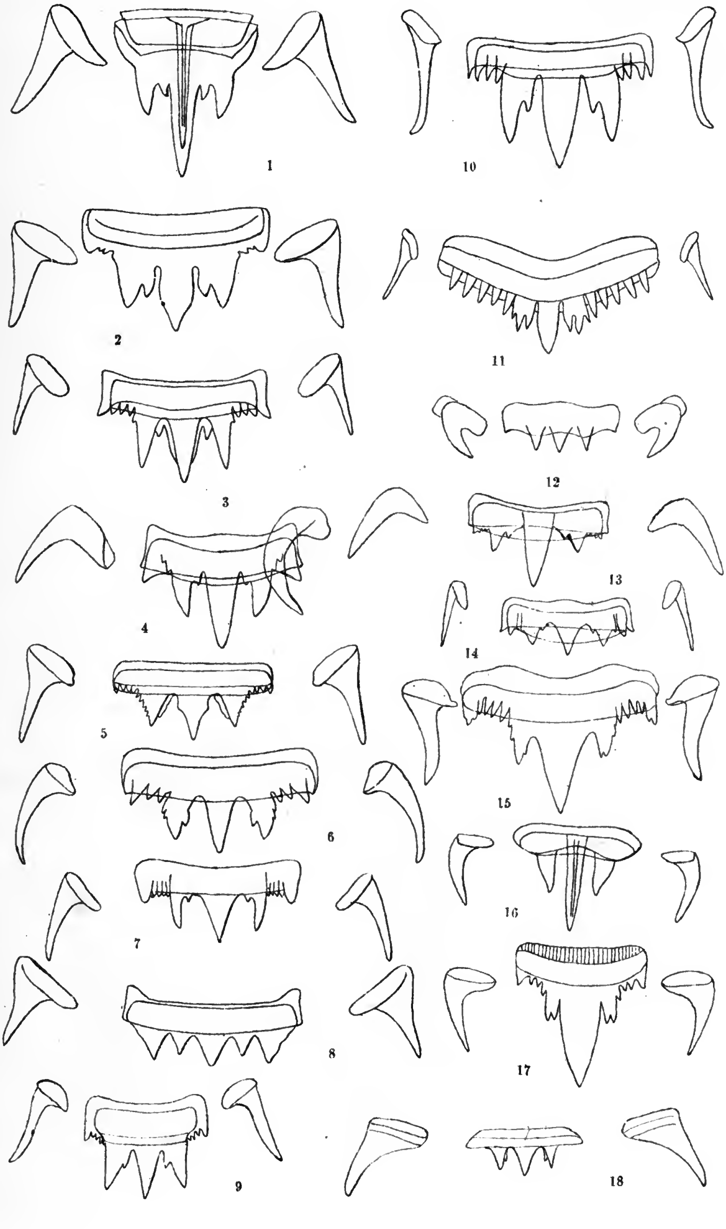
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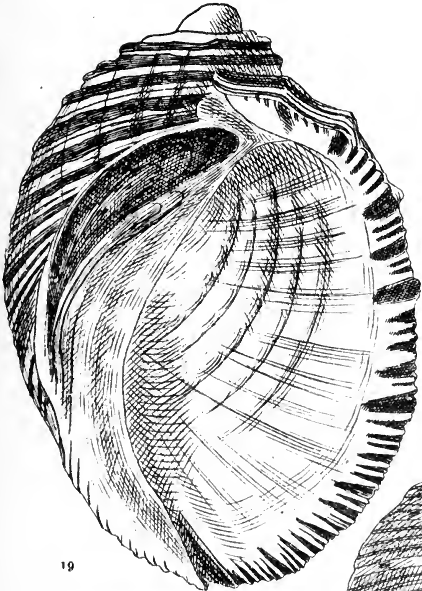

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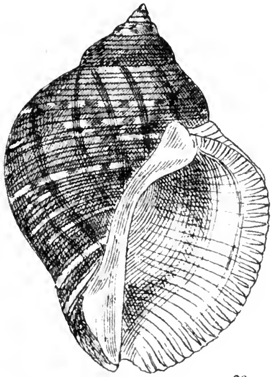

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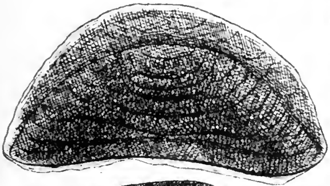

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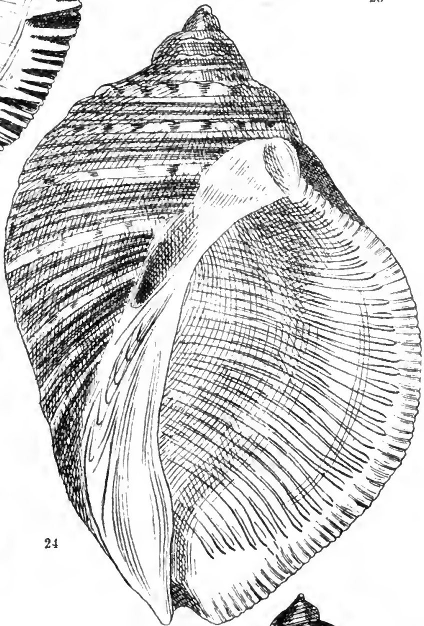

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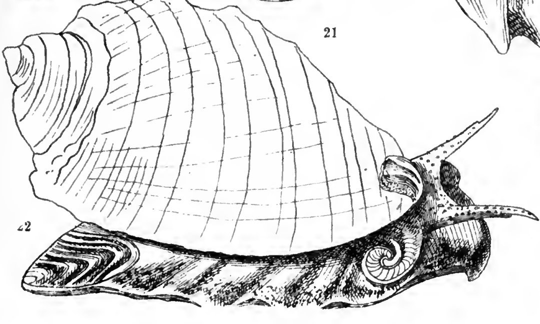

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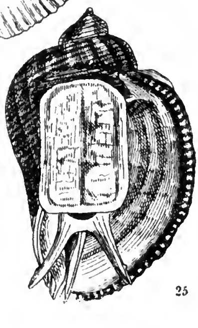

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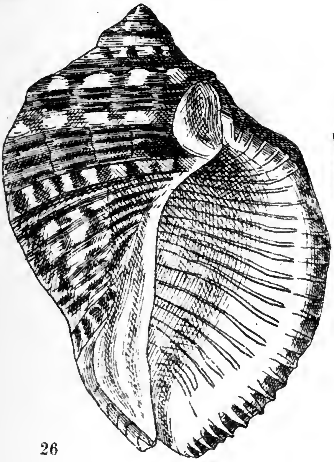

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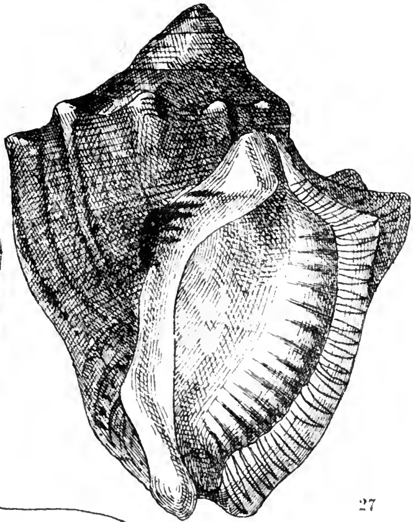

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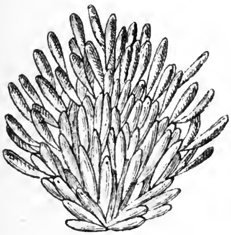

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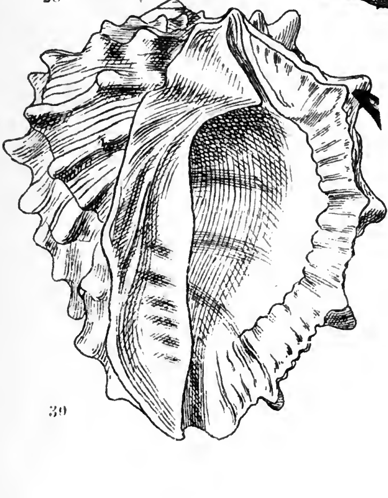

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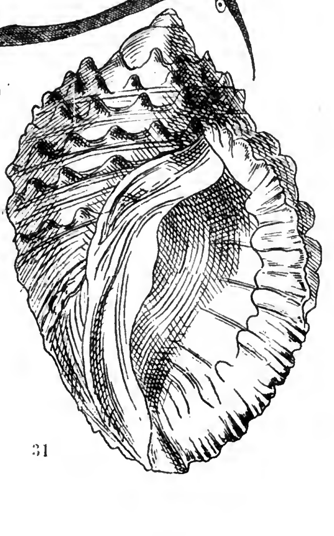

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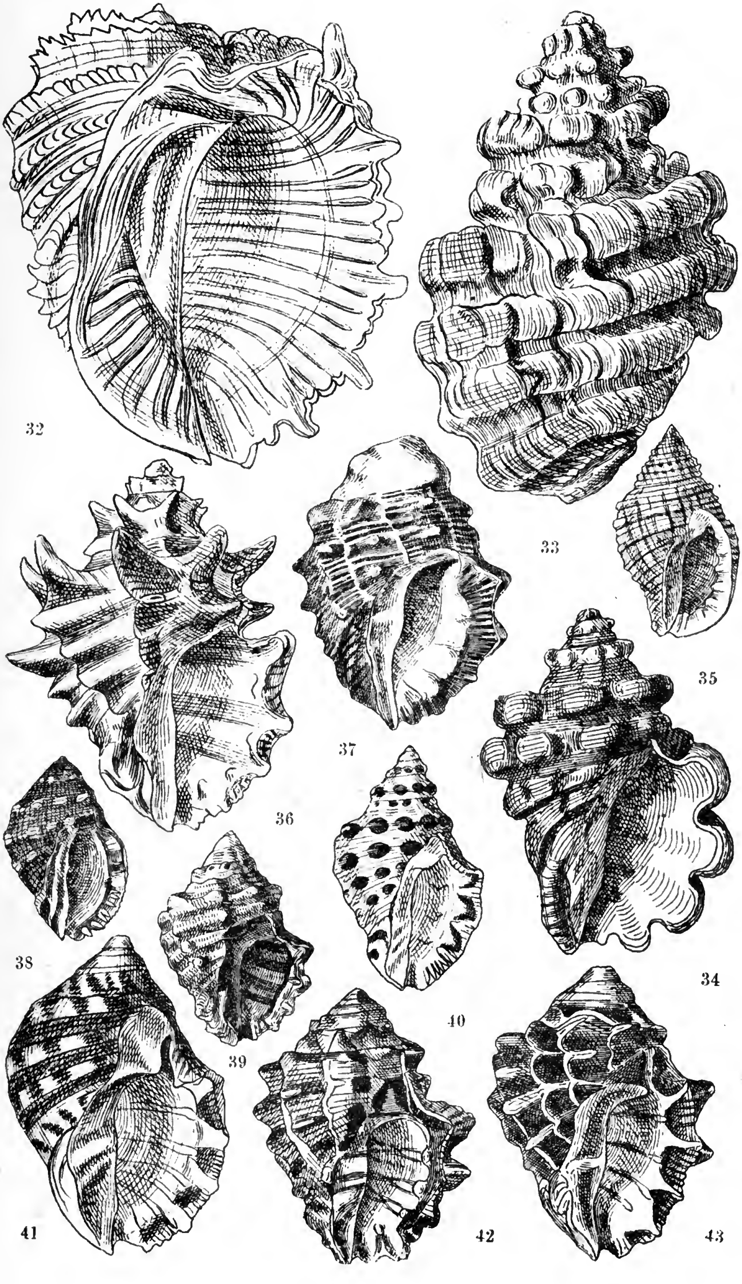
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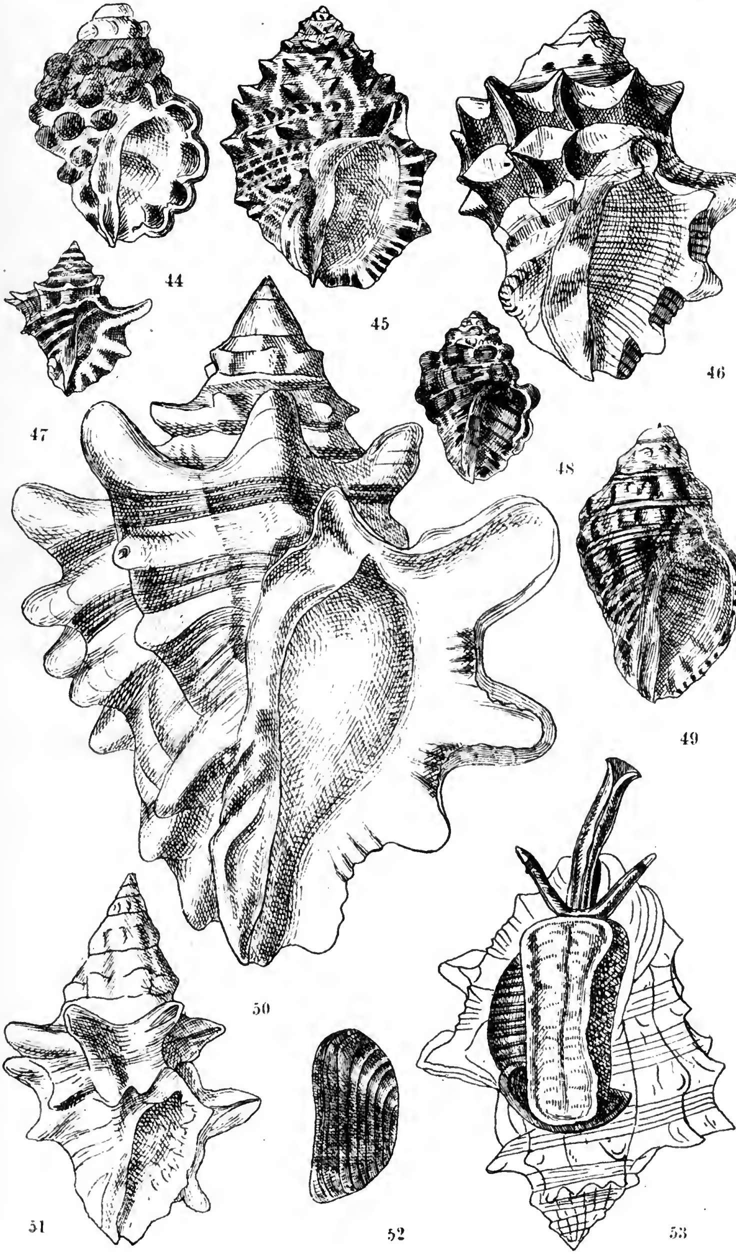
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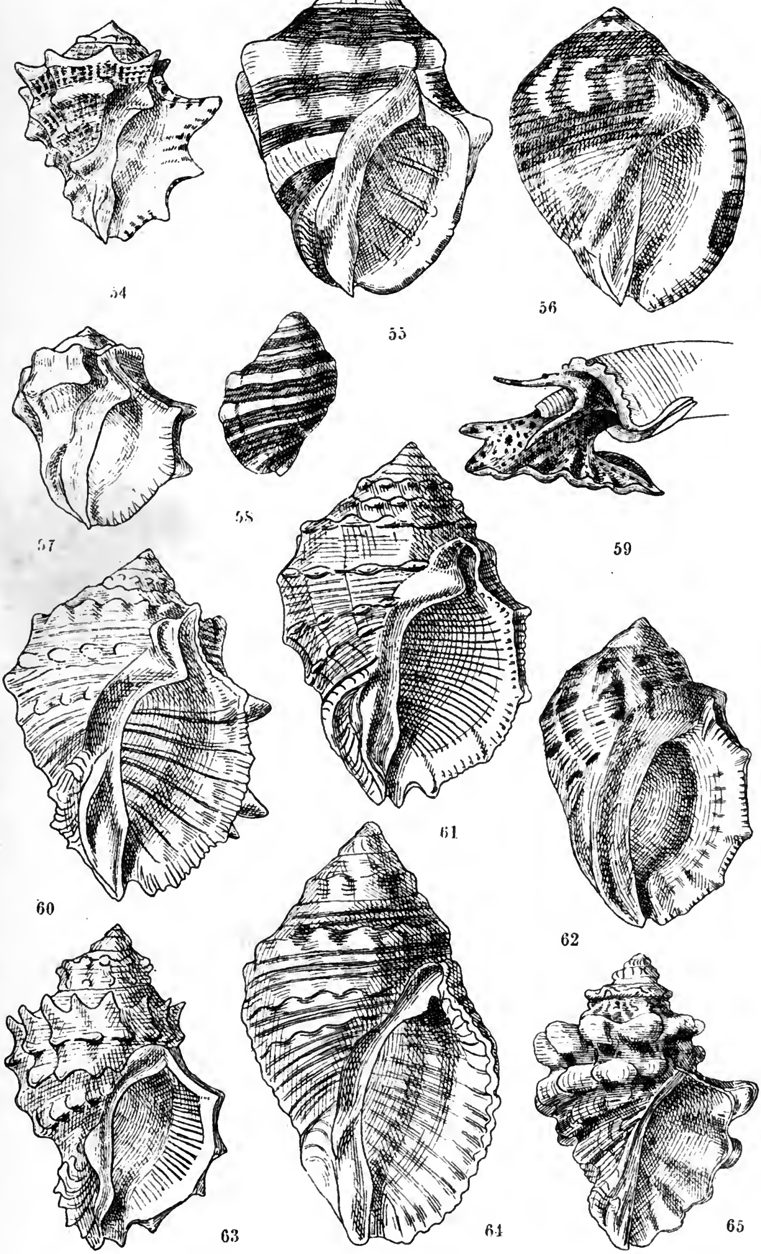
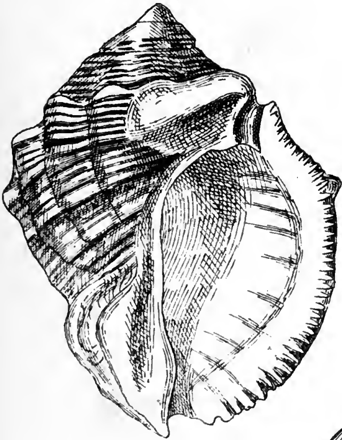
PURPURINÆ. PLATE 47.



