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MOLLUSCA.

THE Molluscous animals to which our attention is to be directed in this article, formed, for a long period, two distinct objects of study. The *naked species* were considered as constituting a particular group, to which the term MOLLUSCA was in a great measure restricted; whilst the *shelly species* attracted a large share of attention, being known as objects of study by the term CONCHOLOGY. Of late years, however, this kind of systematical separation of the naked and shelly species has been supported by few advocates, whilst those who have urged the propriety of their union have not only been numerous, but acknowledged as the intelligent and successful investigators of nature. In consequence of these changes, which have taken place in public opinion by the introduction of more correct notions of the principles of classification, we have in this edition of our work, resolved on incorporating the articles MOLLUSCA and CONCHOLOGY, suppressing the latter term as unnecessary. Indeed, in a physiological point of view, there is no definite boundary between the naked and the shelly species, many of the reputed naked species having shells concealed under their integuments, while in many of the shelly species the solid plate or shell can only be reached by removing the surrounding soft or fleshy matter. But the propriety of abandoning the old divisions will become sufficiently obvious, when we consider that all the species belong to one group in the invertebrate class of animals; that the organs of the species have many points of resemblance; and that although differences prevail in the character of the *protecting covering*, the gradations from one condition of the integuments to another, are too minute, in many cases, to admit of precise limits being fixed. We shall therefore consider *shells* as peculiar modifications of the external coverings of certain species, and, in this subordinate character, incorporate the naked and shelly species; having recourse to the integuments, however, in connection with the other organs, in the distribution of the genera and other divisions of the class now denominated MOLLUSCA.

In treating of this extensive division of the invertebrate animals, we shall confine our remarks to a general view of their physiology, taking notice of the peculiarities of their forms, organs, and functions. This will prepare us for a condensed view of the progress of the science, in reference to systematical arrangement, and the illustrations of the characters of those divisions or groups into which the species may be distributed, whether for assisting the student in his labours of investigation, or for facilitating the judicious disposition of the established truths of the science. We shall then advert, in the last place, to molluscous animals as objects of utility. The limits of the article will unavoidably restrict us to a very brief exposition of the various subjects connected with this very extensive department of natural history.

CHAPTER I.

PHYSIOLOGY.

Molluscous animals exhibit very remarkable differences, both in their form and in the number and position of their external members. Neither head nor foot can be observed in some species; the principal organs being enclosed in a bag pierced with apertures for the entrance of the food, and egress of the excrementitious matter. In others, with an exterior still remarkably simple, cuticular elongations, termed *Tentacula*, surround the mouth, and a foot, or instrument of motion, may likewise be perceived. This last organ is in some free at one extremity, in others attached to the body throughout its whole length. In many species there is a head, not, however, analogous to that member in the vertebral animals, and containing the brain and organs of the senses, but distinguished merely as the anterior extremity of the body, separated from the back by a slight groove, and containing the mouth and *tentacula*.

In many of the animals of this division, the different members of the body are in pairs, and are arranged, in reference to a mesial plane, into right and left. In some, a part only of the organs has respect to a mesial plane, other parts being single, or in unequal numbers. In other species, the organs, which are not in pairs, are arranged round a central axis, and give to the external form a radiated appearance. But these characters are exceedingly variable and uncertain, as indicating the limits of particular tribes; since, in different parts of the same animal, modifications of all these forms may be readily distinguished.

The *skin* of molluscous animals is more simple in its structure than the same organ in the vertebral animals. The *cuticle* is here very distinct; and, as in other classes, it is thick and coarse where much exposed, but thin and delicate in its texture where it lines the internal cavities. A *mucous* web may be detected in the cuttle fish and slug, but of great tenuity. The *corium* is destitute of a villous surface; and on its central aspect it is so intimately united to cellular substance, that its fibrous structure can scarcely be distinguished. The *muscular* web may, in general, be readily perceived. Its fibres proceed in various directions, according to the kind of motion to be executed, and extend or corrugate the skin at pleasure.

The appendices of the skin in this class of animals ought to be carefully studied, as they furnish the most obvious marks for distinguishing species, and for constructing divisions in their systematical arrangement. The appendices of the cuticle are few in number, and perhaps ought to be considered as limited to *hairs*. These, in some species, invest the surface regularly and closely, and may be observed on those which live on land, as well as those which reside in water. In some cases the hairs may be considered as united, and forming continuous crusts or ridges. These hairs, as well as the cuticle, are liable to be worn off, and in some places can seldom be perceived, unless in early age.

The most important appendix to the skin, for such it must be considered, appears to be the *shell.* This part is easily preserved, exhibits fine forms and beautiful colours, and has long occupied the attention of the conchologist. The matter of the shell is secreted by the corium, and the form which it assumes is regulated by the body of the animal. It is coeval with the existence of the animal, and appears previous to the exclusion from the egg; nor can it be dispensed with during the continuance of existence. The solid matter of the shell consists of carbonate of lime, united with a small portion of animal matter, resembling coagulated albumen.

The mouth of the shell is extended by the application of fresh layers of the shelly matter to the margin, and its thickness is increased by a coating on the inner surface. These statements are abundantly confirmed by the observations of Reaumur, (*Mémoires de l'Académie des Sciences*, 1709), whose accurate experiments have greatly contributed to the elucidation of conchology. If a hole be made in the shell of a snail, and a piece of skin so glued to the inner margin as to cover the opening, the shelly matter will not ooze out from the broken margin of the fracture, and cover the outside of the skin, but will form a coating on its inner surface, thus proving it to have exuded from the body of the animal. When a portion of the mouth of the shell of a snail is broken off, and a piece of skin glued to the inner margin, reflected outwardly, and fixed on the body of the shell, the defective part is again supplied, and the matter added to the inner surface of the skin, thus leaving the interposed substance between the new formed portion and the fractured edge. Similar experiments, repeated on a variety of shells, both univalve and bivalve, by different naturalists, leave no room to doubt that shells increase in size by the juxtaposition of shelly matter from the common integuments.

Each calcareous layer is more or less enveloped in the animal matter which we have already stated as being present; so that the different layers of successive growth may, by various processes, be distinctly exhibited. If the shell has been exposed for a short time in the fire, the animal matter will appear charred, and its black colour, contrasted with the white earthy matter, will indicate the arrangement of the different strata; in the same manner as the ivory and enamel of a tooth can be distinguished, when subjected to similar treatment. The same satisfactory results may be obtained by a different process. If the shell be steeped in weak muriatic acid, the earthy matter will be dissolved, and the flakes of albumen will remain as the frame-work of the edifice.

The layers of growth may often be distinguished on the surface of the shell, in the form of striæ or ridges, more or less elevated, but parallel to the margin of the aperture. Other inequalities may likewise be observed on the surface, at right angles to the layers of growth, such as ridges, knobs, and spines. These last derive their origin from the inequalities of the skin on which they have been moulded.

In some univalve shells, the layers of growth parallel to the opening cannot be discerned; when exposed in the fire, there is little darkening of colour; and when dissolved in acids, but a feeble trace of animal matter remains. In the fire, these shells crack in various directions, but exhibit no trace of a scaly structure. By careful management with the file, the shell may be separated into a central layer contiguous to the skin, and a peripheral layer, both similar in structure, though frequently differing in colour. The shells exhibiting such characters have been termed *porcellaneous*, from their dense structure, and the fine polish which their surface presents. The formation of shells of this kind must take place in a different manner from those of the first kind which we have noticed.

If we attend to the form of a young shell belonging to the genus cypræa of Linnæus, we may perceive that an addition of shelly matter to the margin of the aperture, in the manner in which it is applied in other shells, would not enlarge the cavity, but completely close the aperture. The increase of the shell, (accompanied with a corresponding increase of its inhabitant), must take place, therefore, either by absorption of the accumulated shelly matter of the mouth, and an elongation in the direction of the greatest curvature of the shell; or the old shell must be thrown off, and a new one produced, suited to the size of the animal. The former supposition has not been entertained, the latter is now generally received by naturalists, though there are a few individuals unwilling to adopt such a view of the matter. The inner coat of such shells appears to be a transudation from the body of the animal, and the outer one to be laid on the surface by the loose reflected lobes of the cloak. In many other shells, portions of matter, more compact than the other parts, may be observed spread on the pillar, and applied to the margin of the mouth by a similar process. Mr. Platt, in support of Reaumur's opinion, that shells are formed by juxtaposition, against the objections of Mr. Poupart, (*Phil.*

Trans. vol. liv. p. 43), erroneously considers the different sizes of the cypreæ as depending on the thickness of the shell increasing according to age, without admitting a corresponding increase of the dimensions of the contained animal, or cavity for its reception.

The shells of the first kind which we have noticed, from being formed of cones or layers applied to the inner edge of the margin, and extending beyond it, have an *imbricated* structure. Those of the second kind, consisting of layers regularly superimposed, have consequently a *laminated* structure; but between the two kinds there are numerous intermediate links, formed by a combination of the two processes.

In some cases, the hard parts of the skin are not entitled to the appellation of shell, but may rather be considered as horn. Such are the coverings of the mandibles of the cuttle fish, the branchial lid of the aplysia, and the *operculum* of the welk. The two last appendices, however, though horny in some species, are shelly in others.

The position of the shell, with respect to the constituent layers of the integuments, exhibits very remarkable differences. In some it appears instead of a cuticle, or at least without an external membrane investing it. In general, however, it occurs between the cuticle and the skin; a position which induced Cuvier (*Lec. d'Anat. Comp.* xiv. 11.) to consider it as analogous to the mucous web of the vertebral animals. Its intimate connection with the muscular system of the animal, and the protection which it affords, seem adverse to such a conclusion. In many species the testaceous substance occurs in folds of the corium, or inserted in its substance. In this position it never acquires the solid texture which shells exposed, or covered only by the cuticle, exhibit. Those shells which are thus concealed are in general white; those which are more exposed are frequently coloured. The colouring, however, does not depend on the direct exposure to the light, as some have imagined, for many shells which are destitute of a cuticle are white, while many of those covered by a dense cuticle are finely variegated beneath.

Between the skin and the shell neither vessels nor nerves have been traced; and the manner in which the latter is formed, forbids us to expect their existence. Yet the shell cannot be considered as dead matter, so long as it remains in connection with the living animal. In those animals in which the shell is external, there are muscles which connect the animal with its internal surface, and the bond of union being a substance soluble in water, the muscle can be detached by maceration. The analogy between shell and bone is here obvious, although in the one case the connection between the muscle and the bone is permanent, in the other, between the muscle and shell, temporary, or frequently changed during the life of the animal. But the vitality of the shell, if I may use the expression, is demonstrated, from the changes which it undergoes when detached from the animal: the plates of animal matter harden: the epidermis dries, cracks, and falls off; and in many cases the colours fade or disappear. We confess ourselves unable to point out the means employed by the animal to prevent these changes from taking place, by any process similar to circulation. The difficulty, however, is felt in contemplating the functions of hairs, nails, and feathers, in vertebrated animals.

When the shelly covering consists of two or more pieces, they are joined together, as the articulated bones in the higher classes of animals, by ligaments. These, in some cases, are of great thickness and strength, and, in consequence of their elasticity, assist in the motion of the different parts.

In the molluscous animals the skin secretes a viscous, adhesive substance, differing according to the medium in which the animal resides, but in all cases calculated to resist its influence. It is probably owing to the lubricating agency of this secretion, that both the cuticle and shell are preserved from decomposition. The skin likewise secretes the colouring matter by which the shells are variegated. The glands from which it proceeds vary much in different individuals, and even in the same individual in different periods of growth.

The characters furnished by the skin and its appendices are extensively employed in the systematical arrangement of molluscous animals. Nearly all those characters which distinguish the species, and many of those on which genera are established, are derived from the form of the shell, the *tentacula*, or the colour. This last character, however, is one on which little dependence should be placed.

There is nothing peculiar in the MUSCULAR SYSTEM of this class of animals. Where the muscles are inserted in the skin, as is usually the case, that organ is in some cases strengthened by condensed cellular substance, and even acquires a leathery density.

Molluscous animals preserve themselves in a state of *rest*, chiefly by suction and cementation. The organ which acts as a sucker, is in some cases simple, soft, and muscular, as the foot of the snail, while in others it is compound, and strengthened internally by hard parts, as in the arms of the cuttle-fish. The force with which some animals adhere is very considerable, and is strikingly displayed, for example, when we attempt to detach a limpet from the rock.

The rest, which is maintained by cementation, in some cases depends on a glairy secretion, which glues the body of the animal to the substance to which it is disposed to be attached. By such an expedient, the shells of snails adhere to rocks, stones, and plants. It is probable that the bivalve shells of the genus Cyclas, which readily adhere to the side of a glass, secure their temporary attachment by means of their glutinous cuticle. In other animals threads are produced, termed a *byssus*, from particular glands, and while one extremity is glued to the rock, the other remains in connection with the animal. But there is an attachment more durable than any of these, which takes place in some shells, they being cemented to rocks or stones by calcareous matter, and retained in the same position during the whole term of their existence.

The locomotive powers of the mollusca are confined to creeping and swimming. The former action is performed by alternate contraction and relaxation of the foot, or muscular expansion, which serves as a sucker, and is analogous to the motion of serpents. The motion of swimming is executed either by the serpentine undulations of the foot and the body, or by the action of tentacula, or expanded portions of the integuments. Many species are aided in swimming, by being able to vary the specific gravity of their body at pleasure, and either rise or sink in the water as circumstances may require. In some, as the Janthina, there is a cellular organ peculiarly destined for this purpose, which may be regarded as in some measure analogous to the airbladder of fishes. In all these exertions the progress of molluscous animals is proverbially slow. Some bivalve shells have the power of *leaping*, or shifting their position by a sudden jerk, produced by shutting the valves rapidly. This is strikingly displayed in the common scallop, and is less perfectly exhibited in the river mussels. In a few instances, especially among the slugs, a thread is formed of the viscous secretion of the skin, by which the animal is enabled to suspend itself in the air from the branches of trees like a spider.

Although the progressive motions of molluscous animals are comparatively slow, the other muscular actions are executed with ordinary rapidity. The irritability of some parts, as the tentacula and branchiæ, is so great, that the protecting movements are executed almost instantaneously, and the organs are contracted or withdrawn into the body. But these rapid exertions are only called forth in the moments of danger.

The characters furnished by the muscular system, are of great value in the discrimination of species, and in the construction of genera and higher divisions. They are intimately connected with the habits of the animal, and merit the attentive examination of the philosophical naturalist.

In the molluscous animals the Nervous System is less complicated in its structure than in the higher classes, and the brain is not restricted in its position to the head. The whole nervous system appears in the form of ganglia and filaments. The principal ganglion, or the one to which the term *brain* is usually applied, is seated above the gullet or entrance to the stomach. It sends out nerves to the parts about the mouth, the tentacula, and the eyes. It may be considered as analogous to the cerebrum of the vertebral animals. From this ganglion proceed two filaments, one on each side, which in their descent inclose the gullet, and unite underneath to form a second ganglion. From this last, which has been compared to the cerebellum, numerous filaments are likewise distributed to the parts around the mouth, and to the other regions of the body. These filaments in some cases again unite, and form subordinate ganglia. In many cases the brain and ganglia are of a reddish colour, and granulated structure, while the nerves which issue from them are white and uniform, as in the genus Aplysia. The covering of the first ganglion, which is analogous to the *dura mater*, does not adhere to it closely, but leaves a space filled with loose cellular matter. The tunics of the nerves are equally detached; and as they can be inflated or injected readily, some have been led to suppose that the nerves were hollow, and others, that the tunics were the vessels of the lymphatic system.