PURPURINÆ. PLATE 48.



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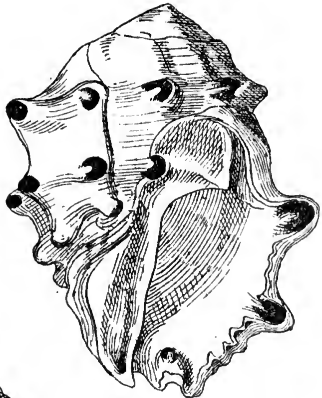

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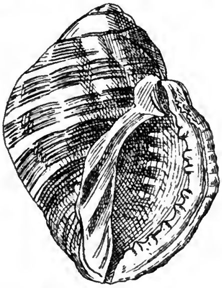

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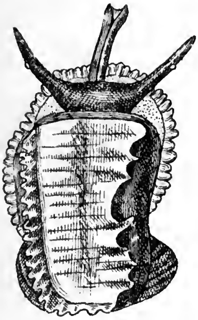

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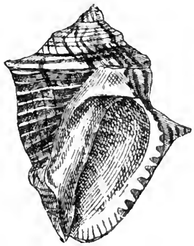

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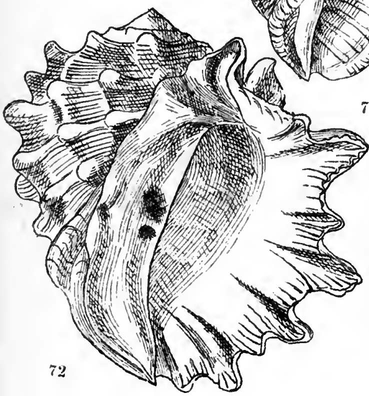

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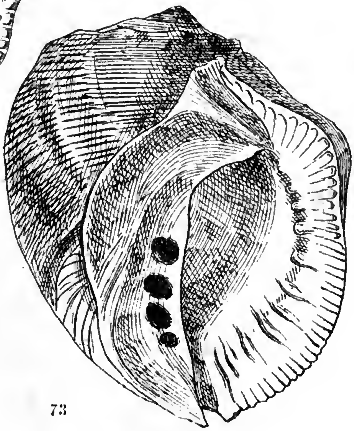

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Genus **MONOCEROS**, Lam.

This small group is restricted in distribution to the Pacific coasts of North and South America and the neighboring islands. It is also represented in the tertiary of Chili.

M. GRANDE, Gray. Pl. 60, figs. 288, 285–287.

Brown externally, flesh-color within the aperture.
Length, 2·5–3·5 inches.

Gallapagos Islands.

The young shell has the ribs rounded, and not crossed by scales. I have before me an extreme variety in which the spire and canal are both produced and the ribs smooth.
Length, 3·5 inches.

M. MURICATUM, Brod. Pl. 60, figs. 290, 289.

Yellowish or brownish; aperture white or flesh-color, the revolving raised lines usually darker. Length, 2·5–3 inches.

Panama to Mazatlan.

Varies greatly in appearance; the typical form having a very much depressed spire and broad shoulder on the body, the whole surface very scabrous, whilst an extreme variety, described by Gray as *M. tuberculatum* (fig. 289), has more elevated spire, the surface not so scabrous, the ribs broken up into tubercles. Carpenter, in his "Mazatlan Catalogue," refers this species to *Purpura*, on account of the slight development of the horn in the specimens which he studied; R. E. C. Stearns (*Am. Jour. Conch.*, vii, 170) facetiously remarks that this horn is sufficiently prominent in his specimens "to enable the shell to enter the genus *Monoceros* on its own hook." This I can confirm.

M. LUGUBRE, Sowb. Pl. 60, fig. 291.

Yellowish brown, blotched or flamed with chocolate; yellowish brown within the mouth. Length, 1–2 inches.

Pacific and Gulf Coasts of Lower California.

Sowerby's is not the earliest published name for this species, but it is so well known that it had better not be changed.

M. BREVIDENTATUM, Gray. Pl. 60, fig. 294.

Dark chocolate, encircled by three or four rows of widely separated depressed white nodules; aperture bluish within, margin stained with chocolate. Tooth very small.

Length, ·75–1·25 inches.

Panama, and W. Coast of Central America.

M. GIGANTEUM, Lesson. Pl. 61, fig. 301.

Yellowish brown, lighter within. Length, 3–4 inches.

Chili.

M. CALCAR, Martyn. Pl. 60, figs. 295, 292, 293, 296, 297; Pl. 61, figs. 298–300, 302, 303, 307.

Varying from chocolate-brown, through yellowish to white; interior and columella usually white, with frequently a chocolate border within the margin of the lip. Surface in the typical form covered with closely imbricated revolving riblets and the lip but slightly thickened within the margin. Length, 2–2·5 inches.

Cape Horn to Chili.

A species which, like *Trophon Geversianus* from the same region, exhibits much variation. At Cape Horn the typical form, as described above, occurs, and this, when the spire is more exserted, has received from Lamarck the name of *imbricatum* (fig. 296). The surface varies to nearly smooth with simply revolving lines occasionally, becoming *M. striatum* of Lamarck (fig. 302).

On the Chilian coast the species is usually heavier, the whorls very thick, smooth or with revolving striæ or riblets, the outer lip very much thickened within and obscurely dentate. This form may, for convenience, be designated as var. *crassilabrum*, Lam. (fig. 307), although its union with the type is apparent from long series of transition forms. With this must be united *M. glabratum*, Lam. (fig. 300), and *M. globulus*, Sowb. (fig. 298), as well as *M. costatum*, Sowb. (figs. 292, 297). *M. citrinum*, Sowb., is a mere color variation, and *M. acuminatum* of the same author (fig. 303) is a form with more exserted spire.

M. ENGONATUM, Conr. Pl. 61, fig. 304.

Whorls with a carinated shoulder, with revolving striæ and intervening, more or less interrupted, chocolate-brown narrow bands. Aperture white within, lip thickened and dentate.

Length, ·8–1·25 inches.

California, from Bolinas Bay to San Diego.

This is the most northern in distribution of three California species, which are evidently of common derivation. Mr. Stearns, who is excellent authority, considers them distinct, although so very closely related, and as I find that I *can* place every specimen of the numerous individuals before me in its appropriate species, I acquiesce in this arrangement.

The *Purpura spirata* of Blainv. is evidently the same species as *engonatum* and would have precedence according to date of publication, but Conrad's name is so well known in connection with the species that I am unwilling to drop it. Mr. Stearns has designated under Blainville's name what he calls a local variety from San Diego, but it does not seem to me to have sufficient character.

M. LAPILLOIDES, Conrad. Pl. 61, fig. 305.

Shell oval, not shouldered, last whorl inflated, aperture wide, canal very short. Covered with revolving riblets and interrupted chocolate bands or series of square spots; aperture chocolate, but little thickened within the lip, and with or without slight teeth. Length, ·75–1 inch.

Monterey to Catalina Island, California.

M. PAUCILIRATA, Stearns. Pl. 61, fig. 308.

Somewhat shouldered; body-whorl with four or five narrow revolving raised ribs, the interstices of which are chocolate-brown, and generally broken up into squares; aperture light-chocolate, slightly toothed within the outer lip. Length, ·5–·6 inch.

Coronado Isles, off San Diego, Cal., to Todos Santos Bay, L. Cal.

Much smaller than the two preceding forms, with fewer revolving ribs and larger tessellations.

M. TESSELLATA, Lesson.

This species has not been recognized, never having been figured. It is said to come from New Zealand—doubtless a mistake.

M. CINGULATA, Lam.

This belongs to the Turbinelloid genus *Leucozonia.*

Genus **PSEUDOLIVA,** Swainson.

The shell has some resemblance to *Monoceros* in its tooth on the outer lip, and its operculum is purpuroid; it also resembles the *Olivancillariæ* The animal is unknown. H. and A. Adams described a subgenus *Macron*, in which are included several species from the west coast of America, but this group must be eliminated, as the operculum has since been ascertained to be unguiculate. *P. Australis* is now placed among the *Eburnæ* as subgenus *Zemira.* The genus thus limited embraces a few African species, but is found in the eocene of Europe and America.

P. PLUMBEA, Chemn. Pl. 61, fig. 310.

Smooth and polished, with sometimes faintly impressed revolving lines. Yellowish or brownish; white or yellowish within the aperture. Length, 1·25–1·75 inch.

? Africa.

Very probably the two next succeeding species are only different stages of the young of *P. plumbea;* unfortunately the material accessible is not sufficient to permit a definitive conclusion upon this point.

P. STRIATULA, A. Adams. Pl. 61, fig. 311.

Yellowish, no callus on the inner lip; evidently quite immature. Length, ·55 inch.

Africa.

P. SEPIMANA, Rang. Pl. 61, fig. 312.

Dull gray, reddish within the aperture and on the columella. Length, ·75 inch.

Prince's Island, Africa.

P. ZEBRINA, A. Adams. Pl. 61, fig. 306.

Yellowish, with zebra-like longitudinal streaks. Length, ·85 inch.

Africa.

It is a question whether this ought not to be referred, like *P. Australis*, to *Eburna*, under the subgenus *Zemira*.

P. ANCILLA, Hanley.

Yellowish-red; oblong conical, solid, rather smooth; last whorl ventricose, pallid in the middle, widely concave above, slowly narrowing and with a wide sulcus below.

L. 1·63, lat. ·85 inch.

Caffraria.

Said to "remind one alike of *Bullia* and *Ancillaria*. The basal distinctive groove is nearly square-cut; its bottom is closely traversed by wrinkles of increase, and is flat, not concave." Not figured, and I have not seen it.

P. NASSOIDES, Hanley.

Small, solid, conic-oval, smooth, yellowish-red; spire one-third the total length, with somewhat obtuse apex; aperture small, sub-elliptical, narrow; scarcely exceeding half the total length; columella white, thick, without posterior callus but obsoletely uniplicate anteriorly. L. ·37, lat. ·19 inch.

Malabar.

The only specimen "bears the aspect of being fully adult. Its outer lip seems thickened externally, and the tooth-like projection over the characteristic groove is rather conspicuous." Not figured.

Genus **CHORUS**, Gray.

To this group have been referred *Ch. monoceros*, Desh. (= *Monoc. giganteum*, Lesson), *Ch. xanthostoma*, Brod. (= *Trophon*), and *Ch. Belcheri*, Hinds. These three species are certainly representatives of three distinct genera, of which the last only remains to represent the genus. The dentition of *Ch. Belcheri* (Pl. 42, fig. 12), reminds one of the Buccinidæ more than any other group, and is nearest to that of the sub-family Photinæ; but the shell does not bear out this relationship, its spines, peculiar varices and long canal suggesting *Trophon*, from which it is distinguished by having a purpuroid operculum and the tooth of a *Monoceros*. A naturalist fond of making systematic groups might construct for this species a family, to follow, perhaps, Ptychatractidæ and intervening between the latter and Buccinidæ.

In placing it between *Monoceros* and *Pseudoliva* and *Rapana*, I think that I have adopted the best alternative to the course above suggested.

C. Belcheri, Hinds. Pl. 61, fig. 309.

Shell very light brown, sometimes with two obscure darker bands; aperture white within. Length, 3–5 inches.

San Diego to Lower California.

Genus **PINAXIA**, A. Adams.

The shell has some resemblance to *Pyrula pugilina* in form as well as in the revolving raised lines within the aperture, but differs in possessing plications upon the columella. Mr. E. A. Smith has, fortunately,* received specimens with the operculum in situ: this is purpuroid, and definitely settles the proper place of the genus, The animal is unknown, and a description of it and its dentition particularly, is desirable. The plications of the columella only appear upon old specimens, and the tubercles of the shoulder of the body-whorl are not always developed.

P. coronata, A. Ad. Pl. 61, fig. 113.

Shell yellow or white, or clouded with those colors, with, usually, equidistant narrow brown revolving bands; aperture yellowish within. Length, ·75 inch.

Ceylon, Philippines, Polynesia.

I agree with Mr. E. A. Smith that it is not advisable to change the well-known name of this species for the prior one of *versicolor* (*Pyrula*), given by Dr. Gray, the latter not having been figured, nor the description identified with this shell until very lately.

Genus **CONCHOLEPAS**, Lam.

The single species has the basal groove of *Monoceros* and *Pseudoliva* but its margins are defined by two sulci, giving rise to two horns, instead of one, on the edge of the outer lip. The immense development of the last whorl gives the shell a somewhat limpet-like rather than a spiral appearance. In consequence of this great enlargement of the aperture the operculum, which is normally purpuroid in its growth, is entirely unfitted to close

* Ann. Mag. N. Hist., 4 Ser. xv, 301, 1875.

the aperture, and in fact, becomes a useless appendage. The shell is used by the Magellanic tribes as a drinking-cup, and by the Chilians the foot is eaten, being well-beaten to render it tender. Large piles of shells around the cabins of the fishermen testify their appreciation of this mollusk as an article of food. The large foot, like that of the limpets, adheres by suction to rocks, and so tightly that the shell is detached from them with extreme difficulty, unless suddenly removed before the animal becomes aware of danger.

Mr. A. Adams formed a subgenus *Coralliobia* for *Conch. fimbriatus* described by him in 1852; subsequently this subgenus and its type were ranged under *Leptoconchus* in H. and A. Adams' "Genera." This latter disposition I consider correct.

C. PERUVIANUS, Lam.' Pl. 62, figs. 314–317.

Shell brownish, white within. Length, 1–6 inches.

W. C. of S. America, from Peru to Patagonia.

Genus **CUMA**, Humph.

This small group is related by some of its species to *Rapana;* by others, to *Rhizochilus.*

The genus *Cuma* of Humphrey is founded upon a number of species, of which about one-half have been identified and referred to other genera, and no species remains which can be certainly made to represent the group. Mörch,* inasmuch as Milne-Edwards has used the name in Crustacea, in 1828, proposes *Cymia* for these shells. I am not disposed to disturb a well-known name, even under these mitigating circumstances; besides, it is not impossible that Milne-Edwards' genus may itself be superseded by some other name or dismembered, and nothing left of it, as in our old genus *Pyrula.*

Humphrey may not have understood what limits he ought to have given to his genus *Cuma*, and whilst I do not think that he has any very strong claim on us for the recognition of any of his names, I am unwilling to increase the already confused state of our nomenclature by attempting to follow out the absurd and impracticable "rules" of the British Association. Every naturalist

* Mal. Blatt., vii, 98, 1861.

knows that the names of genera in his specialty are repeated in other branches of natural science, and accepted without hesitation, and that we only follow the "rules" by changing a duplicated name occasionally. Besides, no one pretends to be a general naturalist in these days, and the conchologist will not find himself embarrassed by the use of the generic name *Cuma* in any other sub-kingdom of nature, or in all of them, whilst he would be "very considerably bothered" upon encountering the name *Cymia*.

C. KIOSQUIFORMIS, Duclos. Pl. 62, figs. 318, 321, 323.

Gray or brown externally, the revolving ribs sometimes white; chocolate-brown, sometimes disposed in many narrow revolving bands, within the aperture. Length, 1·25–2 inches.

Panama to Mazatlan.

Very variable in form; sometimes short and wide, with a conical spire and much-developed angle on the body, in other specimens with scalariform spire. In all forms the characteristic is the presence of growth-laminæ passing over the sutures and connecting the whorls. Abundant on the rocky shores at Panama, at low water.

C. PURPUROIDES, d'Orb. (= C. FUSIFORMIS, Blainv.).

This well-known species, inhabiting the West Coast of Central and South America, is said to have a fusoid operculum; it will, therefore, be described and figured in Vol. III of this work. Conchologically, the species is very closely allied to *C. kiosquiformis*, Duclos, but may be distinguished at once by its greater size and the want of frills below the sutures.

C. CARINIFERA, Lam. Pl. 62, figs. 319, 320, 324, 325, 327.

Shell yellowish-brown or gray externally; yellowish, sometimes obscurely banded, within. Length, 1·25–2·25 inches.

Philippines, Ascension Isl., St. Helena.

Like the preceding species, it is very variable, developing more or less, either one or two revolving rows of tubercles. It rejoices in eleven specific names, representing essentially different degrees of spinous development and age. The series before me is sufficiently large and miscellaneous in character to prove the identity of all these forms, and that none of the names can stand even as designations of varieties.

C. CORONATA, Lam. Pl. 62, fig. 326.

Yellowish, frequently encircled by numerous narrow brown bands; aperture white or orange within, sometimes incisely striate. Length, 1·25–1·75 inches.

W. Coast of Africa.

I have before me a specimen without tubercles, simply incisely striate. Like *C. kiosquiformis*, the whorls are connected across the sutures by laminæ, but these vary from occasional development, with wide intervening spaces, to a continuous succession of closely appressed layers; the latter state being the *Purpura callifera* of Lamarck.

C. GRADATA, Jonas. Pl. 63, fig. 332, 338.

Whitish, with revolving rows of brown spots; aperture cream-colored, and generally brown-banded within.

Length, 1–1·25 inches.

Singapore, Moluccas, China.

The characters by which M. Petit distinguishes his *Purpura Grateloupiana* (fig. 332), are not at all distinctive. Fig. 338 represents *C. trigona*, Reeve.

C. TECTUM, Wood. Pl. 63, fig. 330.

Chocolate-brown externally, yellowish or chocolate within. The deeply incised external sulcations become internally raised lines. Length, 1·25–2·5 inches.

W. Coast of Central America.

Peculiar in the single, prominent median fold on the columella. The adult is very gibbous and heavy.

C. RUGOSA, Born. Pl. 63, figs. 328, 329, 334.

Yellowish or brownish, dark brown on the tubercles; aperture white within. Length, 1–1·5 inches.

Bombay, Singapore, Java.

Known by many under the name of *C. sacellum*, Chemn., adopted by Gmelin, but *C. rugosa* has priority as a binomial designation, and as several conchologists have already adopted the latter name, I do so likewise. The species is exceedingly variable, but in all stages presents a sloping shoulder to the whorls. This shoulder is defined by a line of tubercles, which are open scales in the finest examples, but become mere rounded knobs in more worn specimens. The inferior revolving ribs are also garnished with either tubercles or scales.

C. MURICATA, Hinds. Pl. 63, fig. 335.

Shell yellowish (dead). Length, ·6 inch.

Panama; in mud, 19 fathoms.

A single specimen dredged by Hinds. It is so exactly like a very young *C. rugosa* that the widely distinct locality appears to be the only distinctive feature. It was described as a *Trophon*, but the specific name in that genus being pre-occupied by Montagu, P. P. Carpenter proposed to change its name to *Trophon Hindsii*.

C. MURICINA, Blainv., = *Ricinula undata*, Chemn.

A number of authors have assigned this species erroneously to *Cuma*; among them Pease,* who quotes among the synonyms *P. turbinata*, Bl., which = *Cuma carinifera*, Lam., and *Purpura foliacea*, Conr., which = *Rhizochilus*.

C. COSTATA, Bl., = *Rhizochilus*.

Genus RAPANA, Schum.

This well-characterized group includes a few species usually found upon coral reefs in tropical seas, and probably living upon the coral polyps.

The *Fusus quadricostatus* of Say (Pl. 64, fig. 341), a common American tertiary fossil and very remarkable shell, is referable to this genus: Conrad has formed for it his genus *Ecphora*.

R. BEZOAR, Linn. Pl. 63, figs. 333, 337; Pl. 64, figs. 339, 340.

Shell spirally ribbed or striate; growth-lines smooth or scabrously foliated; shoulder of whorls flattened. Light brown, usually longitudinally flamed and obsoletely spirally spotted with

* Am. Jour. Conch., iv, 111.

darker brown. Internally white or orange-colored, the lip sulcated. Length, 5–8 inches.

China, Japan, Philippines.

The typical form is ribbed, with foliated growth-lines; a smoother form, simply striate, has been described as a distinct species, but may be designated as

Var. THOMASIANA, Crosse.

Purpura marginata (fig. 337), and *P. venosa* (figs. 339, 340), of Valenciennes, are equivalent, and enough intermediate varieties are before me to establish its identity with the type form. It is sold as food in the markets of Yokohama.

R. BULBOSA, Sol. Pl. 63, fig. 336.

Shell bulbous, shoulder convex; only slightly defined by a a revolving series of vaulted scales or tubercles; suture excavated; spire depressed. Yellowish-brown, clouded; white or orange within. Length, 2·5–4 inches.

China, Japan, Philippines.

More inflated, thinner, smoother than the typical *P. bezoar;* of which it is, perhaps, only a variety.

It is the *Murex rapa* of Gmelin, but not of Linnæus, the latter being the same as *Pyrula papyracea* of Lamarck, belonging to the genus *Rapa*.

Subgenus **Latiaxis**, Swainson.

Whorls more or less detached, carinated; aperture small, trigonal; canal narrow, rather long, curved. The animal and operculum are unknown.

R. MAWÆ, Gray. Pl. 64, figs. 344–346; Pl. 66, fig. 383.

White, yellowish or flesh-color; usually flesh-tinted within. Length, 2 inches.

China, Philippines.

With this species I unite *R. Delesserti* (fig. 346) and *R. purpurata* (fig. 345) of Chenu, as well as *R. De Burghiæ* of Reeve (fig. 383).

R. IDOLEA, Jonas. Pl. 64, figs. 342, 343.

Light brown; covered with close revolving ribs; sometimes longitudinally plicate; periphery angulated or carinated. Length, 1–2 inches.

China, Australia, Philippines.

R. Eugeniæ, Bernardi, *R. nodosa*, Ad., and *R. tortilis*, Ad., are referred to this species by Dr. Gray in a short paper in Ann. Mag. N. H., 1867, in which, in a single paragraph, *R. Mawæ* is referred to as *R. Mairæ*, *R. Eugeniæ* quoted as of Beraud instead of Bernardi, and *R. textilis* substituted for *R. tortilis*, Ad.; whilst the adopted name, quoted as *R. pagoda*, Johnson, instead of *R. idolea*, Jonas, caused me to hunt up all the Johnson papers contained in the Royal Soc. Catalogue. Dr. Gray remarks that these so-called species are founded on single variations, such as the presence or absence of a keel on the body, nodose plications, etc. *R. Eugeniæ* only has been figured (fig. 343). I venture to add *Pyrula fusiformis*, Chenu, which appears to agree well in its characters.

R. Fortuni, A. Ad.

Not figured, and no dimensions given. It is widely umbilicated, imbricated, pink in color, and may be a variety of *R. Mawæ*.

China.

R. rhodostoma, A. Ad. Pl. 64, fig. 347.

Yellowish-brown, with white bands; pink within the aperture. Length, 1·38 inches.

China.

The aspect of this species is so decidedly that of a *Turbinella*, that, although no folds are depicted on the columella, or described, I suspect that it really belongs to that group. In a series of *T. carinifera*, Lam., in the collection of the Philad. Acad., occurs an abnormal specimen entirely similar in the wide, carinated umbilicus.

R. turris, Mörch. Pl. 65, fig. 351.

This was described as a *Coralliophila*, but its similarity to *R. rhodostoma* is sufficiently close to make it probable that it may be more properly arranged in the group of *Latiaxis*.

Length, 1·75 inches.

Hab. unknown; probably coll. near *Montevideo, S. Am.*

R. elegans, Angas.

This species, described in 1878, and well figured, is another of the numerous synonyms of *Rhizochilus bracteatus*, being equivalent to the var. *babelis*.

Genus **RHIZOCHILUS**, Steenstrup.

Dr. Gray remarks of this singular genus that "the shell, while the animal is growing, is free; but when the animals have arrived at their full development, two or more congregate together in groups, each animal forming a more or less irregular, opaque, white, solid shelly extension of the outer and inner lip clasping the axis of the coral, *Antipathes ericoides*, or the neighboring shells, or both, and at length entirely closing the mouth of the shell, and firmly attaching the shells to the coral, or to one another, in such a manner that the animal is completely surrounded by a solid shelly case, having no communication with the outer world but through the case of the anterior siphon of the mantle, which, by the contraction of the mouth of the shell, has been converted into a shelly tube. This self-immurement of the animal within its shell has not been described in any other mollusk, and one is led to inquire if by so doing the animal commits voluntary suicide or has a prolonged existence; if the latter, one should expect that it must be of a very torpid or lingering description, as the animal is entirely precluded from procuring its usual or indeed any other food for its subsistence, and the supply of water for respiration which can enter by the single siphon must be of a very limited quantity, there being only one aperture for its entrance and exit. Many of the lung-breathing mollusca cover the mouth of their shell after the animal is withdrawn during very dry weather with a membranaceous or calcareous epiphragm, the animal during the time sinking into a torpid condition; but these animals have the power, at the first recurrence of damp weather, to remove this cover, which is not the case with the hard shelly secretions which cover up the mouth of the shell of *Rhizochilus*."*

Notwithstanding the decided opinion given by Dr. Gray that the self-immurement of the *Rhizochilus* is permanent, I cannot help thinking that it only continues during a period of hibernation, and as many mollusks have the power of absorbing away partitions in their shells, as well as parts of the columella and the interior thickening of the outer lip, it appears to me that his argument that the hardness and thickness of the prison-walls

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* Ann. Mag. Nat. Hist., 2d Ser., VII, 477, 1851.

would prevent escape, can scarcely be sustained. We do not know how many of the species allied to the type of the genus may partake of this singular mode of growth; it has only been observed in *R. antipathicus.* A large number of species have been grouped by Messrs. H. and A. Adams in a subgenus *Coralliophila*, the character of which is, that they do not (are not known to) form this shelly enclosure. If this supposed difference of habit should be proved by observation, there can be no doubt that the two names should be generically separated. It may be remarked that no lingual denticles have been found in the animals of *Coralliophila*, *Leptoconchus* or *Magilus* examined by Troschel. *Coralliophila* possesses an operculum; I do not know whether the younger stage of *Rhizochilus* has one or not, but the presumption is that it has not.

Several species have been described, besides the type; but as the latter only has been observed with the closed aperture, I think it better to refer the others to *Coralliophila.*

R. ANTIPATHICUS, Steenstrup. Pl. 65, figs. 348–350.

Shell thin, whitish. Length, 1 inch.

When adult, grasping the axis of *Antipathes ericoides.*

Subgenus **Coralliophila**, H. and A. Ad.

A large number of specific forms have been described, many of which have not been figured. Judging from the extreme variability of the well-known species both in form and sculpture, it may be anticipated that most of the more recently characterized species will prove to be synonyms, and as the diagnoses alone are insufficient for their determination, I have placed the names of these species at the end of the genus, as doubtful.

C. NERITOIDEA, Lam. Pl. 65, figs. 353, 355, 356; Pl. 66, fig. 375.

White; light purple within the aperture.

Length, 1–1·5 inches.

Central Pacific.

Purpura violacea, Kiener (figs. 353, 375), is undoubtedly the same species and *P. gibbosa* (fig. 356) is a form with the scabrous revolving striæ well developed. *Trichotropis Orbignyana*, Petit (= *Purp. Trichotropoides*, Montr. (fig. 355), from New Caledonia is the latter form not yet adult.

C. PORPHYROLEUCA, Crosse. Pl. 66, figs. 369, 370.

Yellowish white, externally; columella and interior rose-tinted. Length, ·88 inch.

Tahiti.

C. BULBIFORMIS, Conrad. Pl. 65, figs. 357, 359, 360.

Colors as in last species. The spire is more raised and the shell is longitudinally ribbed. Length, 1–1·25 inches.

Sandwich Isles to Tahiti, New Caledonia.

C. ELABORATA, H. and A. Adams.

Shell ovate-conic; solid, white, obliquely longitudinally plicate; with revolving scabrous liræ, the scales of which are produced and aculeate on each side, making the liræ biserrate.

Sandwich Islands.

Not figured; evidently allied to *C. bulbiformis.*

C. CALLAOENSIS, Gray. Pl. 65, fig. 358.

Light brownish white, without and within. Length, 1 inch.

Gallapagos Isles, Peru.

In form not unlike *C. neritoidea*, but has not the violet aperture of that species, and is very faintly longitudinally nodose or ribbed.

C. GALEA, Chemn. Pl. 65, figs. 363, 362, 364.

Shell yellowish white externally; white, frequently tinged with light yellow or light pink within the aperture.

Length, 1–2 inches.

Philippines, Central Pacific, West Indies.

There can be no doubt of the specific identity of the West Indian with the Pacific shells; of the former, I have before me numerous specimens from St. Thomas, St. Croix, Bahamas and Nicaragua. Chemnitz is not a binomial author, and according to priority his name should yield to *C. abbreviata*, Lam., but it has become so well known that its displacement would become an injury to science.

The young shell is *Murex plicata*, Wood; and in this stage the spire is conically elevated, the shoulder of the body-whorl more distinct, below which the shell rapidly narrows to the base, the umbilicus and its ridge scarcely defined.

Possibly *Purp. aberrans*, C. B. Ad., is a still more juvenile state of this species. *C. nodulosa* and *C. salebrosa* of H. and A. Adams, from Guadaloupe, W. I., can both be identified with *C. galea*.

C. deformis, Lam., is treated as a distinct species by Pease, and he refers to it his *C. exarata* (fig. 364) as a synonym, but it is only a monstrosity of *C. galea;* to which *Purpura scalariformis*, Lam., may be also referred.