The organs of perception common to the higher classes of animals, do not all exist in an obvious manner amongst the mollusca. The *touch*, that universal sense, is here displayed in many cases with great delicacy; and the tentacula, and the other cuticular elongations which we have already referred to, contribute to augment its resources. The sense of *sight* is by no means universally enjoyed by the inhabitants of this class. In a few species, the eye is constructed on the plan of the same organ in the vertebral animals. In general, however, it appears only as a black point, the peculiar functions of which can only be inferred from analogy. In many species there is no trace of an eye, consequently they cannot possess that varied information which the others derive from that organ. Where eyes exist in this class, they are uniformly two in number. In one tribe only, namely the cuttle-fish, the rudiments of the organs of *hearing* have been detected. The organs adapted to *smelling* cannot be exhibited, but the existence of the sense is demonstrated by the facility with which molluscous animals discover suitable food, when placed within their reach. The sense of *taste* appears to exist, but it is difficult to point out the particular parts of the mouth fitted for its residence. As, however, particular articles of food are selected in preference to others, it may be concluded from analogy that taste regulates the choice.

In the classification of the mollusca, the characters furnished by the nervous system, from the difficulty of their detection and exhibition, have never come into use. But those furnished by the organs of preception are highly prized. Of these, the eye is the most obvious and constant. It varies in position in different species; but, among individuals of the same species its characters are constant.

In the cutaneous, muscular, and nervous systems, traces of a general plan may be observed, according to which they have been constructed in the different tribes. In the organs which remain to be considered, there is less uniformity of structure, each family almost being constructed according to a model of its own.

The time when molluscous animals feed has not been carefully attended to. Those which live in the water are beyond the reach of accurate observation. Those that reside on land usually shun the light, and creep forth in the evenings to commit their depredations. During warm, dry weather, they stir not from their holes.

The animals under consideration, feed equally on the products of the vegetable and animal kingdom. Those which are *phytivorous* appear to prefer living vegetables, and refuse to eat those which are dried. We are not aware that putrid vegetable matter is consumed by them, although many of the snails and slugs are found under putrid leaves and decayed wood. In these places there is shelter from the sun, together with dampness, so that it is difficult to determine, whether they sojourn in an agreeable dwelling, or a well-stored larder. Those mollusca which are *carnivorous*, prey on minute animals in a living state, and many of them greedily attack putrid matter.

The means employed to bring the food within the reach of the organs of deglutition, are exceedingly interesting, both on account of their variety and success. Some are provided with *tentacula* for securing their prey, and conveying it to their mouth, as the cuttle-fish ; others protrude a lengthened probosis, or an extended lip or tongue, as the limpet, and thus bring their food into the mouth. By many, however, which are fixed to the same spot during the continuance of existence, or only capable of very limited locomotive power, successful efforts are made to excite currents in the water, whereby fresh portions of it are brought in contact with the mouth, and its animal or vegetable contents separated. Where part only of any kind of food is taken into the mouth at once, the lips are possessed of sufficient firmness to cut off the requisite portions, or there are corneous mandibles to perform the office.

In the mouth, there is scarcely any process performed analogous to that of mastication, in the higher orders of animals. When the food is in the mouth, or entering into the gullet, it is mixed with saliva, as in the more perfect animals. The *salivary glands* in which it is secreted, are in general of considerable size, divided into lobes, and, in some cases, separated into distinct masses. In many species the existence of a gullet is doubtful, as the food seems to enter the stomach immediately ; while, in others, there is a portion of the intestinal canal which has some claim to the denomination.

The stomach, in many instances, is membranaceous, and can scarcely be distinguished from the remaining portion of the intestinal canal. In some cases, however, it is strong and muscular like the gizzard of a bird, and even fortified with corneous knobs for the reduction of hard substances. In some species, the stomach opens laterally into the pylorus, and, in a few instances, possesses a spiral cæcum attached to it.

The *liver* is usually of very large dimensions, and seated close to the stomach, which it, in many cases envelopes. It is divided into many lobes, and receives numerous blood-vessels. There is, however, nothing analogous to the *vena portarum* of quadrupeds. The *bile* is poured, in some, into the stomach, and, in others, into the pyloric extremity of the intestine by different openings. There is no gall-bladder.

There is no division of the canal into small and large intestines, as in the higher classes ; or rather, among the mollusca, the relative size of the different parts is reversed. Here the pyloric extremity is usually the largest, while the anal is more slender. The intestine, as in fishes, is short in proportion to the length of the body, and in its course, is subject to few turns. The anus, is, in some, placed on one side of the body ; in others it is terminal, while in a few it opens on the back.

The digestive system is thus more simple in its structure than in the higher classes. It possesses neither pancreas, spleen, nor mesentery. And, we may add, that the calls of hunger are often at distant intervals, and the power of abstinence very great.

The characters furnished by the digestive system are extensively used in the inferior divisions of molluscous animals. The form of the lips, the position of the mouth and anus, and the structure of the stomach, deserve to be attentively considered, as indicating the habits of the species.

Circulating System.—The process by which the food is converted into chyme, has not been satisfactorily traced, nor has the existence of the lacteals for the absorption of the chyme been demonstrated. In this class of animals the veins seem to perform the offices both of lacteals and lymphatics. The blood is white, or rather of a bluish colour. Its mechanical and chemical constitution yet remains to be investigated.

The circulating system of molluscous animals, exhibits very remarkable differences in the different classes. In all of them, however, there is a systemic ventricle; but the other parts of the heart are not of constant occurrence.

The circulating system furnishes few characters which can be employed in systematical arrangements. The structure of the systemic and pulmonary vessels does not appear to be co-ordinate with any particular plan of external configuration and manner, as we see in the case of the pteropoda and gasteropoda. In these, the organs of circulation are very much alike, while the external forms exhibit very obvious differences.

The molluscous animals which respire by means of *lungs* are few in number, and form a very natural tribe, which Cuvier has termed *gasterpodes pulmones*. In them the respiratory organ is simple, consisting of a single cavity, on the walls of which the extremities of the pulmonary artery are spread. This cavity communicates externally by an aperture which the animal can open or shut at pleasure.

The mollusca which breathe by means of *gills*, exhibit very remarkable differences, in their number, structure, and position. In some cases, there is a single cavity communicating by an aperture, through which the water enters. The walls of this cavity exhibit an uneven surface, disposed in ridges, which are the gills, and on which the pulmonic artery is expanded. This structure exhibits itself in the *Gasteropoda pectini-branchia*. In many cases the gills, though seated in a cavity, like the former, and equally exposed to the contact of the surrounding element, are two in number, one on each side, as in the *Cephalopoda*. In the Bivalvia, they are four in number, two on each side like leaves, and extend the whole length of the body. In these, the water is admitted at the pleasure of the animal.

The gills of other mollusca are seated externally, and consist either of aborescent productions, or simple cuticular elongations, within which the pulmonary artery terminates. In some of these, as the *Pteropoda*, the branchial surface is constantly exposed to the action of the surrounding water; whilst in others, the cuticular expansions, which are analogous to gills, are retractile at the will of the animal. In several examples, these cuticular elongations, which execute the functions of respiration, are covered with moveable cilia, well calculated to excite currents in the water, thus renewing the portions applied to the surface.

By means of the characters furnished by the circulating and respiratory systems, the molluscous animals may be divided into several distinct classes. But as we shall employ these characters in the construction of the different divisions to be employed, it is unnecessary, in this place, to enter into their details.

PECULIAR SECRETIONS.—The molluscous animals are considered as destitute of organs for the production of urine, but they possess various organs for the secretion of peculiar fluids or solids, some of which are useful in the arts.

The coloured fluid, which is secreted by the Cephalopoda and some of the aquatic gasteropoda, appears to consist chiefly of a peculiar mucus, united to a peculiar pigment. The animals which furnish this secretion, eject it when in danger or irritated, and thus envelope themselves in a dark cloud, and elude the pursuit of their foes. A milky secretion is poured forth over the surface of the skin of some slugs when irritated. Other coloured secretions may likewise be detected in the mollusca, to which we shall afterwards advert. The threadlike secretions, termed a *byssus*, with which some molluscous animals, especially among the *Conchifera,* fix themselves to other bodies, appear to be of an albuminous nature. A few species in this division have the power of secreting a *luminous* fluid. Its nature, and the organs in which it is elaborated, have not been investigated. It is probable that some animals, as those which have the faculty of raising or lowering themselves in the water, have likewise the power of secreting *air* into those organs which contribute to their buoyancy.

Morbid secretions likewise occur amongst the animals of this division, chiefly, however, amongst the Conchifera. The most important of these are *pearls*, so much prized as ornaments of dress.

The organs of generation, some of which will be noticed afterwards in detail, furnish many important characters for classification. The external openings are those which are detected with the greatest facility, but the structure of the internal organs exhibits more varied and discriminating marks.

Condition of the Mollusca.—Molluscous animals, in reference to their condition, are divided, according to the situation in which they reside, into three groups, which may be termed terrestrial, fluviatile, and marine. Those that inhabit the land belong exclusively to the gasteropoda. Among these, some prefer open pastures, others the rubbish of old walls, while not a few reside in woods or among dead leaves and putrid plants. All the animals of this group respire by means of a pulmonary cavity.

The fluviatile mollusca, or such as reside in fresh waters, include not only many gasteropodous genera, but likewise a few belonging to the Conchifera. Amongst these, some breathe air by means of a pulmonary cavity, and come to the surface to respire. Such species frequent the more shallow ponds and lakes. Others, respiring by means of gills, are less dependent on the shallowness of the water, and consequently reside in different depths.

The marine mollusca include genera of all the classes. Some burrow in the sand, or adhere to the rocks which are left dry by the receding tide. These are termed *littoral* species. Others, however, which have been denominated *pelagic*, reside in the deep, and are seldom obtained but by dredging, or when thrown ashore during storms.

The effect of temperature in regulating the distribution of molluscous animals, has not been investigated with any degree of care or success. Over the terrestrial and fluviatile species, it probably exercises a very powerful control, greatly limiting their geographical range. In proof of this, it may be stated, that the south of France possesses several species not to be found in England, whilst in England, there are a few which have not been detected in Scotland. But, among the marine mollusca, the influence of climate is not felt in the same degree. Living in an element, the bulk and motions of which guard it equally from the extremes of heat or cold, these animals, like the sea-weeds, have a very extensive latitudinal and longitudinal range. Thus, some are common to Greenland and the Mediterranean, others to Britain and the West Indies. The mollusca of the tropical seas, however, differ widely as a whole from those of the temperate regions. Some of the forms appear to be peculiar to warm regions, and, in general, the intensity of colour decreases as we approach the poles. But as there have been few cultivators of this branch of science, the geographical distribution of the species has been but imperfectly explored. Few parts of either England or Scotland have been surveyed by the eye of the helminthologist, so that many species, the range of which is considered as limited, may soon be found to be extensive.

If the observations are few and imperfect, which have been made on the influence of temperature, in regulating the physical distribution of mollusca, we are still in greater ignorance with regard to the power of habit. In the flœtz rocks, the relics of marine and fluviatile mollusca are found mixed in the same bed. This circumstance gave rise to the inquiry, how far the mollusca of fresh water can be habituated to sea-water, and *vice versa*. In the account of the proceedings of the National Institute of France, for the year 1816, it is stated, that M. Beuchant, professor at Marseilles, has directed his attention to this subject. He found, that all these animals die immediately, if we suddenly change their place of abode; but that, if we gradually increase the proportion of salt in the water for the one set, and diminish it for the other set, we can, in general, accustom them to live in a kind of water which is not natural to them. He found, however, some species which resisted these attempts, and which could not bear any alteration in the quality of the water in which they reside. Before much confidence can be placed in the accuracy of these results, it would be desirable that the experiments were repeated and varied by other observers. There are, indeed, many sources of error to be guarded against. When we change animals from fresh to salt water, or from salt water to fresh, we must necessarily derange their motions, by compelling them to reside in a medium of a different degree of density from the one in which they have been accustomed to dwell, and to which the arrangement of the different parts of the body is adapted. By such a change of place, it would be difficult for those which breathe air to come to the surface, and descend again in their new situation. In those with gills, the application of a new kind of fluid to the surface of such delicate organs, would considerably influence the function of respiration. The change of situation would likewise be accompanied by a corresponding change of food, and consequently, not merely the organs of locomotion and respiration, but likewise those of digestion, would suffer a derangement in their operations. We know that the power of *suffering* in the animals of this class is very great, and that they survive, though sadly mutilated. Some of the snails will live in a quiescent state for years, without food, and almost without air. Unless, therefore, the animals subjected to these experiments of a change of situation, have been observed to thrive on the food which it spontaneously yields, to execute their accustomed motions, and above all, to propagate their kind, we shall be disposed to conclude, that patient suffering has been mistaken for health and vivaciousness for the power of accommodation.

The influence of the *seasons*, in regulating the motions and habits of molluscous animals, has been but little attended to. Those which live in the water, avoid the effects of low temperature, on the approach of winter, by retiring to the deeper parts of the lakes or rivers in which they reside. This migration, however, does not, in many cases, furnish the requisite security, so that they betake themselves to burrowing in the mud in which they repose until increasing warmth invites them to return to the open water.

Among the naked terrestrial mollusca, it may be observed, that they burrow in holes of the earth, under the roots of trees or among moss, and there screen themselves from sudden changes of temperature, and appear to spend the winter in a state of torpidity.

The different kinds of shelly mollusca which inhabit the land, such as those belonging to the genera Helix, Bulimus, and Pupa, not only retire to crevices of rocks and other places, for safety in the winter season, but they form an operculum or lid for the mouth of the shell, calculated to exclude the access of the air, and by the intervention of which they likewise adhere to the wall of their dwelling. A rise of temperature, however, especially if accompanied by moisture, excites their revival and motion, and the lid becomes detached. If we bring, for example, the *Helix nemoralis*, from its cold abode, and in an apparently torpid state, with the mouth of its shell closed by the lid and adhering to a stone, into a warm apartment, it will speedily revive, especially if it be moistened with a little water, burst open the lid and begin to crawl. If the animal be again exposed to a low temperature, it again secretes materials for a new lid, and speedily returns to its slumbers or inactivity. The first formed opercula, in these animals, always contain a considerable proportion of carbonate of lime, a material which is found in smaller quantity in those of after formation. If the animal has revived frequently during the winter, the last formed opercula will be observed to consist chiefly of animal matter, and to be very thin. The first formed winter lid of the Helix Pomatia is of the consistence of card-paper.