C. COSTULARIS, Lam. Pl. 65, figs. 365, 366.

Shell white, tinged with yellow or purple; aperture light purple. Length, ·85–1·35 inches.

Philippines, Australia, Central Pacific.

C. undosa, H. and A. Adams, said to come from Sandwich Isles, seems to agree with this species in description, and *Murex planiliratus*, Reeve (fig. 366), is certainly the same.

C. BRAZIERI, E. A. Smith. Pl. 70, fig. 436.

White, the liræ reddish-brown; aperture white.

Length, 44 mill.

Habitat unknown.

Described as a *Fusus*, but appears to be very closely related to *C. costularis*, Lam.

C. CONSTRICTA, Koch. Pl. 70, fig. 434.

Orange-brown. Length, 40 mill.

Habitat unknown.

Described as a *Fusus*, yet I think that the figure justifies me in placing it in *Coralliophila*, and that it has a decided resemblance to *C. Fritschi*, Martens.

C. FRITSCHI, Martens. Pl. 65, fig. 352.

Light rosaceous. Length, 32 mill.

False Bay, South Africa.

Described from a single, evidently worn specimen. It does not appear to me to be sufficiently distinct from *C. costularis*.

C. CONSTRICTA, Koch. Pl. 70, fig. 434.

Orange-brown. Length, 40 mill.

Habitat unknown.

Described as a *Fusus*, yet I think that the figure justifies me in placing it in *Coralliophila*, and that it has a decided resemblance to *C. Fritschi*, Martens.

C. JEFFREYSII, E. A. Smith. Pl. 66, fig. 371.

Light reddish brown; bluish white within the aperture.

Length, 20 mill.

Japan.

This small shell has so much affinity with *C. costularis*, and the variations of form, sculpture and color are so great in this genus, that I much doubt its distinctness.

C. INFLATA, Dunker. Pl. 66, fig. 367.

White; yellowish white within the aperture.

Length, 1·25 inches.

Java.

A wider shell, with more numerous ribs than *C. costularis;* of which it may prove to be only a variety.

C. SQUAMOSISSIMA, E. A. Smith. Pl. 65, fig. 354.

Ovately fusiform, narrowly umbilicated; white.

Length, 31 mill.

Ins. Rodriguez.

Said by the author to be allied to *C. inflatus*, Dunker, "but the sculpture and proportion of the aperture to the shell is very different." Neither of these differential characters appear to me to be of much weight in this genus.

C. PACHYRAPHE, E. A. Smith. Pl. 70, figs. 441, 442.

Varices eight or nine, nodulous at the crossing of the imbricately squamous revolving ridges. Lip margin crenulated; six short liræ within the aperture. Light brown, pale at the angulation of the whorls; fleshy brown within the aperture; columella livid pinkish. Length, 16–21 mill.

Japan.

Described as a *Fusus*, which it certainly is not. I think it may be placed in this genus, although it also somewhat resembles *Ocinebra.*

C. IMBRICATA, E. A. Smith. Pl. 70, fig. 440.

Brownish white, darker on the ribs; aperture white, columella brown. Length, 27 mill.

New Caledonia.

Described as a *Fusus*, but I think it may be better placed here or in *Cuma.* Closely related to the foregoing species.

C. NUX, Reeve. Pl. 66, fig. 368, 374.

Shell white, without and within. Length, ·75–1 inch.

Mazatlan to Panama, Gallapagos Isles.

This solid, white little shell has many synonyms ; among them, *C. osculans*, C. B. Ad., *C. distans*, Carp., *C. niveus*, *C. Californica* and *C. asper* of A. Ad., and *C. parva* of E. Smith (fig. 374) from Gallapagos.

C. CORONATA, Barclay. Pl. 66, figs. 373, 372.

Light rose-purple, darker within the aperture.

Length, ·88–1·25 inches.

Mauritius.

The form of this shell is very distinct. I unite with it *C. Barclayana*, H. Ad. (fig. 372), from same locality ; being merely a better grown or older specimen. E. A. Smith has referred to *C. Barclayana*, a specimen collected at the Andaman Islands, and removes the species to the genus *Muricidea*.

[Genus **PSEUDOMUREX,** Monterosato.]

An aberrant form, referred by authors to *Murex*, to *Coralliophila* and to *Latiaxis.* I cannot find any good characters by which to separate it from *Coralliophila.* It includes four species and numerous varieties, all inhabiting the Mediterranean Sea.

C. BRACTEATA, Brocchi. Pl. 66, figs. 378–380, 384, 386.

Whitish or yellowish. Length, 1–1·3 inches.

Mediterranean ; found on corals at considerable depths.

Very variable in form and ornamentation. Monterosato has distinguished six varieties, which have mostly been described as species :

Var. 1. *C. lamellosa* (Jan), Phil. (figs. 378, 385).
Var. 2. *C. minor*, Mont.
Var. 3. *C. lacerata*, Desh. (fig. 379).
Var. 4. *C. Babelis*, Requien. (fig. 380).
Var. 5. *C. Panormitana*, Mont.
Var. 6. *C. brevis*, Bl. (fig. 384).

C. MEYENDORFFI, Calcara. Pl. 66, fig. 382.

Whitish. Length, 1–1·5 inches.

Mediterranean, Canaries, Madeira.

Aradas and Benoit state that this species, instead of being found at great depths as *C. bracteata*, is littoral.

It is usually known as *Murex scalaris*, Brocchi, but that shell is a fossil and entirely distinct.

P. Sophiæ, Aradas and Benoit. Pl. 66, fig. 381.

Very rare. Length, 1·5 inch.

Palermo.

Distinguished by its ventricose form, numerous ribs, cauda and closed reflexed canal. Monterosato, Kobelt, etc., consider this = *Hindsia nivea*, Pfr., an exotic shell: they are probably correct; still I insert the species here.

P. Spadæ, Libassi.

Described as a fossil, but recently found living. I do not know the species. It has been referred to *Tritonidea*.

Mediterranean.

Species of Coralliophila unidentified.

C. madreporina, A. Ad. = *Rhizochilus coralliophila*, A. Ad. (*Philippines*), C. senticosa (*Bombay*), C. confragosa (*Hab. unknown*), C. asperrima (*Hab.?* resembles *C. scalariformis*, Lam.), C. retusa (*Hab. unknown*), all of H. and A. Adams.

C. radula (*China*), C. pulchella (*Philippines*), C. suturalis (*Philippines*), C. scala (*Juan Fernandez*), C. fragilis (*Philippines*), C. clathrata (*Philippines*), all of A. Adams.

None of these species are figured, and in a genus in which the form and sculpture of the species are so variable, it is very unsafe to endeavor to identify them by descriptions only. Probably most of these names, founded on ideas of the immutability of specific characters which no longer obtain credence, will become synonyms.

Subgenus **Galeropsis**, Hupé.

I venture to place under this name the *Rhizochilus madreporarum*, Sowb., which possesses differential characters from both *Rhizochilus* and *Coralliophila*. The young shell is free, and not unlike a *Coralliophila*, and in this stage it has a small, thin operculum with lateral nucleus. The animal has a short siphon which scarcely projects beyond the canal. It is sluggish in its movements. As it matures it becomes attached to the coral, on which it lies and adheres with great tenacity, often allowing the foot to be torn away before releasing its hold. The conformation of the lip corresponds exactly with the irregularities of the place of adhesion. Upon removing the animal, scars will be noticed on the coral, more or less worn by the abrasion of the shell, and old specimens will be found to have deposited a shelly base. When removed, the animal is very timid and never wholly expands. It can only partly withdraw behind the columella-shelf, leaving a portion of the mantle and foot exposed. The foot is small, of an oval form, thick and fleshy. The tentacles rapidly taper to a fine point, on which the eyes are sessile a little beyond the middle of their length. The foot is tinged with pale orange, dotted with white along the upper margins. The mantle is colorless centrally, tinged with orange along the margins and dotted with white, the dots crowded anteriorly and becoming more and more remote posteriorly. The operculum is of a pinkish violet color. The foot has a well-developed duplication in front. Such is the description given by Mr. W. H. Pease,* who places the species in *Rhizochilus* proper; but it appears to me to differ from that genus in the excavated, shelf-like columella, the expanded continuous lip of the adult (very like *Concholepas*) and in not closing up its aperture with shelly matter when mature. In the expanded lip, flattened columella and tooth-like projection of the basal margin of the latter it well agrees with Hupé's genus *Galeropsis*, a tertiary fossil, the type of which I figure:

GALEROPSIS LAVENAYANUS, Hupé. Pl. 67, figs. 387, 388.

It also has considerable affinity with Mr. Gabbs' cretaceous genus *Lysis* (which I have already figured and described).

R. MADREPORARUM, Sowb. Pl. 67, figs. 389–391, 394.

White externally, tinged with purple on lip, columella and within the aperture. Length, ·75–1·25 inches.

Indian Ocean, Japan, Central Pacific.

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* Am. Jour. Conch., IV, 112.

Genus **SEPARATISTA**, Gray.

The animal is unknown, and the relationships of the genus are doubtful.

S. Grayi, A. Adams.

Shell with the spire depressed, whorls with five transverse keels; aperture transversely oblong; inner lip reflexed, anteriorly rounded.

Cape of Good Hope.

Not figured.

S. Chemnitzii, A. Adams. Pl. 68, fig. 398.

Shell with the spire elevated, whorls with three transverse keels; aperture subcircular; inner lip somewhat reflexed, anteriorly produced and angulated.

Isle of Burias, Philippines.

S. laxa, Say. Pl. 68, fig. 399.

Nearly glabrous; yellowish-white; a dilated, rugose groove on the line of the umbilicus. Length, ·9 inch.

Coast of South Carolina.

Only a single specimen obtained. Mr. Say suggests that it may be a scalariform *Natica*. May it not rather be a valve of the fossil genus *Diceras*, one of the Chamidæ?

S. Blainvilleana, Petit.

Tricarinated on the body-whorl, bicarinated on the spire; membranaceous, transparent; rosaceous under a corneous epidermis. Length 7·5, diam. 10 mill.

Marianne Isles.

Something like *S. Chemnitzii*, A. Ad., but with more elevated spire.

Genus **MELAPIUM**, H. and A. Adams.

This genus was instituted for the *Pyrula lineata* of Lam.; the animal and operculum of which are unknown. Its systematic position is very doubtful. It has the porcellanous texture of *Pusionella*; from which, however, it is distinguished by its ventricose body-whorl and short papillary spire.

M. lineatum, Lam. Pl. 67, fig. 395.

Smooth, porcellanous, yellowish-white, longitudinally streaked with brown; columella violet-tinted. Length, 2–2·5 inches.

East Indies.

Genus **WHITNEYA**, Gabb.

This fossil genus is said by its author to be related, probably, to *Fasciolaria*, but I agree with Stoliczka that its nearest apparent ally is *Melapium;* from which I can only separate it geologically.

WHITNEYA FICOIDES, Gabb. Pl. 68, fig. 397.

Cretaceous, *California*.

Genus **RAPA**, Klein.

This, like the preceding genus, has only one properly authenticated species; but that, is unquestionably very closely related to *Leptoconchus*. The operculum is of the normal purpuroid type, but like the shell, very thin, translucent and yellowish white.

R. PAPYRACEA, Lam. Pl. 67, figs. 393, 396, 392.

Shell very thin, covered by variable revolving striæ or ribs, which, towards the base, become scabrous; sutures also scabrous. White or light yellowish, frequently tinged with rose-pink towards the base. Length, 1·75–2·75 inches.

Indian Ocean, China, Philippines.

Being very thin, the shell of this species is peculiarly liable to distortion. The *Bulbus incurvus* of Dunker (fig. 396) I can only regard as one of these variations of form. I give a copy of the original figure of it. I copy below the description of another species, which does not appear to possess good distinctive characters.

R. BULBIFORMIS, Sowb.

Subglobose, spirally imbricately lirate below; spire produced; whorls six, rounded; aperture somewhat narrowly pyriform; lip crenulate below.

Tongataboo, Friendly Isles.

Has a much more produced spire than the known species; with rounded whorls. I am not acquainted with it; has not been figured. May = *R. papyracea.*

Genus **MAGILUS**, Montfort.

In the "Genera of Recent Mollusca," the authors, following Ruppell, distinguish the species of *Leptoconchus* from the single species of *Magilus*. They thus describe the animal of the former:

The mantle margin is greatly thickened and fleshy; the tentacles are small, broad and united at their bases; the eyes are small and black, on the outer side of the tentacles, near their tips; the foot is small, short, obtuse and rounded behind, with a thin, expanded, disk-like lobe in front, and the siphon is obsolete. The genus differs from *Campulotus* (*Magilus*) not only in the absence of the operculum, but in the shell never forming a long tubular projection of the mouth as in that genus. It comprises but few species, which take up their abode in corals and madrepores.

Deshayes, in his "Conchology of the Island of Bourbon," 1862, describes a number of species of *Leptoconchus* as well as the anatomy of one of them, confirms the non-existence of the operculum and sustains the separation from *Magilus*.

On the other hand, that experienced conchologist, Mr. G. B. Sowerby, in his introductory remarks upon the genus *Magilus*, in Conch. Iconica, xviii, 1872, unites *Leptoconchus* with that genus. He says:

The habits of this genus of mollusca are very curious. The young fry, after a short period of free locomotion, seems to find its way into some hole in a growing madrepore, and then to become stationary; but as the substance grows around it, it would soon become enclosed unless the growth of the shell kept pace with that of the madrepore. In order, therefore, to keep its aperture close to the surface, the two lips are extended in the same direction in the form of an irregular tube. The *Magilus* leaves its shell in the original cavity, and filling it up (with shelly material) so that it becomes solid, occupies only that portion of the tube which is nearest to the opening. The walls of the tube are thickened, and the portion which represents the canal is consolidated into a thick keel. The species which have not been found as yet in an advanced state, and which appear generically to resemble the young shells of *Magilus antiquus*, have been separated by authors under the generic term *Leptoconchus;* and it is asserted that while the *Magilus* possesses an operculum, the *Leptoconchi* do not. It is also said that the young shell of the *Magilus* begins to form a thickened and entire edge to its aperture, as if preparing for the future erratic course of its shell. It appears to me, however, that it depends upon the accidental conditions of habitat and growth whether and at what period of life the shell of a *Magilus* shall become tubular; and as for the operculum, it is certain that some, if not all, the species enumerated as *Leptoconchus* by authors have been found with opercula; notably, we have figured the genuine operculum of *L. Lamarckii*, Desh. The Isle of Bourbon, the Mauritius and Sandwich Islands—perhaps most islands with reefs—afford homes to the Magili.

We agree with Mr. Sowerby; indeed, it would be impossible to designate from the shells which species should be referred to *Leptoconchus* and which ones to the juvenile condition of *Magilus*. It is probable that the development of the tube is accidental, and it is equally probable that, as in *Conus*, the operculum is not always developed. Troschel has not discovered any indication of armature upon the lingual ribbon. So irregular are the shells of the Magili and so much is their growth influenced by the circumstances of their habitation that all the species that have been differentiated from *M. antiquus* must be regarded with suspicion. When immense numbers of specimens, from different localities, and collected with a view to coallescence rather than to differentiation shall have been compared, we shall be able to assign definite places to the species which we are now compelled to take on probation.

M. ANTIQUUS, Lam. Pl. 68, figs. 400–411.

Red Sea, Isle of Bourbon.

M. Djedah (fig. 403) and *M. tenuis* (fig. 404), Chenu, are certainly synonymous. *M. microcephalus*, Sowb. (fig. 401), is separated with some doubt by its author on account of the small size of the spiral nucleus and rapid enlargement of the tube; but I think that the position taken by the mollusk, in this case was so restricted as to prevent spiral growth to the usual dimensions, and the sudden increase in the size of the tube is evidence that such was the case.