All the land shelly mollusca appear to have the power of passing into a state of *quiescence* resembling torpidity, at pleasure, and independent of low temperature. Thus, even in midsummer, if we place in a box specimens of the *Helix hortensis, nemoralis aut arbustorum*, without food, in a day or two they form for themselves a thin operculum, become attached to the side of the box, and assume a dormant condition. In this state of apparent torpidity they may be kept for several years. No ordinary change of temperature produces any effect upon them, but they speedily revive if moistened or plunged in water. Even in their natural haunts, they are often found in this dormant state, during the summer season, especially when there is a continued drought. Thus the *Helix nemoralis* may frequently be observed several feet from the ground, and attached to the stem or leaves of plants, with the mouth of the shell closed.

But it is not drought which influences these terrestrial shelly mollusca to assume this quiescent state. The *Succinea putris*, a species in ordinary cases delighting in moisture, may readily be observed during summer in a dormant state, high on the leaves of the Water Flag, having retired from the moisture below. In the same manner, and from causes equally obscure, some of the marine shelly mollusca, as the Limpet, Periwinkle, and Trochus, may be observed in a quiescent state on the rocks, above the reach of the tide. A shower, however, in general excites the Succinea, as well as the Limpets and Periwinkles, to motion.

CHAPTER II.

PROGRESS OF THE SCIENCE.

NATURALISTS have pursued a variety of methods in their examination of this important branch of Zoology, and have proposed systems of arrangement founded on very different principles, and marking different epochs in the science. In the methodical distribution observed by some, the form of the shelly covering has been exclusively attended to, while the organization of the animal itself has been overlooked, or even disregarded. A few have made the habits of the animal, the groundwork of their system. Others have passed over the characters exhibited by the forms and structure of the shell, and have confined their attention exclusively to the form and structure of the contained animal. Lastly, there have been a few, who, embracing all the circumstances connected with the shell, the animal, and its habits, have constructed systems at once natural and convenient. In the following sections we propose to consider these four classes into which the cultivators of this department of science may be distributed.

SECT. I.—*Systems constructed from circumstances connected with the characters of the Shell.*

The arrangement of the testaceous mollusca, according to the different forms of the shell, is unquestionably the most obvious and the most ancient method. It was first employed by Aristotle, the father of natural history, and even in the present day its admirers are warm in its praise. It is with great propriety termed the *artificial method*, because the characters employed have but a remote relation to the more important functions of the animal. This eminent philosopher had the merit of forming the great divisions of *univalves* and *bivalves*. He likewise separated the turbinated univalves from such as have but an imperfect spire, and formed many genera, or rather families, still retaining the names which he imposed.

The progress of the study of the shelly mollusca (the naked kinds being in a great measure neglected,) made very little progress for many ages after Aristotle had published his method of arrangement. Indeed, the first work of this sort which claims attention, is the *Dictionarium Ostracologicum* of Major, which was published in 1675. To him we are indebted for the threefold division of shells into *univalves, bivalves*, and *multivalves*, and for an explanation of the terms then employed by conchologists.

In the same career, but with more brilliant success, Langius followed, and, in 1722, published his *Methodus Nova Testacea Marina in suas Classes, Genera et Species distribuendi.* The following character is given of this work by the intelligent and industrious authors of the *Historical Account of Testaceological Writers.* (*Linn. Trans.* vol. vii. p. 156.) "After having noticed a multitude of mere describers, we now come to an author who is not undeserving of the title of a scientific one, and whose system, so far as marine *testacea* are concerned, (and of these alone he treats) certainly glances at the great clue to simplicity, which was afterwards so successfully and admirably seized by the great reformer of natural history in general." But Langius deserves more praise than is here bestowed upon him. Before his system appeared, the characters of the genera depended principally on the *outline*, and were of uncertain application. He remedied the defect, by directing the attention of conchologists to the form of the mouth in univalves, and to the structure of the hinge in bivalves. Among the former, he constituted subdivisions of those *ore superius aperto, ore superius in canaliculum abeunte*, and *ore superius clauso*. Amongst the latter, the circumstance did not escape him, that some of these shells are *equivalve*, others *inequivalve;* some *equilateral*, others *inequilateral*. Hence he may be considered as the founder of the inferior divisions of the artificial method, and as having furnished, to modern conchologists, many useful hints, of which they have availed themselves, without, however, acknowledging their origin.

Another important improvement was effected by Breynius in his *Dissertatio Physica de Polythalamiis*, 1732, in 4to. This consisted in separating from the ordinary univalves, such shells as possess a cavity divided by partitions into several compartments, and in forming them into a division, which he termed *Polythalamium*. These shells are now called Multilocular.

The system of Tournefort, which was published by Gualtieri, in his *Index Testarum Conchyliorum quæ adservantur in Musæo Nicolai Gualtieri, Philosophi et Medici, Florentini*, 1742, well deserves an attentive perusal. In his observations on the bivalves, now denominated the acephalous mollusca, he drew the attention of conchologists to an important character, and one of easy application, having observed that, in some genera, the valves do not close or unite all round, but that, at certain places, the shell remains in part open. Such shells, in modern language, are said to *gape*.

The system of the celebrated Linnæus, which ought now to be mentioned, is too well known in this country to deserve particular notice. In many of the other departments of Zoology he effected the most important alterations; but his attempts to reform the science of conchology, were far from being equally successful. To the subject he never was much attached, nor does he appear to have availed himself sufficiently of the labours of those authors whom we have mentioned, and of others who preceded him. The primary divisions which he employed, were those which Major had established, and his genera, with a few exceptions, were those in common use. His merit as a conchologist rests entirely on the accurately defined terms, the concise specific characters, and the convenient trivial names which he employed and introduced. The particular consideration of the Linnæan genera, and the subsequent changes which have been introduced into them, will form the subject of a separate section.

For some time after the publication of the *Systema Naturæ*, the illustrious Swede enjoyed a very dangerous reputation. All his arrangements were regarded as of such high authority, that it was considered as impious to attempt to introduce any change; so that conchology, and along with it the study of the mollusca, according to the artificial method, remained a long time stationary. At last in France, a country which refused to submit to the fetters of the Linnæan school, several new systems were proposed, which had for their object the restoration of those well-founded genera, which Linnæus, in his too great desire to simplify, had suppressed, and the accommodation of the divisions of the science to those new relations which a more extensive knowledge of species had discovered. In this number Bosc stands eminently conspicuous. In his work entitled *Histoire Naturelle des Coquilles, des Vers et des Crustaces*, and in the conchological articles of the *Dictionnaire d'Histoire Naturelle*, he has favoured the world with a detail of his system, the outline of which we shall here present to our readers :

I. Coquilles Multivalves.

1. Les unes n'ont point de charnière.

    Oscabrion, Anatif, Balanite.

2. Les autres en ont une.

    Pholade, Taret, Fistulane, Anomie, Calceole.

II. Coquilles Bivalves.

i. *Equivalves.*

1. A charnière sans dents.

    Pinna, Modiole, Moule, Anodonte.

2. A charnière garnie des dents.

    A. A une dent.

    Mulette, Crassalette, Paphie, Mactre.

    B. A deux dents.

    a. Simple. Trigonie, Tridacne, Hyppope, Cardite, Lutraire, Petricole, Venericarde, Solen, Capse, Sanguinolaire.

    b. Avec des surnumeraires. Isocarde, Donace, Cyclade, Telline, Venus.

    C. A quatre dents.

    Bucarde, Mérétrice, Lucine.

D. A beaucoup de dents.

Nucule, Petoncle, Arche, Cucullee.

ii. *Inequivalves.*

1. A charnière sans dents.

Acarde, Radiolite, Vulselle, Marteau, Huitre, Avicule, Peigne, Lime, Houlette, Cranie, Hyale, Linqule.

2. A une dent.

Came, Corbule.

3. A deux dents.

Spondyle, Plicátule, Placune, Pandore, Terebratule, Calceole.

4. A plusieurs dents.

Perne.

III. Coquilles Univalves.

i. *Uniloculaires.*

1. Sans spirale.

A. En Calotte.

Patelle, Oscane.

B. En Tube.

Vermiculaire, Silicaire, Arrosoir.

2. En spirale.

A. L'ouverture entière et sans canal à sa base.

Carinaire, Haliotide, Sigaret, Stomate, Argonaute, Concholepas, Nerite, Natice, Helecine, Hellice, Volvaire, Bulle, Jacinthe, Turritelle, Cyclostome, Bulime, Sabot, Toupie.

B. L'ouverture echancrée et canaliculée à sa base.

Cérite, Pyrule, Rocher, Rostelaire, Strombe, Buccin, Casque, Vis, Pourpre, Volute, Ovule, Tarrière, Porcelaine, Cone.

ii. *Multiloculaires.*

Nautile, Orbulite, Ammonite, Planulite, Camérine, Rotulite, Turrilite, Baculite, Spirule, Orthocère, Hippurite, Belemnite.

In this system which we have exhibited, the arrangement is more methodical, and the genera are more definite, than in the Linnæan system. It unquestionably holds the first rank in the modern artificial methods.

There is a class of writers whose labours deserve some notice in this place. We allude to those who have devoted their attention to the very minute shells, so common among the sand on every sea-coast. These are too small to be examined by the naked eye, and from the instrument employed in their investigation, they are usually termed *Microscopic Shells.* Plancus, in his work, *De Conchis Ariminensibus minus notis,* published in 1739, may be considered as the first who drew the attention of conchologists to these nearly invisible objects. J. F. Hoffman, in his *Dissertatiuncula de Cornu Ammonis nativo Littoris Bergensis in Norvegia,* published in the *Transactions of the Electoral Academy of Mentz,* 1757, and in his essay *de Tubulis Vermicularibus Cornu Ammonis referentibus,* ibid. 1761, made us acquainted with various species of minute nautili produced on the northern shores. Nor did those discoveries fail to excite interest in this country. Boys and Walker devoted their attention to the subject, and gave to the world the result of their labours, in a thin quarto, entitled, *Testacea Minuta rariora nuperrime detecta in arena littoris Sandvicensis,* London, 1784. Other observers, equally ardent and successful, have increased our knowledge of the forms of these minute bodies, particularly Soldani, who, in his *Testaceographia ac Zoophytographia parva et micros-*

copica, 1789 and 1795, exhibited many figures of the minute shells of Portoferrara, &c. Mr. Adams likewise described the minute species which he observed on the coast of Pembrokeshire, in the third and fifth volumes of the *Transactions of the Linnæan Society of London*, and other species of British growth have been investigated by the author of *Testacea Britannica*. We shall close this list with noticing the *Testacea Microscopica aliaque minuta ex generibus Argonauta et Nautilus ad Naturam Picta et Descripta*, Vienna, 1798. It is the joint production of L. A. Fichel and J. P. C. A. Moll, and merits an attentive perusal.

We are aware that such microscopic investigations are regarded by some conchologists as useless, so that the minute species are excluded from their systems. But it is surely a strange method of proceeding in natural history, to judge of the merits or importance of species from their size. It is true that we are still ignorant of the inhabitants of those shells, and may long continue to be so; but our present knowledge of these shells has enabled us to fill up many blanks, to perceive several new relations, and even to draw some important conclusions.

That this sort of inquiry has in many instances been injudiciously conducted, all who are acquainted with the subject must admit. Due care has not been taken to distinguish these minute testacea from the fry of the larger shells, so that the number of species has been very injudiciously multiplied. These remarks apply to several figures of Walker, and to a still greater number of those of Adams.

Sect. II.—*Systems constructed from Circumstances connected with the Habits of the Animal.*

The authors of the preceding class have laboured to bring to perfection the artificial system of conchology, and have formed their arbitrary characters, independent of the habits of life of the contained animal. But the naturalists whom we have now to consider, have traced these animals to their lurking places, and arranged them according to the situation in which they reside, instead of the forms which they exhibit.

At the head of this class of conchologists, Dr. Martin Lister stands pre-eminently conspicuous. His great work, entitled *Historia sive Synopsis Methodica Conchyliorum*, was begun in 1685, and completed in 1692. It will long remain a monument of the extensive information and unwearied diligence of its author. The following synoptical view of the work will enable our readers to comprehend its plan; the original should be consulted with care.

Lib. i. De Cochleis terrestribus.

Pars 1. De Buccinis terrestribus.

Pars 2. Cochleæ nudæ terrestres Limaces quibusdam dictæ.

Lib. ii. De Turbinibus et bivalvibus aquæ dulcis.

Pars 1. De Turbinibus.

Pars 2. De Testaceis bivalvibus fluviatilibus.

Lib. iii. De Testaceis bivalvibus marinis.

Pars 1. De Testaceis bivalvibus, imparibus testis.

Pars 2. De Testaceis bivalvibus, paribus testis.

Pars 3. De Testaceis multivalvibus.

Lib. iv. De Buccinis marinis, quibus etiam vermiculi, dentalia et patellæ numerantur.

The plan followed by Sir Robert Sibbald in his *Scotia Illustrata* is somewhat different from that of Lister. He divides the Testacea into two classes, land and water shells, and the latter class he subdivides into fluviatile and marine.

His inferior divisions are destitute of precision, and the number of species referred to limited.

The system of D'Argenville, which was so much esteemed and so long followed in France, is essentially the same with that of Lister in the higher divisions. The plan is indeed so simple, and in appearance so natural, that it has met with many admirers. It has even been useful in encouraging naturalists to study particular departments of the science, when they were prevented by their situation from devoting their attention to the whole. It is probably to this circumstance that we are indebted to Schröter for his observations on the land shells in the neighbourhood of Thangelstadt, and on the river shells of Thuringia.

The preceding arrangements, formed according to the situations in which the animals reside, and not according to their external coverings, may be considered as the first attempts at a natural method in conchology. They serve as an introduction to a new class of authors, whose views may be considered as of a higher order, and to whose labours we shall devote our attention in the following section.

Sect. III.—*Systems constructed from Circumstances connected with the Form and Structure of the contained Animal.*

The first attempt of any consequence to arrange testaceous animals according to the soft parts of their bodies, was made by Adanson, in his *Histoire Naturelle du Sénégal*, published at Paris in 1757. In this system, the ancient classes of Univalves, Bivalves, and Multivalves, are employed under the titles *les Limaçons, les Conques,* and *les Conques Multivalves.*

CLASSE I. Les Limaçons.

Sect. I. Les Limaçons Univalves.

Fam. 1. Les limaçons univalves qui n'ont ni yeux ni cornes.

Fam. 2. Les limaçons univalves qui ont deux cornes, et les yeux placés à leur racine et sur leur côte interne.

Fam. 3. Les limaçons univalves qui ont quatres cornes, dont les deux exterieurs portent les yeux sur le sommet.

Fam. 4. Les limaçons univalves, qui ont deux cornes et les yeux placés à leur racine, et sur le côte externe, ou pas derrière.

Fam. 5. Les limaçons univalves qui ont deux cornes et les yeux posés un peu au dessus de leur racine et sur leur côte externe.

Sect. II. Les Limaçons Operculés.

Fam 1. Limaçons operculés qui ont deux cornes, avec un renflement, et qui portent les yeux ordinairement au dessus de leur racine, et à leur côte externe.