M. Cuvieri, Deshayes (fig. 405), is a well-formed young specimen from the Isle of Bourbon. *M. ellipticus*, Sowb. (fig. 408), *M. striatus*, Rüppell (fig. 406), *M. Peronii*, Lam., *M. serratus*, Desh. (fig. 407), *M. rostratus*, A. Ad. (figs. 409, 410), *M. Schrenkii*, Lischke (fig. 411), are all too close in form, and had better be considered synonyms. The latter is from Japan.

M. COSTATUS, Sowerby. Pl. 69, fig. 421.

The revolving costæ are perhaps simply a pronounced form of the somewhat evanescent lines or striæ which frequently occur on *M. antiquus*. The costæ continue on the tube.

Hab.?

M. Cumingii, H. and A. Adams, described as from California, is evidently the same species, and probably described from the same specimen. The name had already been used by Deshayes, I therefore prefer to retain Mr. Sowerby's later name *costatus*.

M. RUPPELLII, Deshayes. Pl. 68, fig 412; Pl. 69, figs. 414, 418.

I unite with this form *M. Cumingii* (fig. 418), and *M. globulosus* (fig. 414), Desh.

The spire is sometimes depressed so as to make the distinction from *M. antiquus* arbitrary, and the body-whorl is narrowed below, and somewhat produced in some specimens so as to suggest a passage into the next form.

Isle of Bourbon.

Mr. Sowerby's fig. 1 *b.*, in the Conch. Icon. (fig. 413), appears to me to represent this form, although I do not dispute his determination of it as *M. antiquus*.

M. MAILLARDI, Deshayes. Pl. 69, figs. 416, 415, 417.

The type is a depauperate shell, somewhat distorted, the normal growth being better shown in *M. Lamarckii*, Desh. (fig. 415), and *M. solidiuscula*, Pease (fig. 417). I have before me a series connecting these species. I have already suggested their relationship through *M. Ruppellii* with *M. antiquus;* on the other hand some transition forms to *M. fimbriatus* are not wanting.

Isle of Bourbon.

M. FIMBRIATUS, A. Ad. Pl. 69, figs. 419, 420, 422, 423.

The fimbriated, ribbed surface, in the type, the great expansion of the body-whorl and large aperture suggest the genus *Concholepas*, and Mr. Adams originally made a subgenus *Coralliobia* under *Concholepas*, for his species; afterwards H. and A. Adams made *Coralliobia* a subgenus of *Leptoconchus*. The shell is very like *Coralliophila madreporarum*, which I have placed in the subgenus *Galeropsis*, Hupé, but differs in the surface and in color. The expansion of the lip does not appear to be uniform;

hence in other stages of growth, additional specific names have been made. *M. Robillardi*, Liénard (figs. 422, 423), is one of these less-developed stages. *Coralliobia cancellata* and *sculptilis* of Pease, neither of which have been figured, present no distinctive characters in the descriptions, and may be here included.

Genus **MAGILINA**, Vélain.

The species which forms the type of this new genus is much smaller than those of *Magilus*. The distinctive characters consist in the spiral shell having one whorl only and in the fixed adult being attached by one side of the tube to the external surface of submarine objects instead of growing in their interior. This is a great change of habit, and the animal may prove to have no relationships with *Magilus* but rather with the *Vermetidæ*. I do not know how closely it may be related to *Nisea*.

M. SERPULIFORMIS, Vélain. Pl. 69, figs. 425, 426.

Shell at first thin, transparent, deep red-brown; growing into an irregular tube affixed by its side to shells, etc., and then becoming whitish. Length 3–4 mill., diam. 1·25 mill.

Isles of St. Paul and Amsterdam, Indian Ocean.

Animal and operculum unknown.

Genus **NISEA**, Marcel de Serres.

A fossil of very doubtful affinities, of which two species have been described.

N. SIMPLEX, M. de Serres. Pl. 69, fig. 424.

Lower Crag, *vicinity of Nimes.*

INDEX AND SYNONYMY.

ADDENDA.

Additional Species of Murex.

M. Bednalli, Brazier. Proc. Linn. Soc. N. S. Wales, II, 6, 1877.

This is a beautiful species of the *Pteronotus* section, having closely frilled, thin, produced varices, and revolving ribs. The color is brownish white, stained chestnut-brown on the varices.

Length, 3 inches.

Hab., Port Darwin, N. Coast of Australia.

The general appearance of this shell is more like *Cerostoma foliatus*, Mart., than any other species. The Proceedings in which the description is published, had not been received by the Philadelphia Academy when my text was issued, consequently it would have been omitted altogether but for the kindness of Mr. Brazier, who sends me a beautiful colored drawing—unfortunately too late for insertion in my plates.

M. contractus, Reeve. I have been misled by an error in numbering the species in the Conchologia Iconica into describing and figuring (p. 131, f. 473) *Buccinum ligneum* of Reeve as a synonym: it should bear the name of *Buc. ustulatum*, Reeve, instead.

Urosalpinx ficula, Reeve. *Fusus Winteri*, Dunker appears to be the same species, and if so, has a year's priority of publication.

Sinusigera.

S. CALEDONICA, Crosse. Jour. de Conch., xxviii, 146, t. 4, f. 2, 1880.

In describing the above species, M. Crosse dissents from the general belief that the genus is synonymous with *Cheletropis.* The former, says he, by its well formed spire, with nuclear apex and thickened lip appears to be adult, whilst the latter, thin and transparent, is probably the larval state of a pelagic species.

Purpura.

P. HÆMASTOMA, Linn. A more critical examination of the figure of d'Orbigny's *P. viverratoides* convinces me that the species has been incorrectly identified by me. It has been referred to *Cantharus variegatus* by several conchologists, and is doubtless that species. A shell of the same general form as *viverratoides* is, however, a frequently occurring variety of *hæmastoma.*

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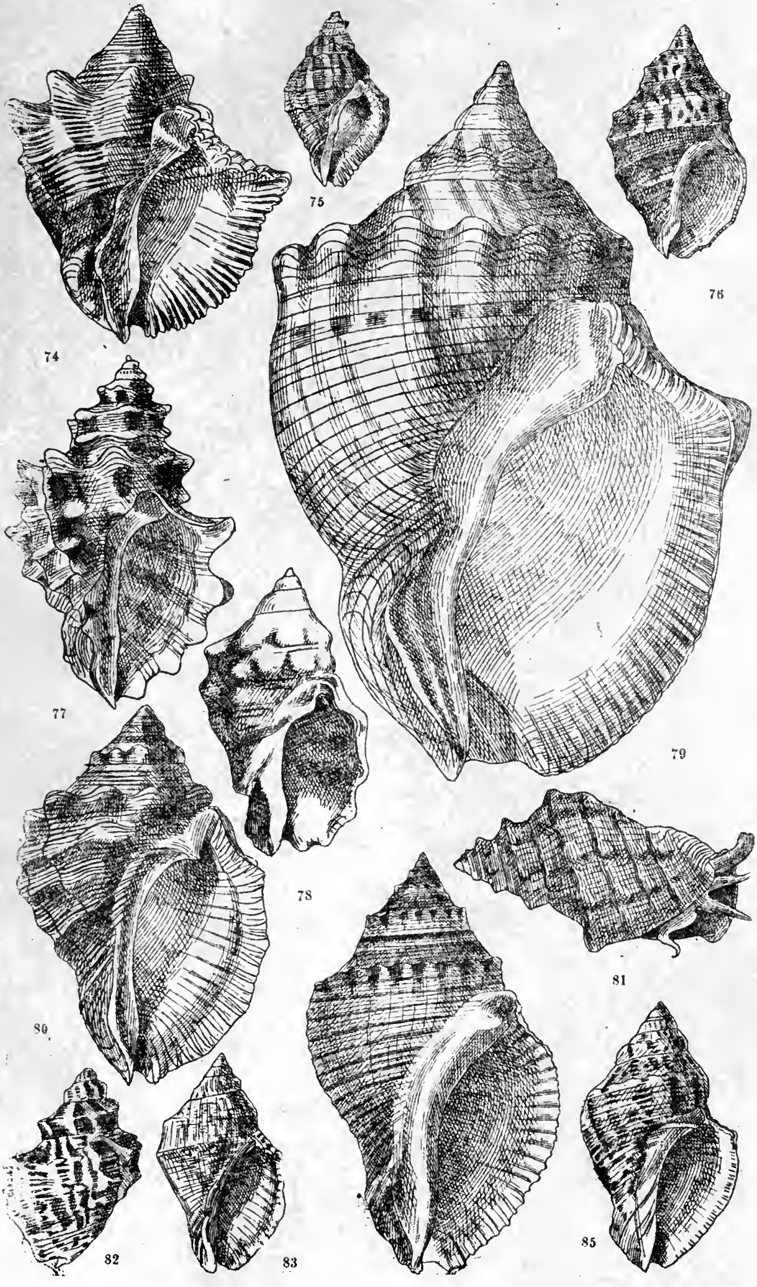
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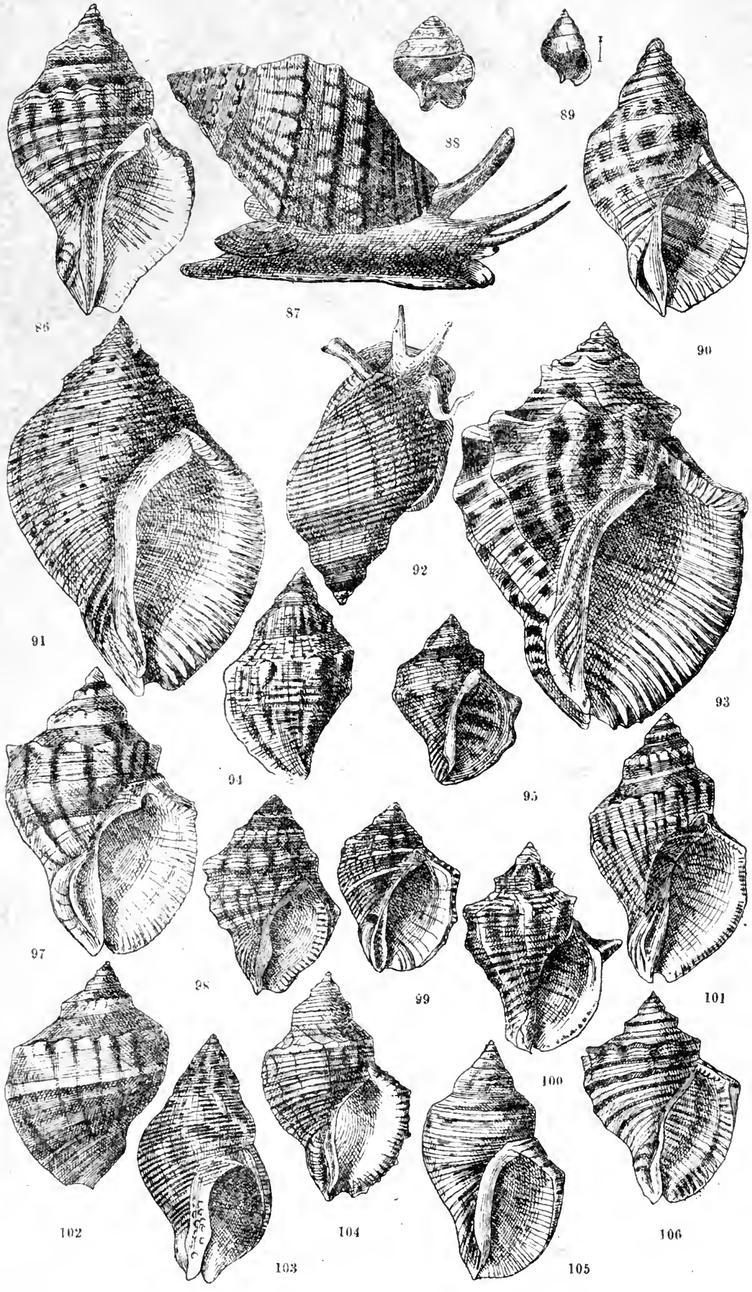

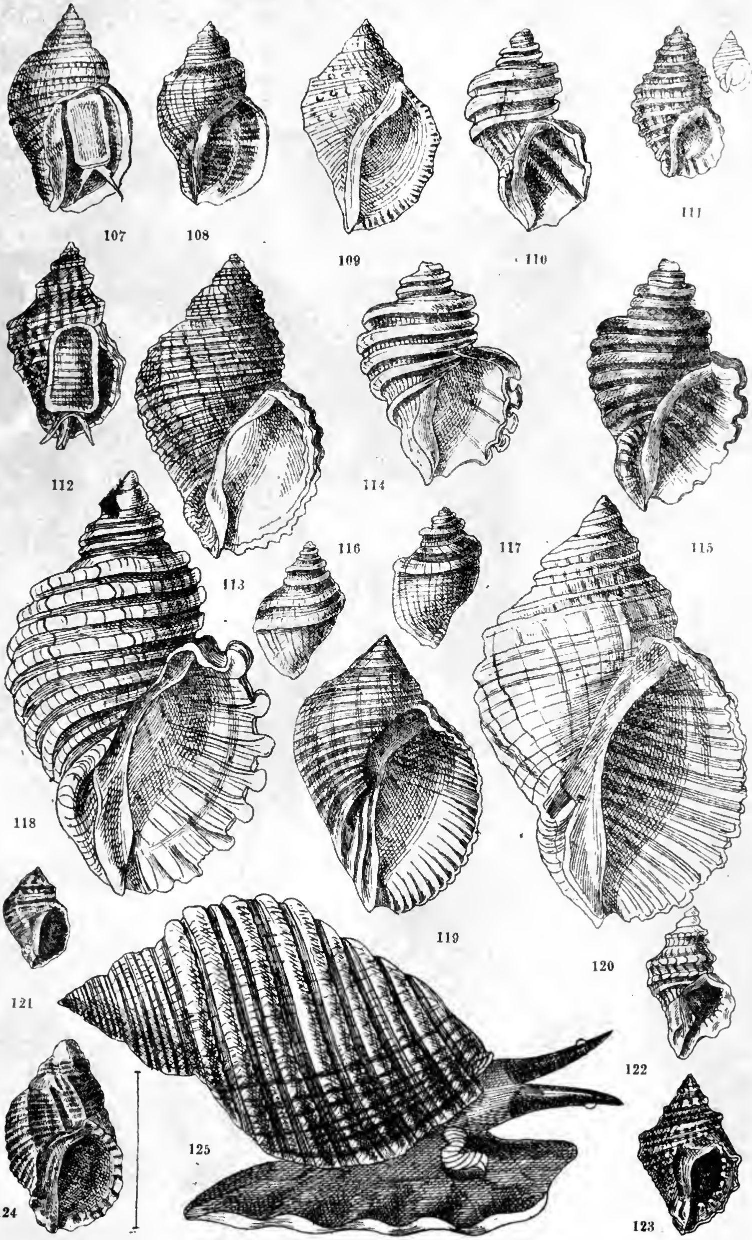
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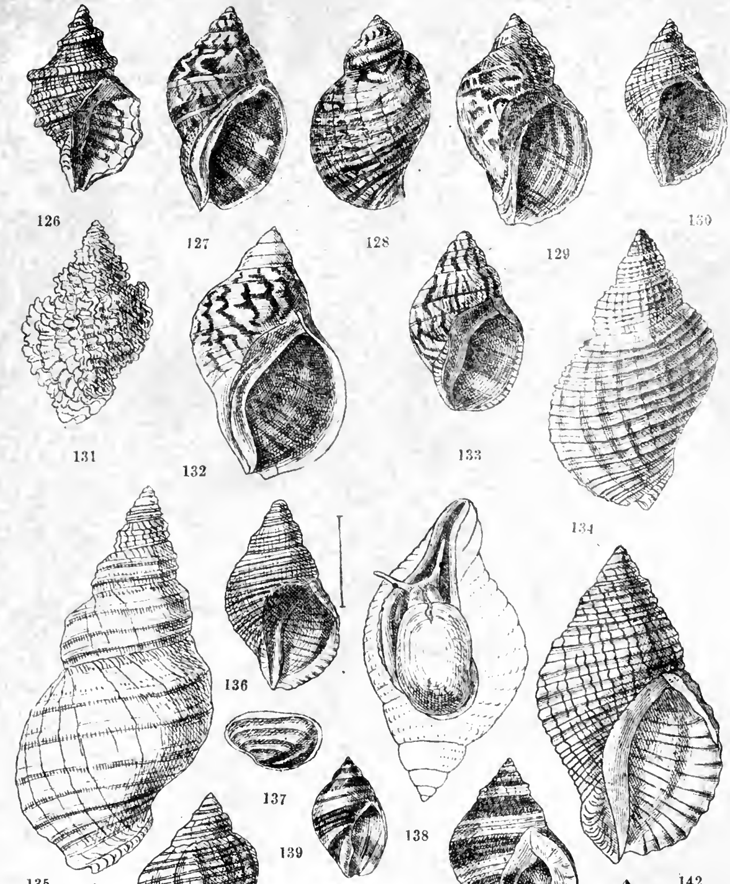