Fam. 2. Limaçons operculés qui ont deux cornes sans renflement, et les yeux placés à leur racine, et sur leur côte externe.

Fam. 3. Limaçons operculés qui ont quatres cornes, dont les deux exterieurs portent les yeux sur leur sommet.

CLASSE II. Les Conques Bivalves.

Fam. 1. Les conques bivalves qui ont les deux lobes du manteaux separés dans tout leur contour.

Fam. 2. Les conques bivalves dont les deux lobes du manteau forment trois ouvertures sans aucun tuyau.

Fam. 3. Les conques bivalves dont les deux lobes du manteau forment trois ouvertures, dont deux prennent la figure d'un tuyau assez long.

The presence or absence of an *operculum* or lid, gives rise, in this system, to a division of the univalves into two sections, and the families are established from circumstances connected with the number of the tentacula, and the number and position of the eyes. The families amongst the bivalves are arranged according to the structure of their cloak or external covering. In the class of multivalves, which we have omitted in the table, the characters are taken from the form and structure of the shell.

The work of Geoffroy, entitled *Traité Sommaire des Coquilles tant fluviatiles que terrestres, qui se trouvent aux environs de Paris*, 1767, is constructed upon the principles of Adanson. Here, however, the objects were not sufficiently numerous to admit of all the subdivisions of that author, but he has made the form of the animal subservient to the construction of generic characters.

After these attempts to classify the animals which inhabit shells had been made in France, the celebrated zoologist of Denmark, O. F. Müller, turned his attention to the same subject. In the *Zoologia Danica*, which contains his digested views of the subject, he employs, in the construction of his genera of univalves, the characters first used by Adanson ; but among the bivalves, besides the form of the tubes or syphon, he notices the construction of the branchiæ and the presence or absence of a foot.

To our knowledge of the animals which inhabit bivalves, Poli, in his expensive work, the *History of the Shells of the Two Sicilies*, made very important additions. In the construction of his families, which are six in number, he employs merely the characters furnished by the syphon and foot. In the first family, the animal has two syphons and a foot ; in the second, there is only one syphon and foot ;

in the third, a syphon and no feet; in the fourth there is an abdominal syphon and no feet; in the fifth there is a foot but no syphon; while, in the sixth, neither foot nor syphon can be discovered. In the formation of his genera, Poli takes advantage of the various forms of the cloak and the branchiæ.

To the celebrated Cuvier, the conchologist is also under the greatest obligations. By applying his vast knowledge of anatomy to the examination of the molluscous animals, he has unfolded many new conformations of parts, and exhibited many unlooked-for relations. The vast collection of objects, the spoils of all the museums of the continent, which Paris once possessed, lay open to his inspection, and his industry appears to have been equal to the harvest which invited him to labour.

In his first attempts to classify the molluscous animals, as contained in his *Tableau Elémentaire de l'Histoire Naturelle des Animaux* (1798); and his *Leçons d'Anatomie Comparée*, (1800-1805), he employed chiefly the characters which the preceding writers had developed, in his inferior divisions; but in his primary distinctions, he distributed the mollusca into three classes: *Cephalopoda*, having the head covered with tentacula, serving as feet; *Gasteropoda*, with the head free, the animal crawling on the belly; and *Acephala*, having no distinct head.

Some years after the appearance of this classification, Cuvier directed more of his attention to the internal structure of the mollusca, and, by means of accurate dissections, obtained a more intimate acquaintance with the organs and functions of these animals than any of his predecessors had acquired. The information which he thus gained was communicated to the public at different periods, in the well-known publication *Annales du Museum d'Histoire Natu-*

relle de Paris. These papers, with some additional observations, were at last published in a separate form, under the title *Mémoires pour servir à l'histoire et à l'Anatomie des Mollusques*, Paris, 1816. In the following year he published *Le Règne Animal, distribué d'après son organisation*, in which he arranged the mollusca according to his peculiar views, from characters drawn exclusively from the animal. In the third volume, of what may be termed the third edition of that invaluable work, published in 1830, the same arrangement, with the exception of a few modifications, was adhered to.

He divides the mollusca into six classes, which he terms *Cephalopoda*, *Pteropoda*, *Gasteropoda*, *Acephala*, *Brachiopoda*, and *Cirrhipoda*.

In the class CEPHALOPODA, the body is in the form of a sack, open above, containing the branchiæ, with a distinct head, surrounded by fleshy elongations or arms, adapted for moving the body or seizing prey. Into this class, along with the Sepia of Linnæus, Cuvier has inserted the multilocular shells of his genus *Nautilus* and the genus *Argonauta*. But it is to be feared, that our knowledge of the testaceous mollusca which inhabit the numerous multilocular shells, is too limited to enable us to assign to all of them their true place in a natural arrangement of animals.

In the second class, termed PTEROPODA, the body is closed, the head is destitute of the long fleshy arms which distinguish the animals of the preceding division; two fin-like membranes, situate on the sides of the neck, and on which the branchial tissue is in general spread, serve as organs of motion. There is only one shelly mollusca belonging to this class, viz., the anomia tridentata of Forskaehl, now forming a part of the genus Hyalœa.

The third class, which includes a great number of naked and testaceous mollusca, and to which Cuvier gives the name GASTEROPODA, from the circumstance of the belly being formed for crawling, has been subdivided into eight orders, from circumstances connected with the organs of respiration.

In the first order, termed *Pulmones*, which breathe air, he has constituted two divisions, the terrestrial and the aquatic. The animals of the former live on land, and were included by Linnæus in his genera limax and turbo. They are the land shells of most authors. Those of the division, termed aquatic, live in the water, but require at intervals to come to the surface to obtain fresh air. They constitute, with a few exceptions, the fresh water shells of naturalists. In the second and third orders, or *Nudibranches* and *Inferobranches*, the species consist almost entirely of genera formed from the animals which Linnæus and many others included in the genus Doris. They are naked mollusca, and are likewise destitute of any internal testaceous plate. The fourth order, termed *Tectibranches*, contains animals whose branchiæ, like small leaves more or less divided, are situate on the right side, or upon the back. The animals of this division possess a shell, but it is in general placed beneath the common integuments, such as the genus *Aplysia* and several species of the genus *Bulla*. The fifth order, termed *Heteropodes*, have the gills plumore and dorsal, with the foot compressed and vertical like a fin, with a small portion of it only formed to act as an organ of adhesion, as in the other gasteropoda. The *Pectinibranches* form the sixth order, and are distinguished by the branchiæ, which are like leaves or threads placed parallel in one, two, or three lines, on the surface of the pulmonary cavity, and by having the sexes separate. It includes the whole of the marine species of the Linnæan genera of turbinated univalves. Into this order, Cuvier, from the consideration of other characters, has inserted the genus *Cyclostoma*, which, according to the characters indicated by the respiratory organs, belongs to the Pulmones.

In the seventh order, termed *Scutibranches*, the branchiæ are similar to those of the preceding order, but the sexes are united, each individual being capable of impregnating or being impregnated. The shells in general are cup-shaped, and destitute of a lid. It includes the genus Halyotis, and many species of the old genus Patella. In the last order, called *Cyclobranches*, the branchiæ appear in the form of small leaves or pyramids strung round the under margin of the cloak. They enjoy a hermaphroditism similar to those of the preceding order. The species of the genus Patella which are allied to the vulgata, and the genus Chiton, are included in this order.

In the fourth class, or Acephala, he includes the bivalve shells, distributing them into families, from characters nearly similar to those which we have pointed out as having been previously employed by Poli.

The fifth class, termed Brachiopoda, contains animals, resembling those of the preceding class in having a cloak of two lobes, but these are always open. The branchiæ consist of small leaves placed on the inner margin of each lobe. In place of a foot they have two retractile fleshy arms, which are extensile. This class includes the Patella unguis of Linnæus, the genus Terebratula and the Patella anomala of Müller.

The class Cirrhipoda, distinguished by the articulated filaments with which the animals are furnished, contains the species of the genus Lepas of Linnæus. The shells belonging to the Linnæan genera Sarpula and Dentalium, are transferred to the class termed Annelides.

This system of the molluscous animals is unquestionably the most perfect of all those which have been published. But, with all its excellence, we must inform the reader, that many species, nay, whole genera, have their places assigned them in this natural method, merely because the shells occupied a similar position in the artificial system, the form of the inhabitants being unknown.

Section IV.—*Mixed Systems.*

In this section, we shall confine our remarks to the only system of this kind of any consequence which has hitherto appeared, and which is the production of the late industrious Lamark, one of the most celebrated zoologists of the French school. The *Système des Animaux sans Vertèbres*, Paris, 1801, of this author, embraces the whole range of animals included in the classes Insecta and Vermes of Linnæus. Where treating of the Mollusca he divides them into two orders. The first, termed *Cephalous,* from possessing a head, includes the univalves. The second, termed *Acephalous,* from the absence of a head, includes the bivalves. This eminent author greatly modified his views, as appears from what he announced in his *Extrait du Cours de Zoologie*, Paris, 1812, the prelude to his last and great work, *Histoire Naturelle des Animaux sans Vertèbres*, the fifth, sixth, and seventh volumes of which refer to the Mollusca, he fortunately lived to finish between the years 1818 and 1822. The arrangement adopted in this invaluable work, has been greatly admired, a circumstance which induces us to give the following synoptical view of its contents.

The species considered by the older naturalists as shells and mollusca, are in this system of Lamark distributed into three great divisions or classes, which he has denominated Cirrhipeda, Conchiferæ, and Mollusca. These classes he has subdivided according to the following tabular view :

CIRRIPEDES.

Animalia mollia, capite oculisque carentia, testacea, fixa. Corpus subresupinatum, inarticulatum, tegumenti appendice involutum, disuper brachiis lentacularibus, cirratis, multiarticulatis instructum.

Os subinferum, non prominulum ; maxillis transversalibus dentatis per paria dispositis. Brachia numero varia, inequalia, biordinata ; singula cerris geminatis, setaceis, multiarticulatis, ciliatis tegumento corneo indutis, pediculo impositis. Anus tubum proboscedeum terminans.

Medulla longitudinalis nodosa, branchiæ externæ, interdum absconditæ ; circulatio corde vasculisque confecta.

Testa vel sessilis vel pediculo flexili tendineo elevata ; valvis pluribus modò mobilibus, modò ferruminatis, tegumenti appendice intus vestitis.

Ordre Premier.—Cirrhipèdes Sessiles.

Leur corps n'a point de pédoncule, et se trouve enfermé dans une coquille fixée sur les corps marins. La bouche est à la partie superiéure et anteriéure du corps.

1. *Opercule Quadrivalve.*

Gen. Tubinicelle, Coronule, Balane, Acaste.

2. *Opercule bivalve.*

Gen. Pyrgome, Creusie.

Ordre Second.—Cirriphèdes Pèdonculés.

Leur corps est soutenu par un pédoncule tubuleux, mobile, dont la base est fixée sur les corps marins. La bouche est presqu' inférieure.

(1.) Corps incomplètement enveloppé par sa tunique. Sa coquille composée de pièces contigües, laisse à l'animal une issue libre, lorsqu'elle s'ouvre.

GEN. Anatife, Pouce-pied.

(2.) Corps tout à fait enveloppé par sa tunique, mais qui offre une overture antérieure. Sa coquille, formée de pièces séparées, n'a pas besoin de s'ouvrir pour la sortie des bras de le animal.

GEN. Cinéras, Otion.

CONCHIFÈRES.

Animalia mollia, inarticulata, in testa bivalvi perpetuo affixa, capite occulisque nullis; ore nudo, abscondito, partibus solidis destituto; pallio amplo, corpus totum amplectante, lobos duos laminiformes formante; laminis vix liberis vel antice coadunatis. Generatio ovo-vivipara; copulatio nulla.

Branchiæ externæ, intra corpus et pallium reconditæ. Circulatio semplex; cor uniloculare. Gangliones aliquot rari; nervi varii; at chorda medullaris nodosa nulla. Testa semper bivales, animal penitus vel partim recondens, modo libera, modo affixa; valvis sœpissime cardine vel ligamento marginali unitis. Partes testaceæ, accessoriæ, vavis alienæ, testam interdum amplificant.

ORDRE I.—CONCHIFÈRES DIMYAIRES.

Ils ont au moins deux muscles d'attache. Leur coquille offre intérieurement deux impressions musculaires séparées et latérales.

1. Coquille régulière, le plus souvent équivalve.

(a) Coquille en général béante aux extrémités latérales, ses valves étant rapprochées.

(*) *Conchifères crassipèdes.* Leur manteau a ses lobes réunis par-devant, entièrement ou en partie; leur pied est épais, postérieur; le baillement de leur coquille est toujours remarquable, souvent considérable.

(1.) Coquille, soit contenue dans un fourreau tubuleux, distinct de ses valves, soit entierément, ou en partie incrustée dans la paroi de ce fourreau, soit saillante au-dehors.

Les Tubicolées.

(2.) Coquille sans fourreau tubuleux.

(*a*) Ligament extérieur.

(†) Coquille, soit munie de pièces accessoires, étrangères à ses valves, soit trés bâillante antèrieurement.

Les Pholadaires.

(††) Coquille sans piéces accessoires, et bâillante seulement aux extrémités latérales.

Les Solénacées.

(*b*) Ligament intérieur.

Les Myaires.

(**) *Conchifères ténuipèdes.* Leur manteau n'a plus ou presque plus ses lobes réunis par-devant ; leur pied est petit, comprimé ; le baillement de leur coquille est souvent peu considérable.

(†) Ligament intérieur, avec ou sans complication de ligament externe.

Les Mactracées, Les Corbulées.

(††) Ligament uniquement exterieur.

Les Lithophages, Les Nymphacées.

(*b*) Coquille close aux extrémités latérales, lorsque les valves sont fermées.

(***) *Conchifères lamellipèdes.* Leur pied est applate, lamelliforme ; non postérieur.

Les Conques, Les Cardiacées, Les Arcacées, Les Nayades.

(2.) Coquille irrégulière, toujours inéquivalve.

Les Camacées.

Ordre II.—Conchifères Monomyaires.

Ils n'ont qu'un muscle, qui semble traverser leur corps. Leur coquille offre intérieurement une impression musculaire subcentrale.

I. Section. Ligament marginal, allongé sur le bord sublinéaire.

(*a*) Coquille transverse, équivalve, à impression musculaire allongée, bordant le limbe supérieur.

Les Tridacnées.

(*b*) Coquille, soit longitudinale, soit subtransverse, à impression musculaire resserreé dans un espace isolé sans border le limbe.

(†) Ligament au bord latéral de la coquille et toujours entier.

Les Mytilaces.

(††) Ligament au bord inférieur de la coquille, ou divisé.

Les Malléaceés.

II. Section. Ligament non marginal, resserré dans un court espace sous les crochets, toujours connu, et ne formant point un tube tendineux sous la coquille.

(*a*) Ligament intérieur ou demi intérieur. Coquille régulaire, à test compact non feuilleté.

Les Pectinides.

(*b*) Ligament intérieur ou demi intérieur. Coquille irregulière, à test feuilleté, quelquefois papyracé.

Les Ostraciees.

III. Section. Ligament, soit nul ou inconnu, soit représenté par un cordon tendineux qui soutient la coquille.

(*a*) Ligament et animal inconnus. Coquille trés-inequivalve.

Les Rudistes.

(*b*) Coquille adhérente, soit immédiatement, soit par un cordon tendineux qui la soutient et lui sert de ligament; l'animal ayant deux bras opposés, cilies et cirreux.

Les Brachiopodes.

MOLLUSQUES.

Animalia mollia, inarticulata, antice capitata; capite plus minusve prominulo, oculis tentaculisque sœpissime instructo, aut brachiis pluribus superne coronato. Os, vel breve, vel elongatum, tubulosum, exsertile, sœpius partibus duris armatum. Pallium varium ; modo marginibus liberis ad corporis latera, modo lobis in saccum coadunatis corpus partim vaginans.

Branchiæ variæ, raro symmetricæ ; circulatio duplex, particularis et generalis. Cor uniloculare ; interdum auriculis duabus divisis et valde remotis. Chorda medullaris nodosa nulla ; at gangliones sparsi rariusculi, nervique varii.

Corpus modo externe nudum, et intus vel partibus solidis destitutum, vel testam aut corpora aliquot dura recondens ; modo extus testa vaginante vel obumbrante tectum. Testa nunquam valvis duabus oppositis et cardine marginali unitis composita.

I. Ordre.—Les Pteropodes.

Point de pied pour ramper, ni de bras pour se trainer ou saisir le proie. Deux nageoires opposées et semblables, propres à la natation. Corps libre, flottant.

1. Hyale ; 2. Clio ; 3. Cléodore ; 4. Limacine ; 5. Cymbulie ; 6. Pneumodermie.

II. Ordre.—Les Gastéropodes.

Animaux a corps droit, jamais en spirale ni enveloppé dans une coquille qui puisse le contenir en entier ; ayant sous le ventre un pied ou disque musculeux uni au corps à peu près dans toute sa longueur, et servant à ramper.

Les uns nus, d'autres ombragés par une coquille dorsale, non engaînante, et d'autres encore contenant une coquille plus ou moins cachée dans leur manteau.

I. Section.—Branchies, quelle qui soit leur possition, s'elevant, soit en fillets, soit en lames, soit en piegnes ou panaches. Elles ne respirent que l'eau.

(Hydrobranches.)

(*a*) Branchies extérieures, placées au-dessus du manteau, soit sur le dos, soit sur ces cotés, et n'étant point dans une cavité particulière.

Les Tritoniens.

(*b*) Branchies extérieures, placées sous le rebord du manteau, et disposées en série longitudinale, soit autour du corps, soit d'un seul coté ; n'étant pas non plus dans une cavité particulière.

Les Phyllidiens, Les semi-Phyllidiens.

(*c*) Branchies placées dans une cavité particulière sur le dos située antérieurement près du cou.

Les Calyptracions.

(*d*) Branchies placées dans une cavité particulière, vers la partie postérieure du dos, et recouvertes, soit par le manteau, soit par un écusson operculaire.

† Point de tentacles.

Les Buléens.

†† Des tentacules.

Les Laplysiens.

II. Section. Branchies rampantes, sous la forme d'un réseau vasculeux, sur la paroi d'une cavité particulière dont l'ouverture est un trou que l'animal contracte ou dilate à son gré. Elles ne respirent que l'air libre.

(Pneumobranches.)

Les Limaciens.

III. Ordre.—Les Trachélipodes.

Le corps contourné en spirale dans sa partie postérieure, cette partie étant séparée du pied, et toujours enveloppée dans une coquille. Le pied libre, aplati, attaché à la base inférieure du cou, ou à la partie antérieure du corps, et servant à ramper. Coquille spirivalve engaînante.

I. Section. Trachélipodes sans siphon saillant, et respirant en général par un trou. La plupart phytiphages et munis de machoires. Coquille à ouverture entiére, n'ayant à sa base ni échancrure dorsale subascendante ni canal.

* Trachélipodes ne respirant que l'air. Coquille spirivalve, mutique non distinctement nacrée.

(a) Ceux qui habitent hors des eaux.

Les Colimacés.

A quatre, } Tentacules.
A deux }

(b) Ceux qui vivent dans les eaux, mais qui viennent respirer l'air à leur surface. Coquille à bords de l'ouverture jamais réfléchis.

Les Lymnéens.

** Trachélipodes ne respirant que l'eau. Branchies saillantes en forme de filets, de lames ou de hupes, dans la cavité branchiale. Coquille souvent nacrée et souvent aussi ayant des parties protubérantes à sa surface.

(a) Coquille fluviatile, operculeé, dont le bord gauche n'imite pas une demi-cloison.

(†) Coquille à bords désunis.

Les Mélaniens.

(††) Coquille à bords réunis.

Les Péristomiens.

(b) Coquille fluviatile ou marine dont le bord gauche imite une demi-cloison.

Les Néritacés.

c. Coquille marine, dont le bord gauche n'imite pas une demi-cloison.

(†) Coquille flottante à la surface des eaux.

Les Janthines.

(††) Coquille non flottante, ayant l'ouverture très évasée ; point de columelle.

Les Macrostomes.

(†††) Ouverture sans évasement particulier ; des plis à la columelle.

Les Plicacés.

(††††) Point de plis à la columelle.

(a) Les bords de l'ouverture réunis circulairement.

Les Scalariens.

(b) Les bords de l'ouverture désunis.

Les Turbinacés.

II. Section. Trachélipodes à siphon saillant, et ne respirant que l'eau qui parvient aux branchies par se siphon. Tous sont marins zoophages, déspourvus de mâchoires et munis d'une trompe rétractile. Coquille spirivalve, engaînante, à ouverture, soit canaliculée, soit échancrée ou versante à sa base.

(a) Coquille ayant un canal plus ou moins long à la base de son ouverture, et dont le bord droit ne change point de forme avec l'age.

Les Canalifères.

(b) Coquille ayant un canal plus ou moins long à la base de son ouverture, et dont le bord droit change de forme avec l'age et a un sinus inférieurement.

Les Aileés.

(c) Coquille ayant un canal court, ascendant postérieurement, ou une échancrure oblique en demi-canal à la base de son ouverture, ce demi-canal se dirigeant vers le dos.

Les Purpurifères.

(d) Point de canal à la base de l'ouverture, mais une échancrure subdorsale et des plis, sur la columelle.

Les Columellaires.

(e) Coquille sans canal, mais ayant la base de son ouverture échancrée ou versante, et ses tours de spire étant larges, comprimés, enroulés de manière que le dernier recouvre presque entièrement les autres.

Les Enroulées.

IV. Ordre.—Les Céphalopodes.

Manteau enforme de sac, contenant la partie inférieure du corps.

Tête saillante hors du sac, couronnée par des bras non articulés, garnis de ventouses, et qui environnent la bouche. Deux yeux sessiles ; deux mandibules cornées à la bouche ; trois cœurs ; les sexes séparés.

1. DIVISION.—CÉPHALOPODES POLYTHALAMES.

Ils ont une coquille multiloculaire, partiellement ou completement intérieure, et enchassée dans la partie postérieure de leur corps.

* Coquille multiloculaire à cloisons simples.

Leurs cloisons ont les bords simples et n'offrent point de sutures decoupées et sinueuses sur la paroi interne du test.

(1.) Coquille droite ou presque droite : point de spirale.

Les Orthocérées.

GEN. Bélemnite, Orthocère, Nodosaire, Hippurite, Conilite.

(2.) Coquille partiellement en spirale ; le dernier tour se continuant en ligne droit.

Les Lituoleés.

GEN. Spirale, Spiroline, Lituole.

(3.) Coquille semi-discoïde, à spire excentrique.

Les Cristacées.

GEN. Rénuline, Cristellaire, Orbiculine.

(4.) Coquille globuleuse, sphéroïdes ou ovale ; à tours de spire enveloppans ou à loges réunies en tunique.

Les Sphéruleés.

GEN. Miliole, Gyrogone, Mélonie.

(5.) Coquille discoïde, à spire centrale, et à loges rayonnantes du centre à la circonférence.

Les Radiolées.

GEN. Rotalie, Lenticuline, Placentule.

(6.) Coquille discoïde, à spire central, et a loges qui ne s'etendent pas du centre jusqu'à la circonférence.

Les Nautilaces.

GEN. Discorbe, Sidérolite, Polystomelle, Vorticiale, Nummulite, Nautile.

** Coquille multiloculaire, à cloisons découpées sur les bords.

Les Ammonées.

GEN. Ammonite, Orbulite, Ammonocérate, Turrilite, Baculite.

2. DIVISION.—CÉPHALOPODES MONOTHALAMES.

Coquille uniloculaire, tout-à-fait extérieure, et enveloppant l'animal.

GEN. Argonaute.

3. DIVISION.—CÉPHALOPODES SÉPIAIRES.

Point de coquille, soit intérieure, soit exterieure. Un corps solide, libre, crétacé ou corné, contenu dans l'intérieur de la plupart de ces animaux.

GEN. Poulpe, Calmaret, Calmer, Sèche.

V. ORDRE.—LES HÉTÉROPEDES.

Corps libre, allongé, nageant horizontalement. Tête distincte ; deux yeux. Point de bras en couronne sur la tête ; point de pied sous le ventre ou sous la gorge pour ramper. Une ou plusieurs nageoires, sans ordre régulier et non disposées par paires.

GEN. Carinaire, Firole, Phylliroé.

The authors of the first class of conchologists which we have mentioned, employ exclusively the characters furnished by the shell, and scarcely deign to tell us that there is an animal attached to that shell. The authors of our third class are anxious to keep the shell out of view, and draw their distinctions from the animal ; but they have failed in the attempt. In extreme cases, the characters of the shell are resorted to in the absence of distinctions furnished by the animal.

Lamark perceived the inconvenience of separating these two modes of examining molluscous animals, and fortunately formed a very natural combination. We shall give his character of the genus Patella, as a specimen of this mixed system.

Patella.

Corpus testa univalvi penitus obtectum ; capite tentaculis duobus acutis, basi externa oculferis. Branchiæ infra veli marginem per totam corporis periphæriam seriatim dispositæ. Orificia pro generatione et ano ad latus dextrum anticum.

Testa univalvis, non spiralis, animal obumbrans, clypiata vel retuso conica, imperforata; fissura marginali destituta ; cavitate simplici ; apice anterius recurvo.

In this manner the generic character is dependent equally on the shell and the contained animal, and that genus in a system is consequently not sufficiently established in which both these characters are not included. How many genera are in this imperfect state ! Were the same plan followed in the description of species, everything we could wish for would be detailed ; and our knowledge of the forms of molluscous bodies would approach to perfection. How much is it to be wished that this plan of Lamark's were generally adopted in this country ! conchology would assume a new aspect, and the number of his votaries would rapidly increase.

The reader will have perceived, in the course of the hasty review of those systems which we have enumerated, that we have refrained from making any remarks on their comparative excellence. This deficiency we now propose to supply in the following observations.

The authors who have arranged testaceous bodies, without reference to the animals that reside in them, appear to have mistaken the house for the inhabitant, and the thing formed for the being that produced it. They have torn asunder objects which are closely related, and united others which differ in structure and economy. These are necessary consequences of an artificial system, and they become more obvious in proportion as we descend in the scale of being.

The examination of shells, according to this method, may be viewed as the study of the osteology of the mollusca. It has not for its object the investigation of living matter, but of dry bones. Nor has it any of those advantages which result from the study of the osteology of the vertebral animals. A knowledge of the bones of these animals enables us to ascertain many of their primary functions, the nature and extent of their powers of motion, and even the food on which they subsist. But our knowledge of shells does not enable us to say, whether the animal can crawl or swim; whether it feeds on plants or animals. The reason is obvious. All the muscles inserted upon the shell are either mere organs of adhesion, or destined to open and shut the valves. None of those muscles connected with any of the primary organs have any connection with the shell. That the shell furnishes several most important characters, we readily grant; but we are here reasoning against the propriety of attending to the shell, to the exclusion of the animal, and, to this extent, our reasoning appears to be conclusive.

We are aware, that, in the other departments of natural history, the appearances which the external parts of an animal exhibit are constantly employed in the construction of orders and genera, and all the intermediate divisions. Thus, for example, the bill, feet, and feathers of birds, furnish the characters by which they are arranged in the system. Here, however, it must be observed, that the combined information yielded by these parts, makes us acquainted with the habits and organization of a bird. By means of these we can judge, and with certainty, not merely of its internal structure, but the places which it frequents, and the food which it consumes. Hence these characters may be applied with equal propriety in an artificial as in a natural method. But what opinion would we form of that ornithologist, who could readily inform us that the cormorant has fourteen tail feathers, and the shag only twelve, but who was ignorant of the haunts of these birds, their food, and the number of their young. We might prize him as a companion in surveying a museum, but he is alike a stranger to science and nature.

Nor can we feel more respect for the student of mere shells. He may be able to tell us the number of whorls in a spiral univalve, or the form of the hinge in a bivalve ; but if he knows not the nature of the organs of respiration, digestion, and reproduction of the animal to which the shell belongs, and contentedly remains in this ignorance, he has yet to learn the value of method in natural history. He cherishes with mistaken fondness the maxim of Linnæus, "Nomina nosse oportet qui rem scire velit," while he overlooks a more important object, expressed in the motto of the Linnæan Society, "Naturæ discere mores."

These remarks apply to the conchological labours of Linnæus and his followers, who have devoted their whole attention to the arrangements of the shells, without attending to the animals. We know that some of the admirers of the Swedish naturalist presume to say, "But our great author was not wholly inattentive to the creatures for which the beautiful and endless diversified receptacles that he had characterised were designed. Among the generic marks was included the name of the molluscous inhabitant ; or, where the animal differed from any which had a place in other parts of his system, he described it at length." (Linn.

Trans. vol. vii. 175.) Now, to what does all this attention of Linnæus amount? In all the species which he has described, he has only noticed the animals of four of these, and in a very slight manner; and, with regard to the name of the molluscous inhabitant which he included in his generic marks, we hesitate not to say, that by this union he has betrayed carelessness. To many British ears these terms may sound harsh, but the proof of their correct application in the present instance will be abundantly evident, if we examine the references to the animals of a few of his genera. The genus *chiton* is thus characterised; "Animal Doris. Testæ plures, longitudinaliter gestæ, dorso incumbentes." Are we not led to conclude from this character, that the animals of the chiton exactly resemble the animals of the doris genus, with the addition of the shells? If this be the case, how artificial is that system which places these two genera in separate orders! Upon turning, however, to the genus doris among his vermes mollusca, we find the following characters assigned to it; "Corpus repens, oblongum, subtus planum. Os antice subtus. Anus postice, supra cinctus ciliis. Tentacula duo, supra corpus antice intra foramina retractilia." Now, the fine fringes around the anus of the doris, which are the branchiæ of the animal, and form the essential character of the genus, are not to be found in the animals of the chiton, whose branchiæ are in the form of leaves placed along the margin of the body, and the anus is a simple pore.