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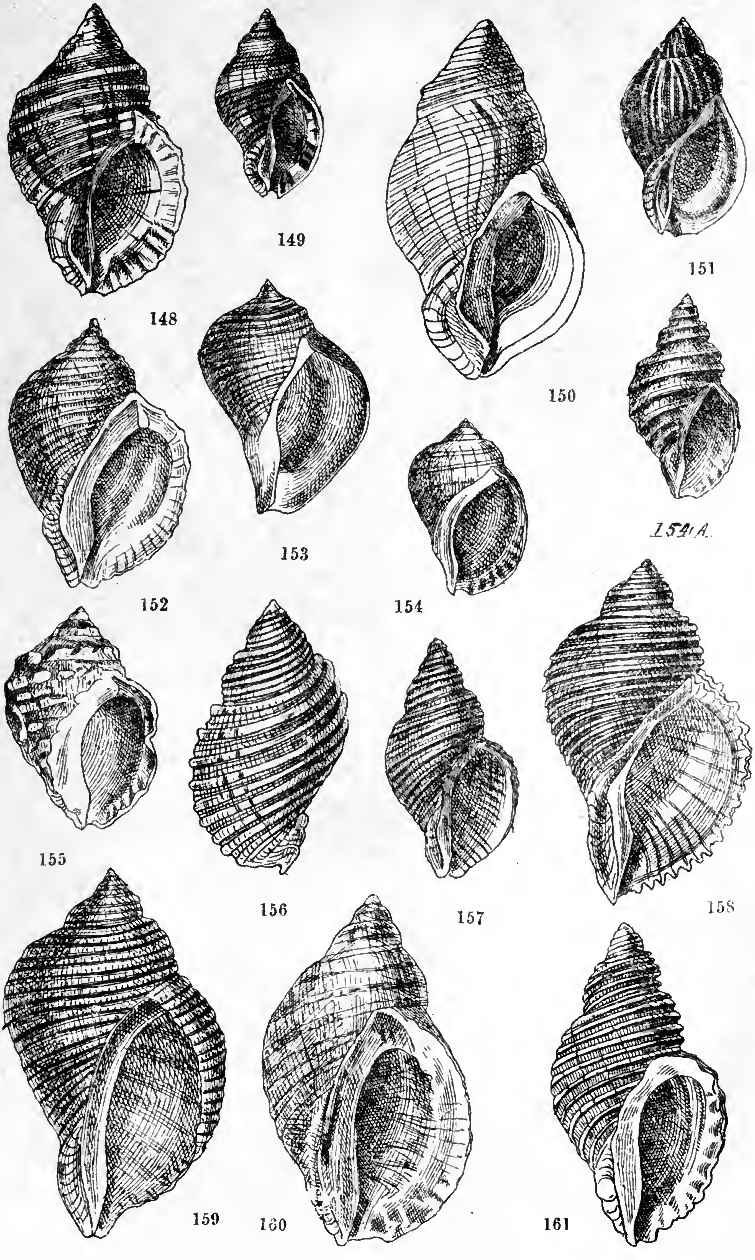


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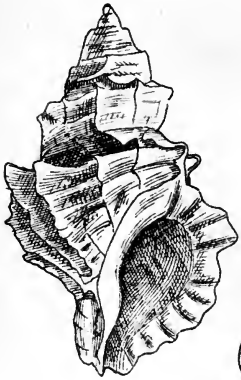
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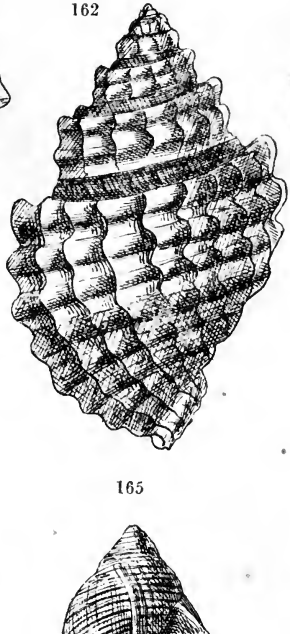
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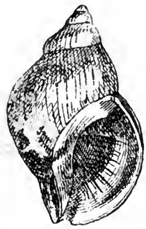
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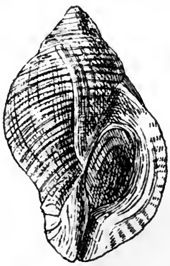
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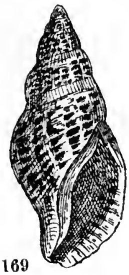
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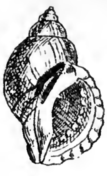
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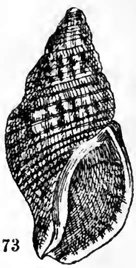
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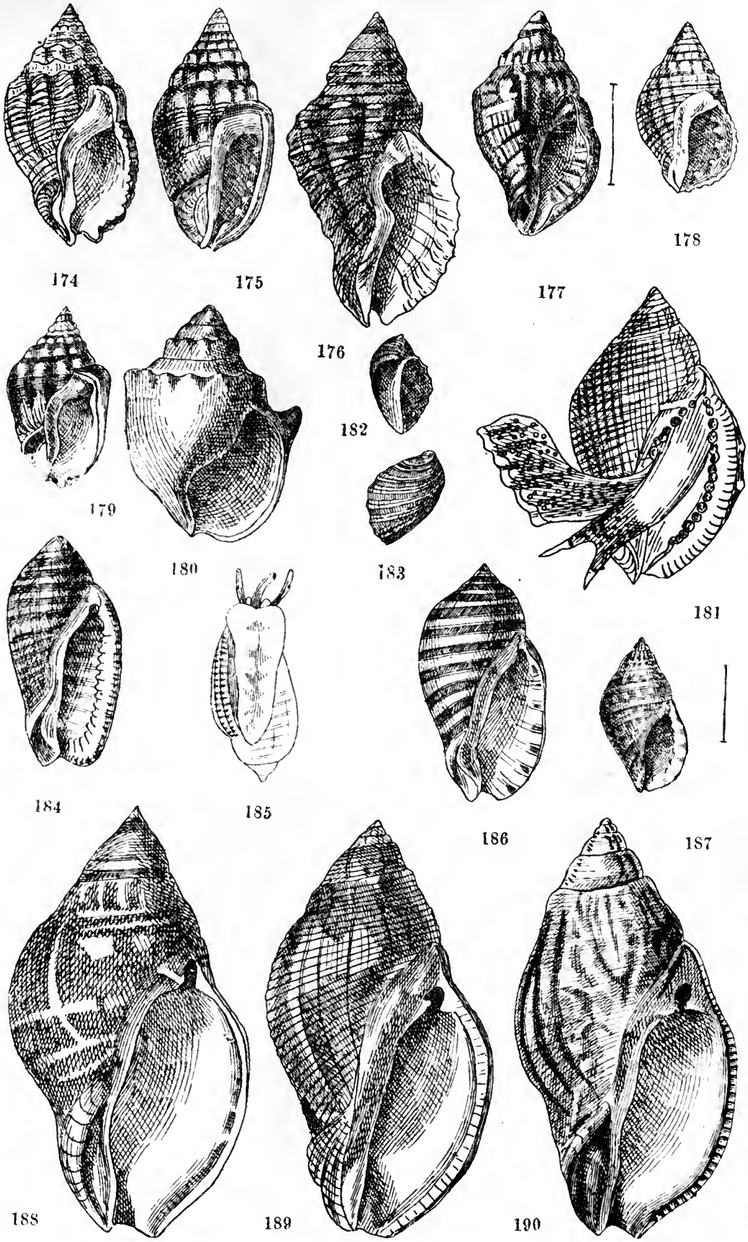

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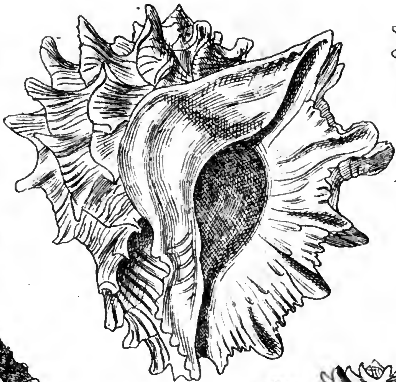

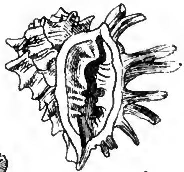

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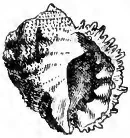

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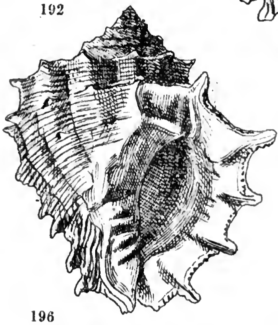

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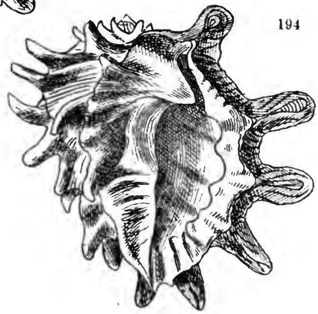

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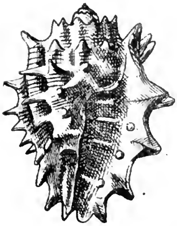

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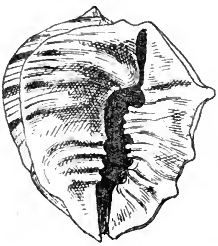

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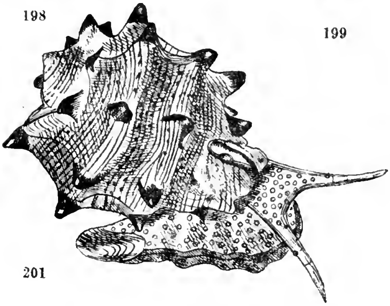

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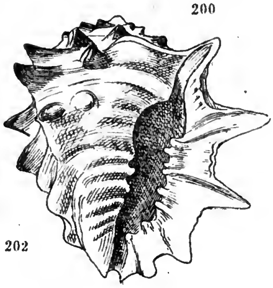

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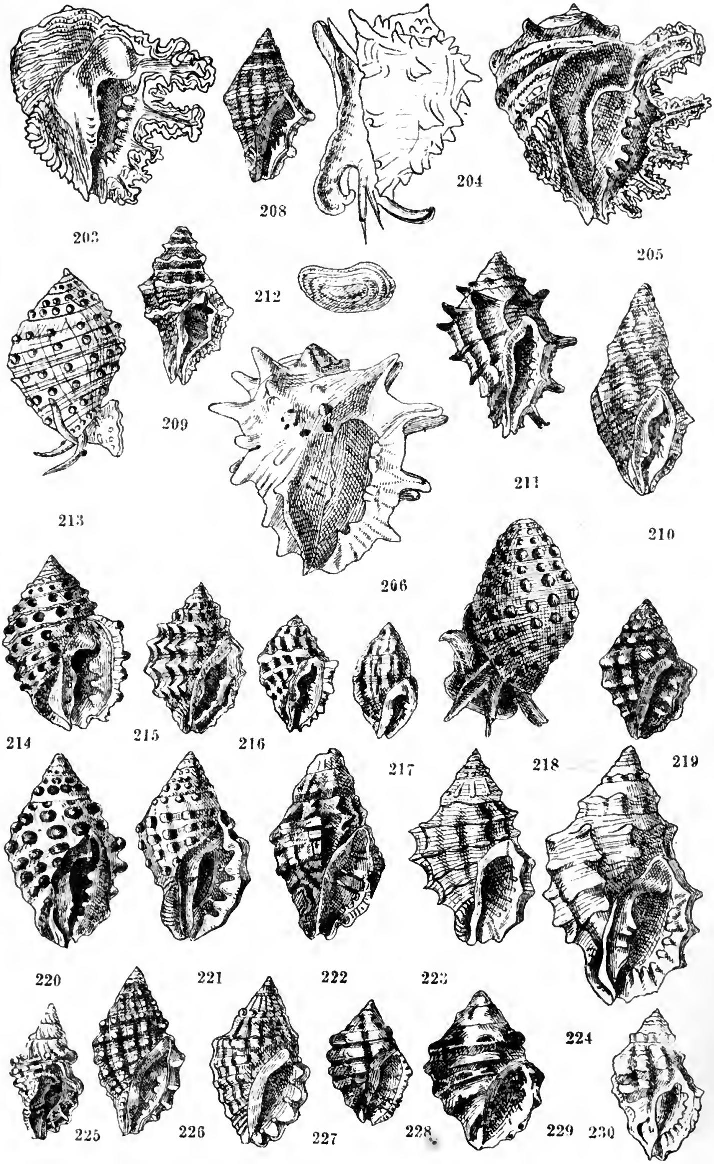
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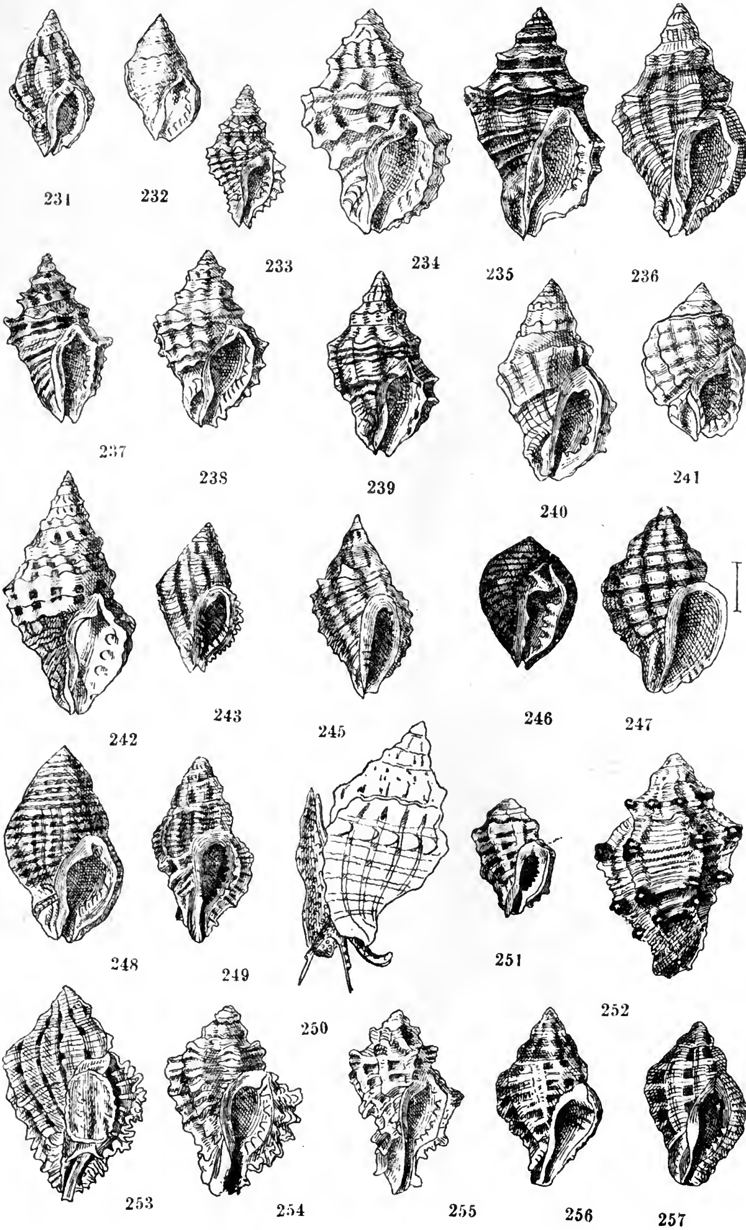
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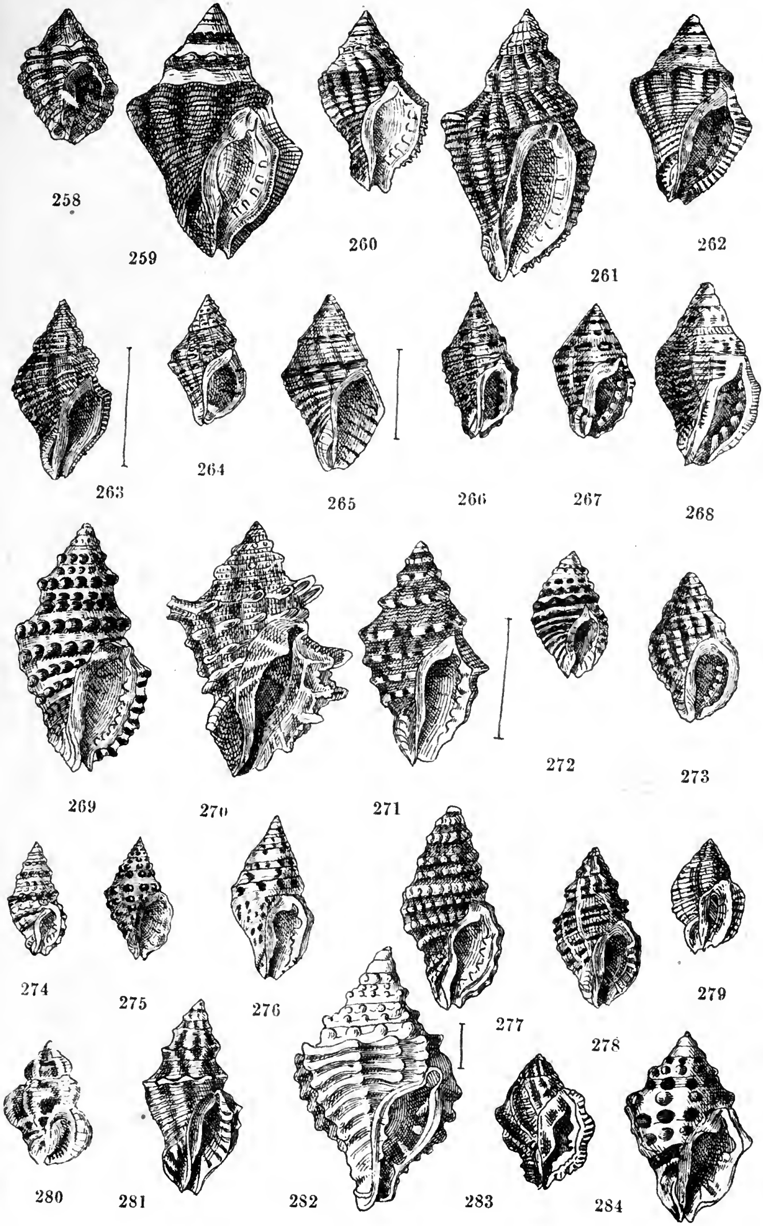
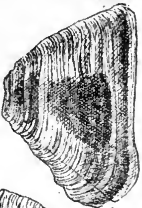
PURPURINÆ. PLATE 59.