According to the generic character of the mya, the animal is an *ascidia*, with the appendage of a shell. Upon turning to the genus ascidia, we find it said, "Corpus fixum, teretiusculum, vaginans. Aperturæ binæ, ad summitatem; altera humiliore." To prove the impropriety of referring the animal of the mya to the genus ascidia, we shall only mention, that the former has a foot, and possesses a locomotive power; the latter has no foot, remains immoveably attached for life upon the substance to which it at first adhered, and depends on the accidental bounty of the waves for all its nourishment.

The animals of nearly all the univalves are represented as belonging to the genus limax. But, with the exception of the restricted genus helix and bulimus, the animals of the univalves are all generically different from the limax. Their tentacula are generally two in number, with the eyes at the base; while the tentacula are four in the limax, with the eyes at the tips of the two longest. These examples will suffice to establish a truth so palpably obvious.

The principal objection against this system of employing the shell, to the exclusion of the animal, arises from the fact, that nature has not drawn a line of distinction between the mollusca and the testacea. Thus, many of the vermes mollusca of Linnæus include shells in their bodies, as the *aplysia*; and many of his vermes testacea likewise are soft on the outside, the shell being inclosed by the integuments, as the *helix laevigata*, now constituting the genus VELUTINA.

We have another objection to this artificial system, and one which we consider of great force; that, wherever it prevails, the form and habits of the animal are overlooked. How fully is this truth illustrated in the works of the testaceologists of this country! We might examine all their writings, from the *Pinax* of Merret to the *Descriptive Catalogue* of Maton and Rakett, including the works of Pennant, Berkenhout, Da Costa, and Donovan, and learn little more, besides the *habitat*, than that to every shell there is an animal attached. Of this charge the names of Lister and Montagu stand acquitted. The former has given us several good dissections, and the latter minute descriptions of the testaceous animals.

Whilst, in the preceding remarks, we have objected to all arrangements taken exclusively from the characters of the shell, we also disapprove of those systems founded exclusively on the characters of the animal. By the former class of methodists, the simplicity of nature is sacrificed to their peculiar views, and, by the latter, practical utility is disregarded. Devoting their whole attention to the animal, the later naturalists have overlooked the house in which it resides; the roof which shelters it from the blast; and the walls which guard it from its foes. The former observers possessed very limited views of nature, and erected systems obviously artificial. To the systems of the latter, the same objections will apply. Thus, for example, among the univalves of Adanson, the families are formed from the position of the eyes chiefly. That the black points which we witness at the tips or at the base of the tentacula are actually eyes, we readily admit; but what influence have these eyes on the habits of the animal? or rather, does a change of position of these organs occasion a corresponding change in the habits of the animal? Unless this is answered in the affirmative, we must consider such characters as equally artificial with any employed by Linnæus or his followers, since they have no relation to any of the primary functions of life.

The employment of characters taken exclusively from the animal is attended with so many practical difficulties, that it never can be introduced into general practice. If we find a shell thrown ashore, the animal may be dead, or it may refuse for a time to display its organs, and prevent us from arriving at its name and history. This defect, however, is partly remedied when we can call to our aid the characters furnished by the shell.

Another objection against this method arises from the well known difficulties attending the preservation of the soft parts of molluscous animals. To dry these, destroys their form and texture; to inject them is impracticable; and when put into spirits of wine, they generally appear a shrivelled mass. But the coverings of these animals are durable, and, since they form a part of the animal; since they are produced at first along with it, increase by the addition of new matter from its body, and continue attached to it for life; we must condemn any classification from which the shell is excluded.

From these remarks, it will be obvious, that we consider the mixed system as the most natural and the most useful. It possesses all the advantages to which the other systems lay claim, while it is free from their defects. It withdraws part of our attention from the shell, because it is destitute of peculiar vessels, and possesses no vital energy, to fix it on those organs of the animal which are subservient to its existence. It leads us to examine the whole animal, instead of certain parts of it merely, and has a tendency to excite us to become acquainted with the manners of a tribe, from which, imperfect and artificial systems have hitherto withdrawn our attention.

Value of the Characters Employed.

It is of the utmost importance in the formation of any arrangement of natural bodies, to have an exact idea of the relative value of the characters used, and of their true subordination. This is a subject of vast moment, and too little attended to by naturalists. We do not here consider that character as of the highest kind, which is the most general, but that which has the greatest influence over the faculties and instincts of the animal. Had this subject been studied with greater care, the science of conchology would, at this period, have been in a more flourishing condition. To ascertain, in some degree, this subordination of character, is the object of the following observations.

The division of the testaceous mollusca into three orders, as adopted by Linnæus, is confessedly artificial. The Multivalvia of that author possess no characters in common, neither can they boast of a general resemblance. The first genus, *Chiton*, consists of animals which belong to the cephalous and gasteropodous mollusca. The animals of the genus Lepas approach more nearly to the crustacea than the mollusca; while the animals, inhabiting the genus Pholas, belong to the acephalous mollusca, and are closely connected with the Myæ and Solenes. The shells of the first genus are merely calcareous scales, arranged transversely on the back of the animal. The shells of the second genus are variously articulated, fixed, and either sessile or pedunculated. The shells of the third genus are bivalves, with a few accessory calcareous plates. It is to be hoped that modern conchologists will avoid so incongruous a combination.

The two remaining divisions of Linnæus, the bivalves and univalves, are not only obvious, but natural. They indicate the existence of certain forms peculiar to the animals whose shells are thus separated in the system. The univalve shells are inhabited by animals which possess a head, and whose organs of motion are either tentacula situated on the head, or a foot spread over the belly, as in the slug. The animals of the bivalve shells, on the other hand, are destitute of a head; some of them have no locomotive power; and, in others, the organ of motion is a fleshy foot, which the animal can protrude at pleasure. These circumstances point out the connection which subsists between the organs of the animal, and the external forms of the shell; a connection which, in every system, ought to be carefully attended to.

It is somewhat difficult to point out, among the univalves, the true subordination, or relative importance of the characters employed by conchologists in describing them. We have much to learn of their anatomy, and hence we cannot with certainty point out the relation of the parts of the shells to the organs which those parts protect. The form and structure of the mouth of the shell, however, may be expected to furnish characters of the first-rate importance, and have always attracted the notice of the student of testaceous bodies. The very shape of the animal, together with its ordinary habits, must necessarily depend, in a great measure, on the form of the mouth.

In many genera, the mouth of the shell towards the base is produced, and terminates in a groove or beak. These univalves are termed *canaliculated*, and are readily distinguished from those whose mouth is *entire*. The differences in the form of the shell in these two divisions is an index of equally remarkable differences in the form of the animals. The canaliculated shells contain animals possessed of an elongated tube for the purposes of respiration, and this canal is destined for its reception and protection when expanded. The animals whose shells are destitute of this canal, are likewise destitute of this lengthened respiratory tube. Circumstances of this kind induce us to believe, that shells, agreeing in external form, in general, contain animals of a similar organization. We consider this division of the univalves into canaliculated and entire, as obvious and natural.

The next character, in point of importance, appears to depend on the direction of the revolutions of the spire. In general, when a spiral univalve is placed upon its base, or mouth, with its summit towards the observer, the mouth will open on the right side of its axis or pillar, and the whorls will be observed to revolve from right to left, beginning at the base, and ending at the summit. These shells are termed *dextral.* In a few shells, however, this order is reversed. The mouth occurs on the left side of the pillar in the above-mentioned position, and the whorls from the mouth to the summit revolve from left to right. Shells of this sort are termed *sinistral,* sometimes also heterostrophe or heteroclite, and are generally called by dealers *unique.*

In the *dextral shells,* the animals have the external openings of the rectum, penis, and uterus, on the right side of the body, and the heart on the left. In the *sinistral shells,* these organs are placed on the opposite sides. Thus the openings of the rectum and organs of generation are on the left side, while the heart is situated on the right. Here again we have an external character impressed on the shell, which indicates certain arrangements in the organs of the animals. We are aware that some conchologists consider the sinistral shells as accidental varieties, and on that account regard the character which is indicated as of inferior importance. Bosc, indeed, says, "La cause de cette variation dans la direction des spires, vient des circonstances dans lequelles s'est trouvé l'animal au moment de sa naissance, et d'un obstacle qu'il a trouvé lorsqu'il a voulu tourner sa tête du côté que la nature lui a indiqué." This explanation might have been received, had such changes in the direction of the whorls been confined to one individual or two, of particular species. But when we observe all the individuals of particular species, nay even of genera with their whorls thus invariably reversed, we are disposed to regard the occurrence as connected with the primary structure of the animal, and not as the result of accident. Besides, the viscera of the animal of a reversed shell are not placed in the same position in relation to its back or belly, as the animals of the dextral species. A simple change of direction in the spire, therefore, will not convert a dextral into a sinistral species, and the character must be considered as of a higher order than those employed for the separation of the species merely. We consider sinistral shells as belonging to distinct genera from those which are dextral, it being inexpedient to make use of the character for higher divisions.

Among many of the univalves, the animal is furnished with a lid, by means of which it can close up the entrance of the shell after it has withdrawn itself into the cavity. It is in general corneous, sometimes also calcareous. It is usually flat, and attached to the superior and posterior part of the foot of the animal. The shells which possess this lid are generally termed *operculated shells*. They must not be confounded with those land shells of which the animals form a temporary covering to the mouth, previous to winter, for the purpose of protecting them from the vicissitudes of the weather. This lid, in the former case, is permanent, in the latter deciduous ; in the former it adheres to the animal, being in connection with it ; in the latter only to the margins of the mouth of the shell.

This character was first employed by Adanson in the construction of the second section of his class univalves, and has been more or less attended to by succeeding conchologists. It is certainly a very general character, and at first sight might be supposed worthy of forming some of the higher divisions. It appears but rarely in the land shells, more frequently in fresh water shells, and generally in the marine species. It does not, as yet, appear to be connected with any peculiar organization, although it must influence to a certain extent the economy of the animal. Were we, however, to employ it in higher divisions than generic ones, some confusion would certainly arise. It would cause the separation of many genera which are nearly allied, and even divide several natural families. Thus, for example, among the porcellaneous shells, it would separate the *olives* from *cones*, the former being destitute of an operculum, while the latter possess one. These two genera, however, belong to a natural family, the animals of both genera having a respiratory tube upon the head, and the eyes placed on the sides of the tentacula, instead of being situated, as in the other gasteropoda, on the tips or at the base. This circumstance is calculated to convince us of the necessity of caution in the admission of characters. These may at first appear to be of extensive occurrence, and well adapted for the formation of families, but unless they exercise some visible influence on the animal, they can never be employed with propriety in a natural system, however convenient they may be in an artificial arrangement. Operculated shells may be considered as generically different from those which are destitute of that organ, without any injury to the natural method. It would even, in many instances, be convenient.

Amongst univalve shells, considerable differences are observable in the shape and position of the cavity of the shell.

In some cases this cavity is simply conical, while in others it is conico-tubular, either revolving horizontally round a centre, or spirally twisted upon an axis or pillar. These circumstances furnish characters of great importance in an artificial system, as by means of them all testaceous bodies may be arranged into two tribes, the one possessing a pillar, round which the tube of the shell is twisted, while the other is destitute of any pillar. The former have been termed *Stulidia*, the latter *Astulidia*. As a natural character, however, these distinctions are of inferior importance, and, if employed would occasion a separation between the genera Planorbis and Lymnæa, which are demonstrated by Cuvier to be nearly related. In the formation of genera, it may be employed with advantage, even in a natural system, aided by the structure of the pillar, and the direction of the whorl.

The last character which we have to notice while speaking of the univalves, depends on the circumstance of the cavity being entire, or divided into chambers, being *unilocular* or *multilocular*. In the multilocular testacea there are a number of transverse plates, in some species perforated, in others entire, which cross the cavity of the shell, and, in general, divide the external cavity, in which the animal resides, from the older and smaller ones, from which it has receded. In an artificial arrangement, such distinctions may be employed with advantage, even in the formation of the primary divisions, but we entertain doubts as to the propriety of using them in a strictly natural method. We are in a great measure ignorant of the animals which inhabit the multilocular shells, yet as far as our knowledge goes, we are induced to regard the distinction as merely conventional, and as unconnected with any peculiar order of organization. Such a division may be useful in the present state of the science, and may be permitted on that account; but in proportion as our knowledge of the mollusca advances, this distinction will be deemed inexpedient. Indeed, were this division adopted, the genera Argonauta and Nautilus would be torn from each other, although they are, by Cuvier and many others, regarded as members of a family of cephalopodous mollusca. The Nautilus lacustris of Lightfoot, now constituting the genus SEGMENTINA, would, in that case, likewise be separated from the genus Planorbis, with which it is very closely allied. In the meantime, until our knowledge of the multilocular testacea arrives at a greater degree of perfection, such divisions may be employed as convenient, and of easy application.

The preceding remarks apply to those shells which belong to the cephalous mollusca. Among the bivalve shells, which belong to the acephalous mollusca, the characters which they exhibit are of very different degrees of importance. Here, as among the univalves, the appearance of the shell enables us to form an idea of the organization of the animal, so that the characters thus furnished by the shell may be safely employed in a natural system.

The bivalve shells, in general, possess the faculty of moving from one place to another, or of attaching themselves to rocks and stones, by means of temporary threads. These are termed *free* shells. But there are others which secrete at their birth a calcareous cement, which unites the shell to the rock or stone immoveably for life. These last are known by the name of *fixed* shells. If we thus consider the difference in the economy of these two divisions of bivalves, we may reasonably expect to find corresponding differences in their organization. The free shells contain animals endowed with locomotion, and by consequence with feet. In few of the animals which inhabit fixed shells can a foot be observed. They are more simple in their organization than the free shells, and are destitute of absorbing or ejecting syphons, the place of these being supplied by holes in the duplicature of the cloak. This last distinction, however, is not peculiar to the fixed shells, although found in all of them.

Among the free shells, a very important circumstance occurs, which we have already noticed, viz. that some of these adhere to rocks and stones by means of temporary threads produced by the animal. They are termed *byssiferæ*. Independent of the utility of this power of producing threads of attachment, to the economy of the animals, the byssiferæ must possess at least three organs of which the other testaceous mollusca are destitute. The first of these is a gland for the secretion of the substance of which the threads are formed; the second, a foot so constructed as to be capable of spinning these threads and fixing them to the rocks or other bodies to which they are intended to adhere; and the third is a muscle in the animal to which the inner end of these threads may be attached, and which muscle, in general, has the power of contraction and elongation. This character, then, appears perhaps of the very highest order, so that, in a natural arrangement, we might divide the molluscous bivalves into such as spin threads of attachment, and such as do not. We must, however, confess, that the byssiferæ have scarcely any other subordinate characters in common, to warrant such an arrangement.

In general, the valves of which the shell consists close upon each other in such a manner as to leave no opening. In a few genera, however, the valves do not close upon each other at one end, and sometimes at both; the point of union being at one side or in the middle. The former are termed *close* shells, the latter *gaping* shells. The character of gaping, so very obvious in the shell, is an index of equally important distinctions which prevail in the animal. In the gapers, the syphons, or the absorbing and ejecting pipes, are two in number, and very long, and frequently united. The foot is contained in a sheath, from which it issues at the pleasure of the animal. Besides, the branchiæ are always united, and equal in length to the tubes. This character appears, therefore, equally important as the former. It has hitherto been employed in the construction of specific characters merely, rarely of genera.

When the two valves are of the same size and form, the shell is said to be *equivalve ;* but when the one valve differs from the other in these particulars, the shell is said to be *inequivalve.* This character, so obvious and so commodious, is not the index of any peculiar organization of the animal. If employed in the higher divisions, it would separate closely connected genera, and destroy some natural alliances. The inequivalves, however, are for the most part irregular in their growth. The molluscous inhabitants have no lengthened syphon nor foot.

When we examine the inner surface of bivalves, we observe some spots of a different colour and lustre from the general surface. These are the places to which the muscles adhered, which connected the animal with the shell, and are termed *muscular impressions.* They are either separate and lateral, subcentral, or simple, or composite. This character was long employed by conchologists in their specific distinctions, and sometimes in the formation of the genera. It has been more recently employed by Lamark, as a character of the first importance in the division of the bivalves. He forms these shells into two sections, the first containing those shells which have the muscular impressions separate and lateral, and the second such as have only one subcentral, simple, or compound impression. However highly we respect the conchological labours of this naturalist, we cannot join with him in the present instance, and elevate a subordinate character to a primary rank. If, by muscular impressions, he means those marks impressed on the valves of the shells by the muscles which serve to close it, then his character is unconnected with any of the primary functions of the inhabitant. For is it of much consequence whether the valves be brought into contact by the action of one muscle or by the assistance of two? In so far, the character is evidently artificial, when the impressions of the abductor muscles only are employed. But he evidently uses the term in a more extensive sense, to refer to those impressions left on the shell by some of the other muscles by which the animal is attached to it. To the mere conchologist, these marks are of a very uncertain import, and can never enable him to construct natural families, and the student of the mollusca will employ more important distinctions. If we are to take all the muscular impressions into account, the arrangement of Lamark must undergo great alterations. Let us take the common mussel as an example. It is placed by the French Conchologist in the second section, as having only one muscular impression, although no less than four muscles adhere to each valve, destined for the performance of very different functions. The largest impression, which is situate near the obtuse end of the shell and towards the posterior margin, belongs to the abductor muscle, employed in closing the valves. Connected with this impression there is a tongue-shaped mark, reaching nearly to the ligament. This mark is occasioned by one of the lateral muscles for supporting the byssus, and by one of the lateral muscles of the foot. The other muscle for supporting the byssus, is inserted under the teeth which occur at the beak. There is even another mark of adhesion on the margin of the shell, irregularly denticulated, occasioned by the fringed margin of the cloak, which is there united with the shell. This mark may be termed the *marginal impression*. To which of these marks then are we to attach the greatest importance? To the impression of the one abductor muscle, which is common to all shells, —to the marks of the muscle of the byssus, or to the indented mark of the fringed margin of the cloak. If we attend farther to Lamark's arrangement, we shall find the Camacea separated from the Ostreacea, although the two families possess numerous external and internal points of resemblance. We regard the muscular impressions as furnishing a convenient character for the construction of genera, and the discrimination of species, but it is not worthy to occupy so high a rank as Lamark has assigned to it.

As intimately connected with the muscular impressions, we may here notice the *ligament*. It is a horny elastic membrane, which serves to open the valves, when the adductor muscle relaxes. It is placed on the exterior margin in some shells, and is concealed in others. When external, it is stretched when the shell is closed, and when it is internal, it is compressed in similar circumstances. This character is very useful in the construction of genera, but it ought never to be employed in any of the higher divisions. It is not the index of any peculiar organization, neither does it serve to unite natural families. Lamark, without due consideration, regarded it as next in importance to the muscular impressions.

The *teeth* of the hinge of bivalves, since the days of Langius, have been studied with care, and the characters which they furnish have been employed, both in artificial and natural arrangements, in the construction of the primary divisions. It would have been of some advantage to the science, had conchologists ascertained the use of the teeth in the economy of the animal, before forming any divisions from their presence, absence, or position. They do not appear to be the index of any peculiar organization, neither can they be employed to bring together naturally allied families. The use of the adductor muscle is to close the shell; the ligament opens it; and the teeth of the hinge seem destined to modify and direct these movements. The characters furnished by these three parts of the shell appear to be nearly of equal importance, and fit only to occupy a very subordinate place. Were the circumstances connected with the teeth of the hinge to become the foundation of the higher divisions, many natural families would be broken. Thus, the genus anodonta would be removed from the unio, although they are both fluviatile, possess one long subulated foot, one syphon in the form of a hole, the summit of the cloak furnished with cirri, the branchiæ in part re-united, viviparous, carrying the young in the branchiæ. In short, it seems to be a character fit only for generic and specific distinctions.

Bivalve shells have often been divided into equilateral and inequilateral. These differences do not appear to be the signs of any peculiar character of the animal, or any of its functions. They must influence, to a certain extent, the relation between the different parts, but this influence is not sufficiently obvious. The character thus furnished is of an uncertain kind. It is influenced by the age of the individual, and therefore can only be employed with caution in specific distinctions.

The last character of the bivalves which we shall notice is the power which some of them possess of piercing stones and wood for the purpose of forming to themselves a retreat. These are termed *borers*. It was supposed by many that the animal secreted a liquor with which it dissolved the bodies into which it penetrated, but the sagacious Reaumur soon ascertained that the boring was performed by means of a rotatory movement of the larger valves. M. Fleurieu-Bellevue states, that the calcareous stone in which the rupellaria lithophaga is found, is often discoloured in the immediate neighbourhood of its recess. This may arise from other secretions of the animal, or even from the stagnant sea water in the hole, and not from the action of the phosphoric acid, or any other solvent supposed to be employed by the animal. These would act equally on the shell as on the calcareous rock. But the borers are not confined to calcareous rocks, they also lodge in slate-clay, and other argillaceous strata. This is very often the case with the Pholades. But this character can never be extensively employed, as the same species which, at one time, may be found imbedded in stone, will be observed at another seated among the roots of sea-weed, or buried among gravel.

From the preceding remarks it will appear obvious, that there are many characters furnished by the shell, which give us indications of corresponding peculiarities in the structure of the animal, and on that account ought to be employed in every natural arrangement. These characters have this circumstance to recommend them, that they are obvious and permanent. The objects which furnish them can be preserved in our cabinets, and serve to perpetuate our recollection of the appearances which the more perishable parts have exhibited.

There is yet another class of characters to be considered, very variously rated by different authors. These characters are taken from the situation in which shells are found, whether on the land, in fresh water, or in the sea.

This mode of dividing testaceous bodies has not been sufficiently attended to by conchologists, who have, in general, condemned the plan, as founded upon an improper principle, viz., the classification of animals from the places which they frequent, instead of the forms which they exhibit. Such a mode of arranging the higher divisions of the different classes we would readily censure; but when employed in the inferior subdivisions of the testacea, we regard it as an important and a natural character. We ask the true naturalist to say, which is the most important character, the hinge having teeth or wanting projections, and the animal residing in fresh water or in the sea? We anticipate with confidence the preference which would be given to the latter, although the decision might provoke a sneer in a mere collector. Nature has evidently drawn a line of separation between the three tribes, which it is not difficult to perceive.

The terrestrial testacea are destined to live on vegetable matter. Their organs of respiration are suited to the medium in which they reside. Their organs of feeling are, in general, more numerous than those of the fluviatile or marine shells. The tentacula of the latter seldom exceed two, while in the land shells the tentacula are, in general, four in number. The eyes are likewise differently placed; in the aquatic testacea they are situate on the head, at the base of the tentacula; whereas the eyes in nearly all the terrestrial species are placed on the tip of these organs. We might also add, that no bivalve shells are found on the land; they belong exclusively to fresh water and to the sea.

The fluviatile shells, though destined to reside in a different medium from the terrestrial, have in the greater number of genera their organs of respiration (according to Cuvier) nearly the same, and are, therefore, compelled to come occasionally to the surface to respire. They have usually two flat tentacula, with the eyes placed at the base. They may, in general, be distinguished from the marine kinds by the superior thickness of their epidermes, their corneous colour, and semi-transparency.

The marine shells are the most numerous, the most beautiful, and the most highly prized of all the testacea. Many of the univalves of this tribe possess a lengthened respiratory tube, with a canal in the shell for its protection, a circumstance not observed in the fluviatile testacea. There is one circumstance which at once points out the difference in structure between the fluviatile and marine testacea: the fluviatile cannot live in salt water, nor the marine in fresh water. This fact points out an arrangement in their organization to which conchologists ought to pay attention.

These remarks are calculated to persuade conchologists to attend to the character furnished by the habitation of shells. In the formation of genera, it ought to be respected; in the higher divisions it would be inconvenient. The carelessness of Linnæus with regard to this character, is the principal reason why his genus helix is such a confused and indigested mass. Were the distinction arising from habitation to be observed in the distribution of the testacea, no confusion could possibly take place. Some changes might be occasioned by it, but much practical difficulty would be avoided. Indeed, so useful is the distinction, that conchologists, without avowing the propriety of the principle, have in many instances observed it.

Having thus taken a short view of the different characters employed by conchologists in the arrangement of the testacea, and endeavoured to ascertain their relative importance, we shall conclude this part of the article by an application of the principles we have established, to an examination of the Linnæan genera, and to an enumeration of those genera which subsequent naturalists have formed, without, however, attempting to give even an approximation to many of the modern divisions, which have been multiplied beyond all bounds; as our present object is to convey to the reader some farther remarks, illustrative of the history of the science, rather than specific descriptions.

Linnæan Genera.

1. Chiton.—The only change which has taken place in this genus, of any consequence, is its transference to the naked cephalous mollusca, effected by Lamark. The inhabitants bear a near resemblance to those of the genus patella, and belong to the order cyclobranchia of Cuvier. The marginal ligament which connects the testaceous plates, even after the extraction of the animal, is, in fact, the margin of its cloak, and offers, in connection with the notches of the plates, more certain and convenient distinctions for the distribution of the species, than the number or appearance of the valves, a character exclusively employed by Linnæus.

2. Lepas.—This genus has undergone several important

alterations since the days of Linnæus. As originally constructed by that author, it contained shells which differ widely from one another in habit and form. Bruguière, the celebrated French conchologist, separated the fixed shells furnished with an operculum, under the name of *Balanus*, and those which were seated on a peduncle, he retained under the generic name *Anatifer*. He thus suppressed entirely the Linnæan name of the genus. To the name of his first genus, we have no objections, but the second, though it records a curious fact in the history of popular errors, has been injudiciously selected. The name *Lepas* has been retained by the best British writers, who have described seven species which live in our seas. These are distributed into two sections, according as the valves are five or more in number. The *Lepas anatifera* is an example of the first division, and the *L. scalpellum* of the second.

The genus balanus, as thus formed by Bruguière, and represented by the lepas balanus of Linnæus, contained nineteen species. From these Lamark has separated the *B. diadema*, *testudinaris*, and *balanaris*, to form his genus *Coronula*. These shells are conical, and have the compartments formed into twelve areæ, six of these being depressed, and six elevated. They chiefly inhabit the skin of the whale, the base of the shell being placed in the fat. Lamark has likewise formed another genus, from two species analogous to the coronolulæ, which he terms *Tubicinella*, and characterises it thus:—"Testa univalvis, regularis, non spiralis, tubulosa, versus basin attenuata, utrique truncata; apertura orbiculata terminali; operculo quadrivalvi." The lepas striata of Pennant is now the representation of a new genus termed Creusia.

M. Dufresne (*Annales du Museum*, vol. i. p. 465), endeavours to prove by very inconclusive reasoning, that these shells are formed posterior to the birth of the animal. He supposes that, when they become too small to contain the inhabitants on account of their increasing size, the old shells are forsaken, and more commodious dwellings formed, until the animal reaches its full size. Other proof, however, than what the author adduces, is necessary to render the opinion probable.

Lamark, in his *Système des Animaux sans vertèbres*, placed these shells in a separate section at the end of the bivalves, and among the acephalous mollusca. Afterwards he considered them as constituting a particular division of the crustaceous animals; and, lastly, he has assigned them a place in his new class, which he terms CIRRHIPIDES.

3. PHOLAS.—This very natural genus was placed among the multivalves by Linnæus, in the twelfth edition of his system. It is now united with the bivalves, the accessory plates at the hinge being regarded as of subordinate importance. In other respects it has stood the test of modern innovation, with the exception of the genus GASTROCHÆNA of Spengler, in which the teeth are obsolete. This includes the pholas hians of Chemnitz, and the mya dubia of Pennant.

4. MYA.—If we consider as definite the character assigned to this genus by Linnæus himself, we shall find that it excludes many species which differ from the *M. truncata*, at present considered as the type of the genus. In this shell, the valves gape at both extremities, the ligament is internal, and placed on a thick erect tooth in one valve, not inserted into the opposite side. As the M. vulsella of Linnæus is close at both ends, and destitute of a tooth, it has been separated from the true myæ, and formed into a distinct genus by Lamark, under the title VULSELLA. This

shell presented some difficulty to Linnæus, as he placed it at first among the *Pinnæ,* and afterwards among the *Myæ.* Even Bruguière gave it a place among the oysters.

Another genus has been formed by Lamark from the mya siliqua of Chemn. (*Conch.* vol. xi. p. 192, tab. 198, fig. 1934). He calls it GLYCIMERIS. Though nearly related to the true myæ, by gaping at both extremities, yet it differs from them in the hinge, which is destitute of teeth, and in the ligament being external.

A new genus was formed by M. M. Groye, (*Annales du Museum,* vol. ix.), which he terms PANOPEA, and assigns to it the following characters :—"Coquille transverse, baillante inegalement au deux bouts, charnière semblable dans l'une et dans l'autre valve, ayant une callosité ou grosse dent allongée, placée en avant et sur le corselet ; decurrente sur le bord interieur, relevée en arête, mousse et saillant posterieurement ; une dent cardinale conique un peu comprimée et arquée, et sur le valve droit une fosette dans laquelle s'engrène la dent de la valve opposée ; ligament exterieur, crochets peu protuberans, corselet large, deux impressions musculaires dans chaque valve situées vers les extremites." The type of this genus is the mya glycimeris of Gmelin first noticed by Aldrovandus. It is inserted among the British shells by Mr. Donovan upon very slight authority. In the construction of the genus, we think, that M. Groye has acted properly, but there was no necessity surely for changing the trivial name (of the first described species) bestowed upon it by the discoverer. He has added another species from Monte Pulgnasco in Parma. In the trivial name of this species, we consider that he has been guilty of an act of injustice. He has called it *P. Faujas,* in honour of Faujas St. Fond, the zealous Professor of Geology in the Museum of Natural History at Paris. But the truth is, that it was found by M. Cortezi, Counsellor at Parma, and a successful investigator of the organic remains of that district. It ought, therefore, to have obtained the name of P. Cortezi, in honour of the discoverer, instead of the name of Faujas St. Fond, who received it from M. Cortezi, and whose sole merit in the subject consisted in his bringing it in safety to Paris.