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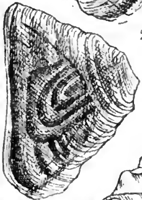
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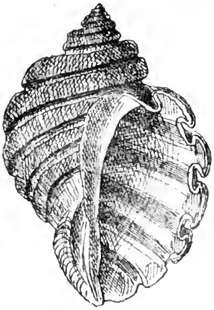
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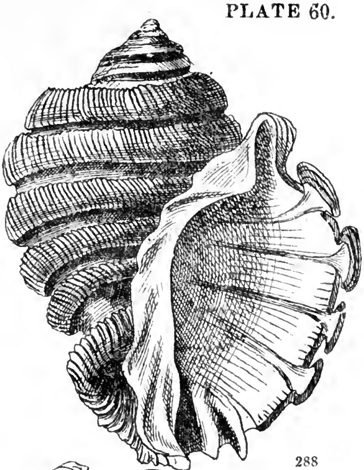
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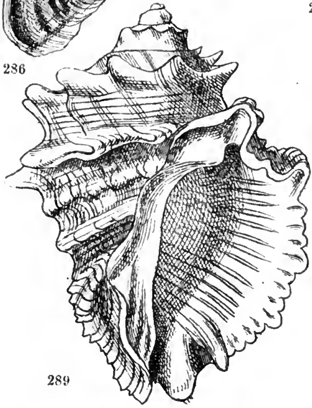
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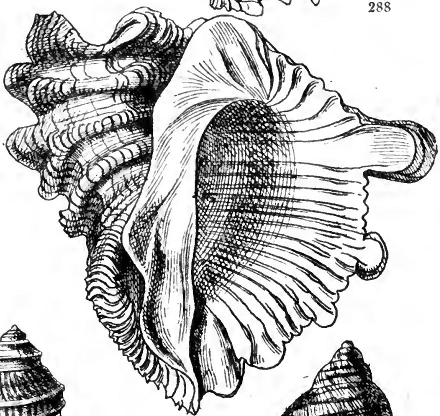
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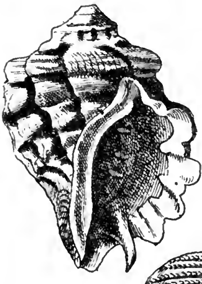
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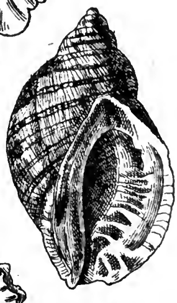
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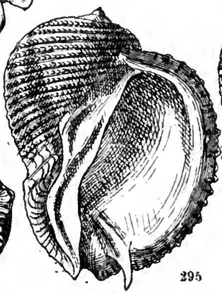
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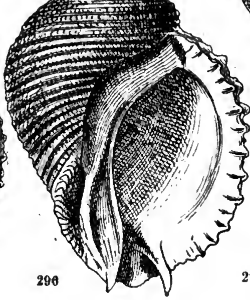
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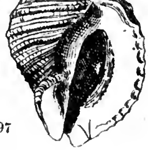
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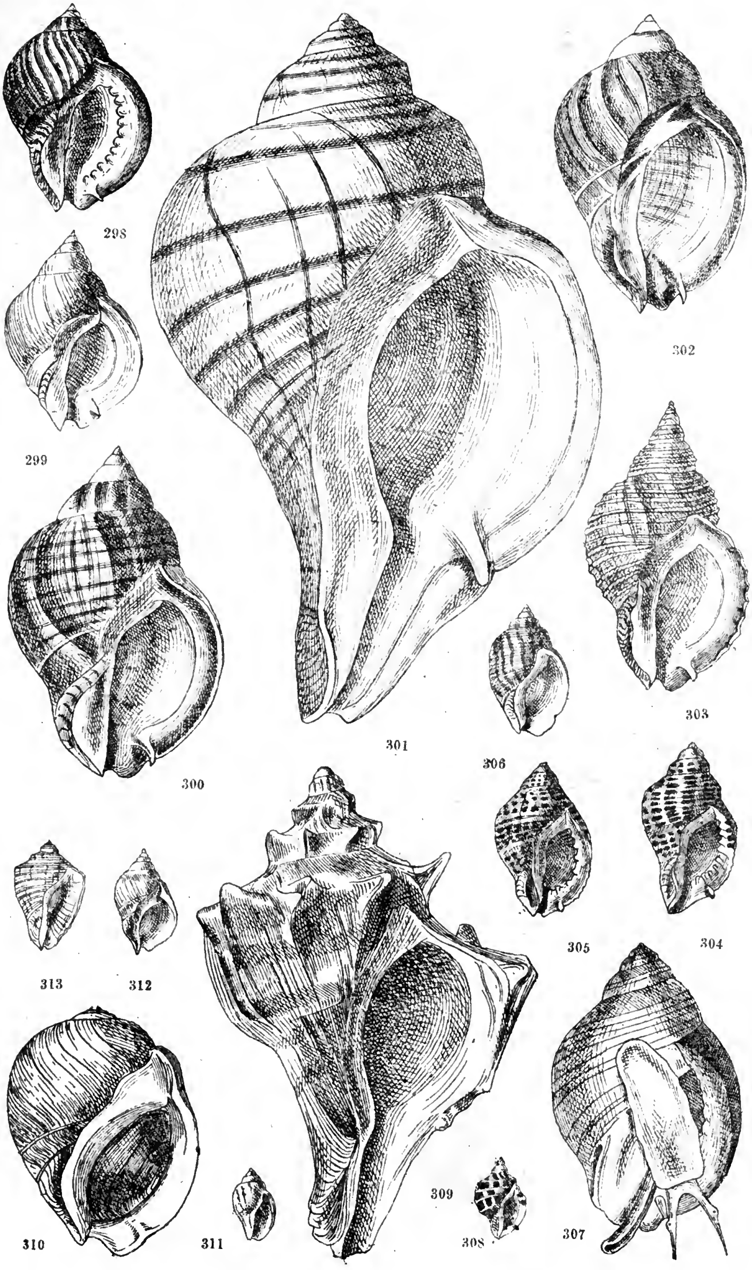
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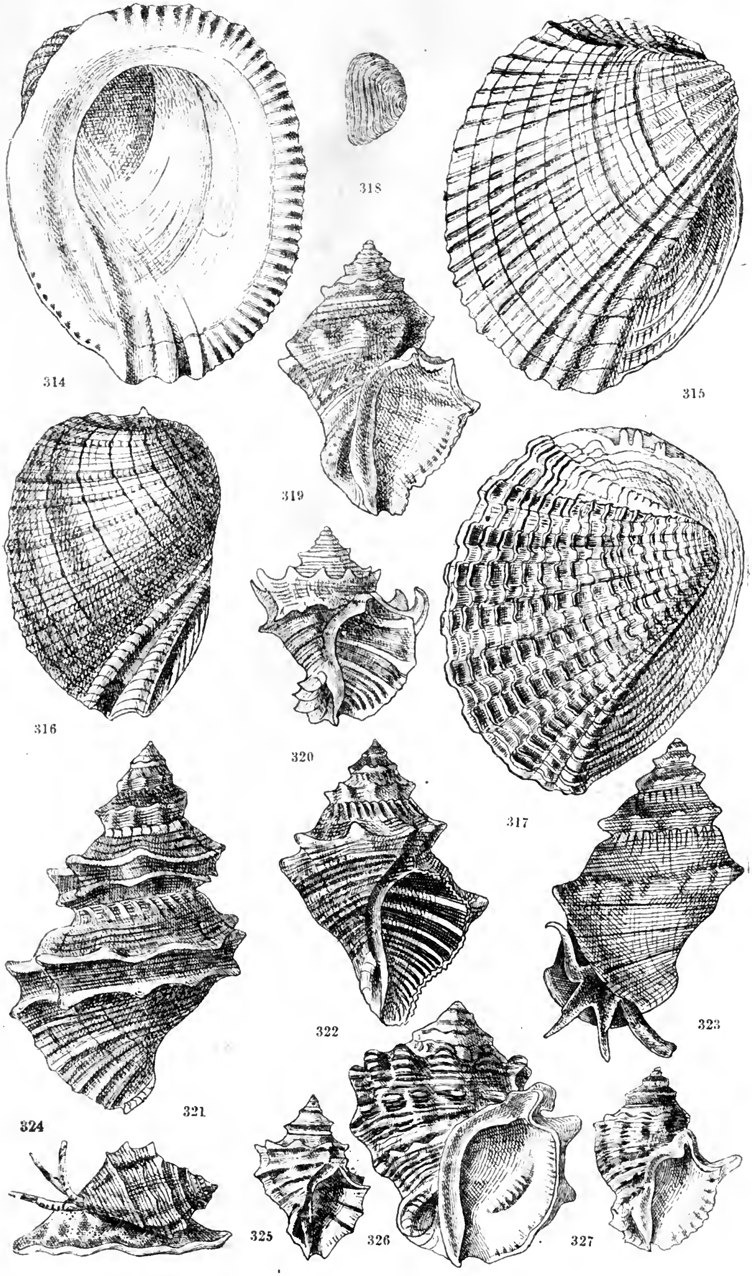

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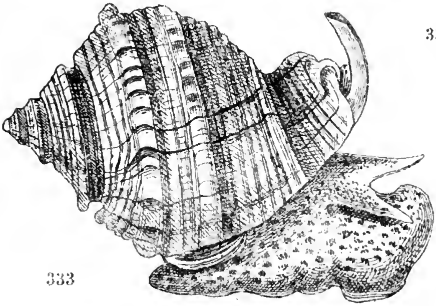

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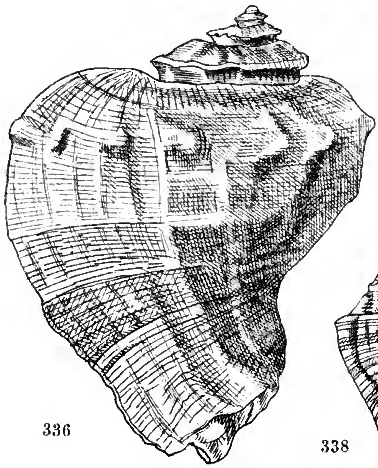

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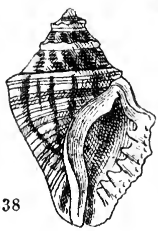

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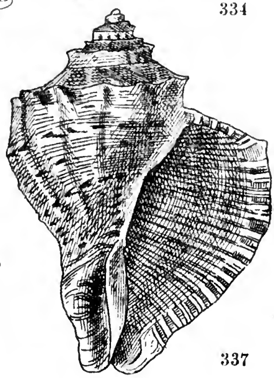

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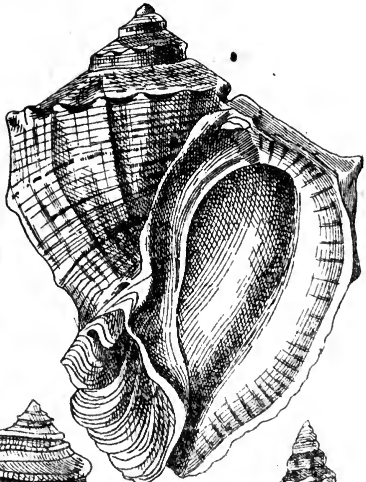

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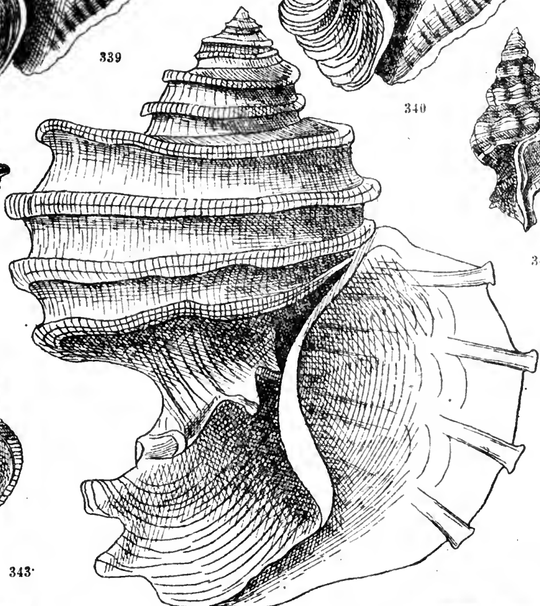

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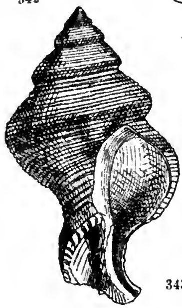

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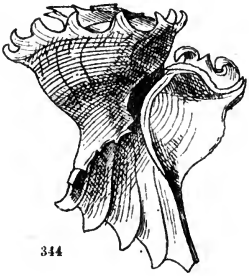

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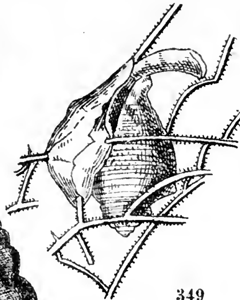

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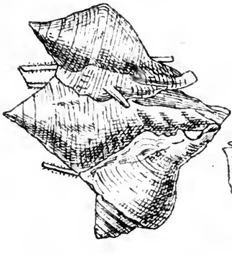

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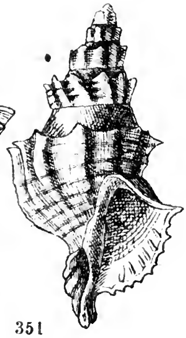

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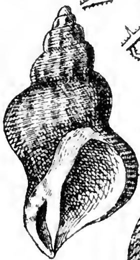

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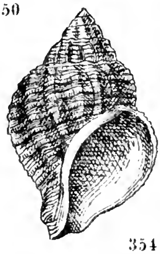

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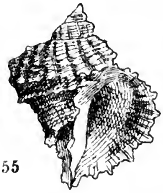

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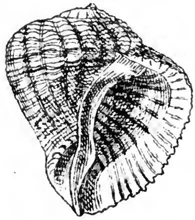

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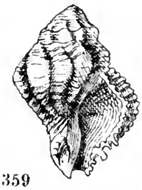

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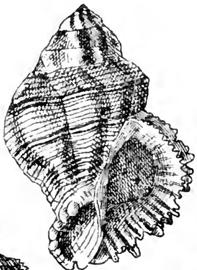

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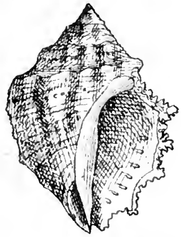

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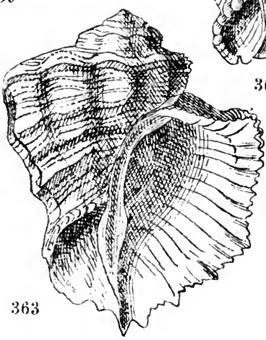

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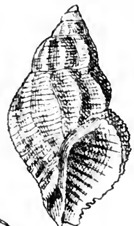

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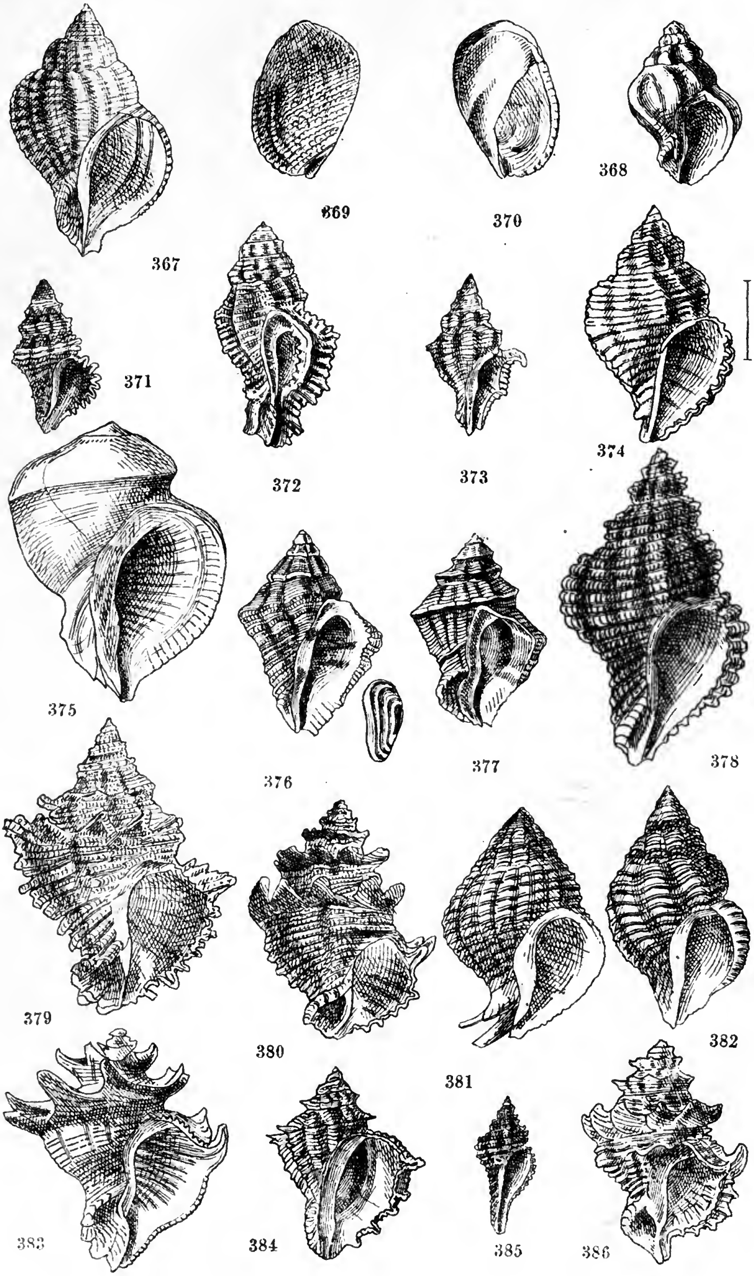
PURPURINÆ. PLATE 66.

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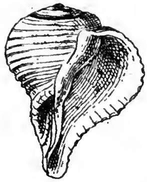
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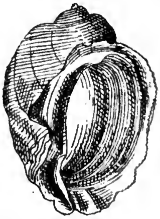
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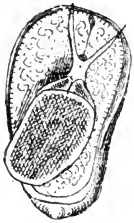
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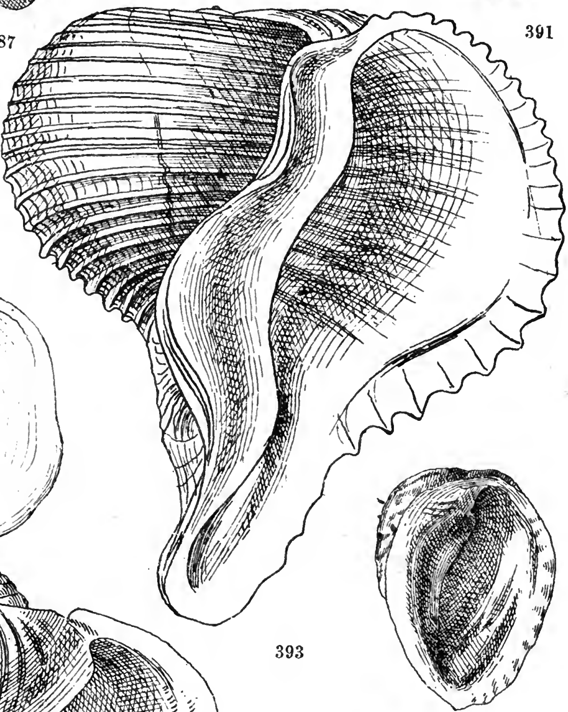
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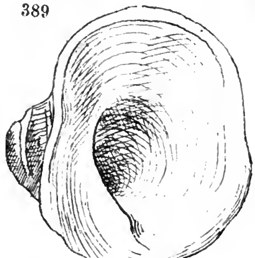
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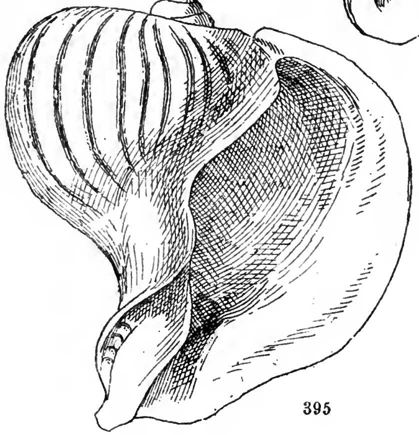
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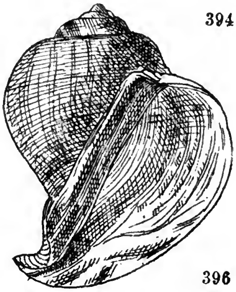
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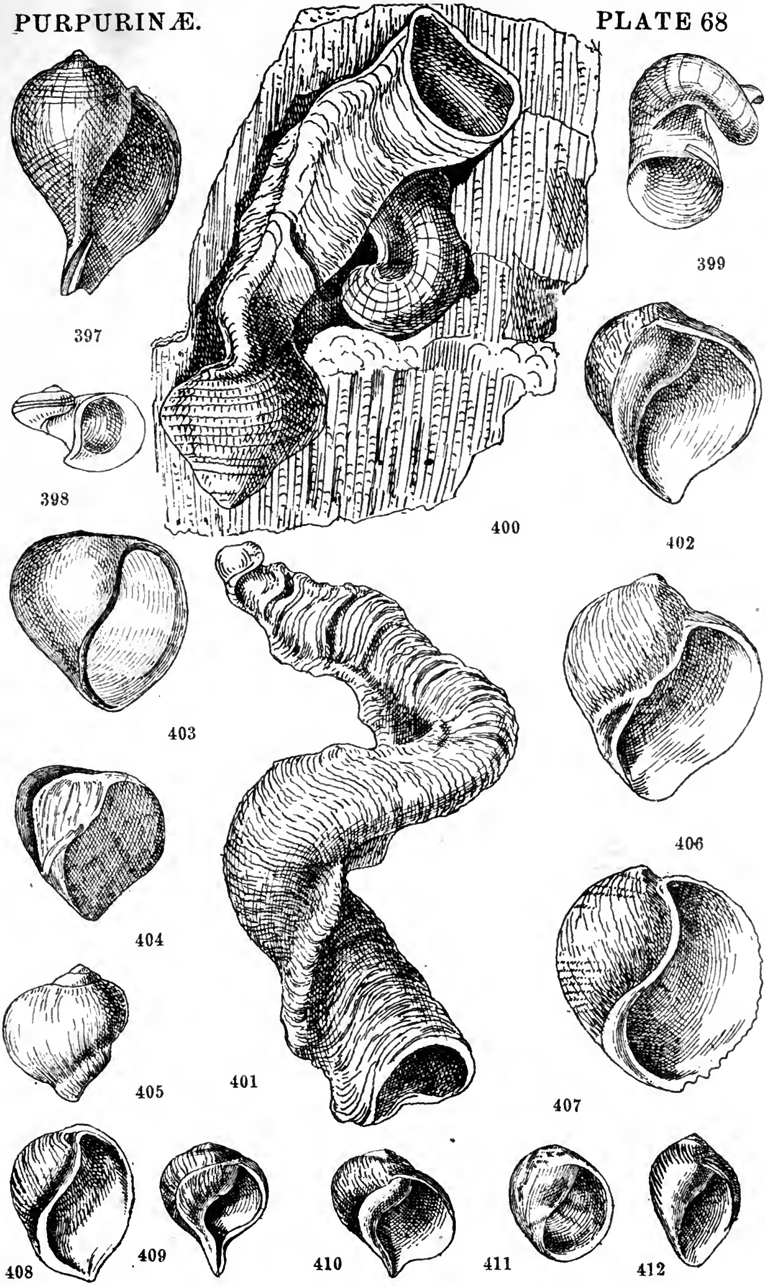
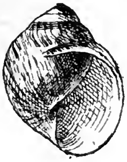
PURPURINÆ. PLATE 68



PURPURINÆ. PLATE 69



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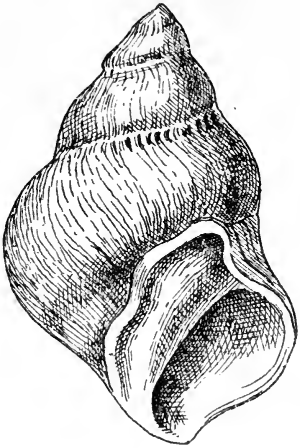

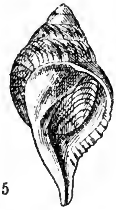

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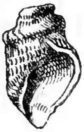

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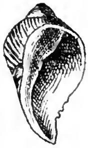

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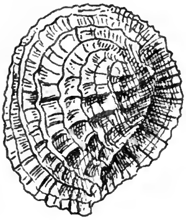

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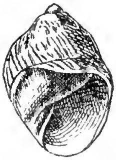

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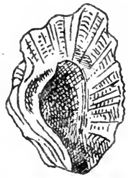

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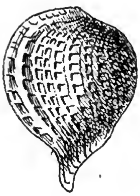

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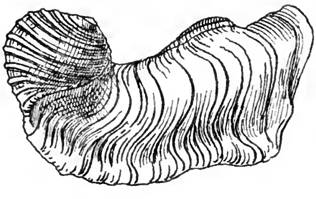

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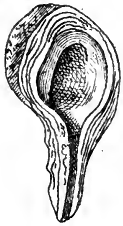

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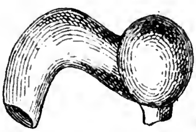

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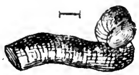

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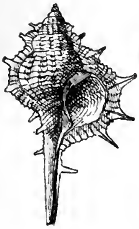
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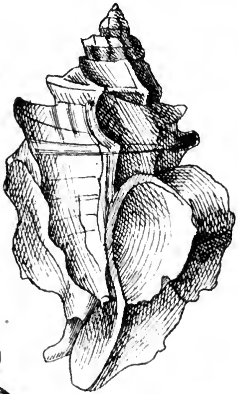
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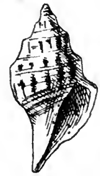
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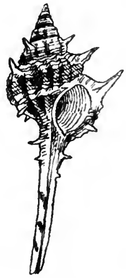
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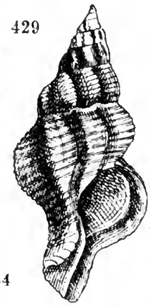
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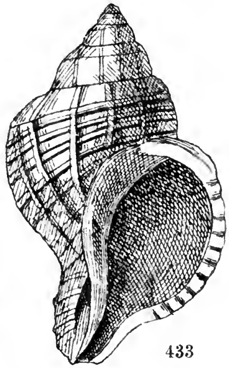
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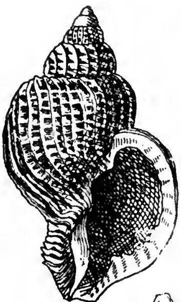
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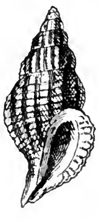
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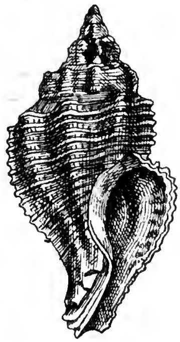
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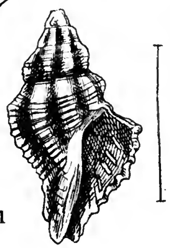
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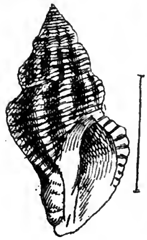
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