The principal error of Linnæus in the construction of this genus, consisted in the insertion of fluviatile shells among his marine species. Bruguière readily perceived this error, and formed a new genus for their reception, which he called Unio. But this group, now denominated Nayades by Lamark, includes the genera unio hyria, anadonta tridina, and, we may add, alasmodon.

5. Solen.—This genus has undergone few changes since the days of Linnæus. The character has been somewhat restricted, and those species have been removed, in which the external margin is a little arcuated, and the cardinal teeth articulated, and two in number, and formed by Lamark into a new genus, which he terms Sanguinolaria. The animals of this genus, according to Poli, differ from the solens, in having the tubes of the syphon separate, and of unequal length and thickness. The *S. minutus* of Linnæus, found in our seas, is referred to the genus Hiatella by Cuvier, a genus very imperfectly defined, but nearly allied to, if it be not identical with, the byssomia of the same author, which includes the mytilus rugosus of Linnæus.

6. Tellina.—This extensive genus of Linnæus, the essential character of which is to have an anterior inflection or fold in each valve, and lateral teeth, includes many shells which differ greatly in form and habit, and which disagree

even with his own definition. Hence several important improvements have taken place in the distribution of the species.

The first change in the genus of any consequence consisted in the separation of the fluviatile from the marine species. This was accomplished by Scopoli, (*Introd. ad Hist. Nat.* 397), who bestowed on them the generic name of *Sphærium*. Bruguière afterwards wantonly changed the name to CYCLAS, and this change has been embraced by Lamark and other naturalists.

Another new genus of fluviatile shells, allied to the preceding, has been formed by Bruguière and Lamark for the reception of one species. The genus is termed GALATHEA, and the species *G. radiata*. There are two approaching hinge-teeth in the right valve, with a cavity in front, and two distant hinge-teeth in the left, with an intermediate large grooved callosity. The lateral teeth are of considerable size. The ligament is external, and the muscular impressions are two in number, and lateral.

The *Tellina inæquivalvis* presents characters which readily distinguish it from the other species with which Linnæus placed it. The shell is inequivalve and inequilateral; the ligament is internal, and the lateral laminæ are wanting. Besides, the animal differs from the other inhabitants of the tellinæ, and is nearly related to the solens. Hence Bruguière formed a new genus for its reception, which he termed PANDORA.

There are several species of the genus tellina and Venus, which Bruguière and Lamark have formed into a separate genus called LUCINA, which is thus characterised:—"Testa bivalvis, æquivalvis, orbiculata, vel ovato transversa; natibus arcuatis, postice versis. Cardo dentibus cardinalibus 1. s. 2. variabilibus; lateralibus 1. s. 2. remotis, interdum subnullis." ... this genus Lamark brings the *Tellina lactea* and *divaricata* of Linnæus, and the *muricata* of Chemn. (*Conch.* vol. xi. p. 209, tab. 199, fig. 1945-6), together with the Venus *fimbriata*, and *Pensylvanica* of Linnæus, and the *Jamaicensis* of Chemn. (*Conch.* vol. vii. p. 24, tab. 39, fig. 408-9). Cuvier, however, has restored the T. lactea to the genus Loripes, which Poli instituted for its reception.

7. Cardium.—This is, perhaps, the best constructed genus which Linnæus formed. The characters are definite and obvious, and all the species are naturally allied. Hence few changes have taken place in their arrangement. The animal constitutes a new genus in the system of Poli, which he terms cerastis.

Cuvier is disposed to constitute a new genus under the title Hemicardia, for the reception of the *C. cardissa* of Chemn., commonly called the Venus-heart cockle. The truncated appearance on the one side, and its being carinated in the middle, point out a conformation of the inhabitant different from the true cockles. Of this new genus we possess some fossil species.

8. Mactra.—The ligament, in the marine bivalves, is, in general, placed on the outside, but in this genus, of which Lamark has formed his family *mactreacea*, the ligament is internal, and inserted in a cavity at the hinge formed for its reception. This family, as it stands at present, contains several well characterised genera.

In the restricted genus, Mactra, as represented by the *M. stultorum* of Linnæus ; the shell gapes a little, and the lateral teeth are strong, and lock into each other. The shells with age arrive at a considerable thickness. The inhabitant belongs to the genus callista in the system of Poli.

The genus Crassatella of Lamark contains shells which close exactly, and have the lateral teeth obsolete. He describes seven fossil species, and eleven recent ones, viz. mactra *glabrata*, (*Encyclopédie Méth.* tab. 257. fig. 3); venus *divaricata* of Martini, (*Conch.* vi. p. 318. tab. 30. fig. 317, 318,) under the title *Crassatella contraria;* and the following new species, *rostrata*, *Kingicola* (from King's Island!) *donacina*, *sulcata*, *subradiata*, *erycinæa*, *cycladea*, and *strata*.

The genus Erycina is composed entirely of fossil species. Lamark has assigned it the following character: "Testa bivalvis, equivalvis, inequilatera, transversa. Dentes cardinales bini, superne divergentes, cum foveola minima intermedia: laterales compressi oblongi. Ligamentum foveola cardinali insertum." From the situation of the ligament being inserted in the small space between the teeth, the pit or cavity is less than in any of the other genera. The muscular impressions are two in number.

The transverse mactræ, which gape, but are destitute of lateral teeth, such as the M. lutraria of Linnæus, compose the genus Lutraria of Lamark. The species already mentioned, and the mya *oblonga* of Gmelin, or mactra *hians* of Montagu, occur on our coasts; the former in great abundance at the mouths of the European rivers.

The genus Ungulina, formed by Daudin, contains only one species, existing in the cabinet of Favanne. It is uncertain from what country it came. It is a regular longitudinal shell. The hinge is formed by one small tooth between two oblique pits. The muscular impressions are two in number. It is figured in Deterville's edition of Buffon. (*Hist. Nat. des Coquil.* tom. xx. f. 2, 3.)

Another genus established by the same author, and termed Erodona, is subtransverse, irregular, and gaping, the hinge, in one valve, consisting of one hollowed tooth, and in the other a depression between two eminences. It includes two shells from the cabinet of Favanne. It is intermediate between the mactræ and myæ.

9. DONAX. The shells of this genus are readily known at first sight by their singular cuneiform shape. The hinge teeth are two in number, and the lateral teeth are spreading. The ligament is external, and, like the tellinæ, it is placed on the shortest side. This is a circumstance of rare occurrence among the inequivalve testacea. The animal belongs to the genus peronæa of Poli.

Lamark has instituted a genus nearly allied to the preceding, termed PETRICOLA, the shells of which gape a little at both ends. There is one hinge tooth in one valve, and a bifid one in the other. The ligament is external; the muscular impressions are two in number; the structure of the hinge teeth, and the absence of the lateral teeth, at once distinguish this genus from the donax and venus. These animals are likewise peculiar in their habits. Lamark quotes the venus lithophaga of Retzius, *Act. Acad. Tour.* vol. iii. p. 11, and the venus lapicida of Chemn. *Conch.* x. p. 356. tab. 172, f. 1664–5. But Lamark's genus has been again altered by Fleurieu-Bellevue, who has formed his genus RUPELLARIA, from the V. lithophagus of Retzius, and another species termed *striata*. (*Mem. de l'Acad. de la Rochelle*, ii. tab. ii, fig. 9.) In this genus the shell is transverse and inequilateral, compressed in the anterior part, and swollen behind. There are two crooked hinge teeth on each valve, one simple, the other bifid. The ligament is external, and there are two muscular impressions. The donax irio belongs to this genus. The same author has formed two other genera of borers. The first he terms Rupicola, having a transverse inequilateral shell, a little gaping at the ends; no teeth or callosities. In an internal projection of each valve, there is a pit for the ligament. The other genus is named Saxicava. It is transverse, inequilateral, and gaping, without teeth, or callosity, or pit. The ligament is external.

10. Venus. This Linnæan genus contains so many species, that there is considerable difficulty in studying it. The formation of new genera, from its members, by diminishing their numbers, must prove highly acceptible to the student of conchology. Lamark has succeeded so far by previously restricting the character of the original as follows: "Testa bivalvis æquivalvis, binæquilatera transversa vel suborbicularis. Dentes cardinales tres in utroque valva, ad nates basi convergentibus. Ligamentum externum, nymphas labiaque obtegens." The three diverging hinge teeth constitute the essential character of the genus, so that Lamark has been able to form three other genera from different characters.

The genus Cytherea (the meretrix of Lamark's *Système des Animaux*) is thus characterised: "Cardo dentibus duobus tribusve approximatis, basi convergentes; uno solitareo remotiuscula sub ano." It must be confessed that the insulated teeth under the lunule, in the absence of other characters, is obviously artificial. This genus contains many species requiring subdivision.

The genus Venericardia, formed for the reception of some fossil species, is thus defined: "Testa bivalvis, æquivalvis, inæquilatera, extus longitudinaliter costata. Dentes cordinales sub-bini crassi obliquè secundi." The number of hinge teeth, and the longitudinal ribs, readily distinguish it from the genus Venus. It is very limited in recent species.

Another genus instituted by Lamark, and termed by him CAPSA, has two teeth in one valve, and a bifid tooth in the other, the type of which he considered to be the donax lavigata of Gmelin.

It was in the construction of the characters of the genus Venus that Linnæus unfortunately indulged in obscene allusions. It is now time that the pages of natural history were freed from such pollution. Other names, more expressive, can easily be substituted, alike advantageous to the interests of science, and the reputation of the illustrious Swede.

11. SPONDYLUS.—The shells which Linnæus included under this head are usually denominated prickly oysters. The genus represented by the *S. gæderopus* of Linnæus. The *S. plicatula* of the same author has been separated from the spondyli, and placed in a new genus, under the name PLICATULA. This genus differs from the former in the valves wanting ears, and in the absence of the triangular unisulcated space at the teeth of the under valve, so characteristic of the parent genus.

12. CHAMA.—This is by no means a well constituted genus in the Linnæan system, as it includes shells possessing very different characters. It has, accordingly, undergone several important alterations. Bruguière proceeded so far by establishing two new genera, and Lamark, following the same plan, has added three more to the number. Those shells, which now belong to the genus CHAMA, are irregular, inequivalve, and adhere to other bodies. The hinge contains only one thick oblique tooth. It is represented by the chama *Lazarus* of Linnæus.

The genus CARDITA, of Bruguière, represented by the *C. variegata*, (Lister, tab. 344, fig. 84.,) consists of equivalve free shells, with the hinge furnished with two unequal teeth, the one situated under the beak, the other lateral, under the anterior margin.

The *chama cor* of Linnæus appeared to Lamark possessed of sufficient characters to constitute a distinct genus, which he has named ISOCARDIA. It is an equivalve, free, regular, heart-shaped shell, with two cardinal teeth, and a separate lateral one, with separate, diverging, involuted beaks. It is an inhabitant of the British Seas.

To Bruguière we owe the institution of the genus TRIDACNA, which is represented by the chama *gigas* of Linnæus, the largest shell in nature. The shell is equivalve and free. The hinge consists of two compressed teeth, and there is a gape at the lunule.

From the preceding genus of Bruguière, Lamark has separated the chama *hippopus* of Linnæus, and formed from it a new genus, which he calls *hippopus*. In its hinge it resembles the tridacna, but differs in the structure of the lunule, which in this is closed.

The genus DICERAS of Lamark, which he formed from the chama *bicornis* of Bruguière, approaches the isocardia in appearance, but the following character which he assigns, is fully sufficient for their discrimination: "Testa bivalvis inæquivalvis, adherens: natibus conicis, maximis, divergentibus, in spiram irregularem contortis. Dens cardinalis maximus, crassus, concavus, auricularis in valvula majore. Impressiones duo musculares." It occurs only in a fossil state.

Before dismissing this Linnæan division of shells, we must notice another genus which has been added to it by Lamark, from species brought from the Indian Seas. He terms it *etheria*, and originally described its generic character in the following words: " Coquille bivalve, inequivalve, irregulière, adherente, a crochets court, enfonces dans la base des valves et deriges de cote. Charnière sans dent; deux impressions musculaires separées et laterales. Ligament demi-interieur, enveloppant une callosite oblongée, et sortant en dehors par une fissure recourbée." He has described four species which are very rugged on the outside, but finely nacred within, and has placed the genus in his family *camacea*, while in external aspect, and in the absence of teeth, the species make a near approach to the *ostreacea*.

13. Arca. Linnæus assimilated, under this genus, every shell the hinge of which presented numerous mutually inserted teeth. The shells which were thus united, have numerous relations, and constitute a very natural family. But in this family there are several groups of which Bruguière formed sections and Lamark genera. The genus arca is now restricted to those shells in which the hinge is in a straight line, and composed of numerous small lamelliform teeth, without lateral ribs. They have obtained their name from their resemblance to a ship, when the shell is inverted. Many species of this genus gape a little at the superior margin, to enable the animal to send out those tendinous threads by which it adheres to the rocks. The *A. lactea*, *noæ*, *tetragona*, *barbata*, and *fusca*, are natives of the British Seas.

The Linnæan arcæ, which have the hinge line broken and angular, belong to the genus Nucula. In this genus the beaks are contiguous and turned a little backwards. The *nucula*, *nuclea*, *minuta*, *rostrata*, and *tenuis*, are found on our shores.

In the genus Pectunculus, the hinge teeth are situated on a curved line, the shell is nearly orbicular, and the muscular impressions, which are two in number, form each a callous projection with a sharp margin. The arca *pilosa*, a native of Britain, is referable to this genus.

In the genus CUCULLÆA, the teeth of the hinge are similar to the arcæ, but at each extremity there are three or four transverse parallel ribs. It is represented by the arca *cucullata* of Chemn. (*Conch.* vii. p. 174. tab. 55. f. 526-528.)

To the family arcacea, Lamark, at one period, added the genus which he terms TRIGONIA. The hinge teeth are only two in number, diverging and compressed, but they are transversely grooved on each side. The muscular impressions are two in number in the recent species, *T. pectinata*, but in some of the fossil shells referred to in this genus, Mr. Sowerby could observe only one. The trigonia now forms along with castalia, the small family of Trigonées formed by Lamark at the suggestion of M. Valenciennes.

14. OSTREA.—Linnæus, in the construction of this genus, brought together many shells totally dissimilar in form, character, and habit, and hence it has undergone great alterations in the hands of succeeding conchologists. To associate in one genus shells which remain immoveably fixed to the rocks and stones from their birth, and which exhibit few other signs of vitality than the opening and shutting of their valves, with those which possess a locomotive power; to unite such as are irregular in their form and imbricated in their structure, with such as are of regular growth and solid texture, might surely be regarded as a violation of all the laws of a natural or an artificial system. Yet of such incongruous materials is the Linnæan genus ostrea composed, which, in spite of all its imperfections, has still its admirers in this country. (See *Descriptive Catalogue, Lin.*

Trans.) The first important improvement in the reformation of the genus, consisted in the separation of the *pectens*, which was executed by Pennant, and afterwards by Bruguière and Lamark. Since new characters have been assigned to the genus ostrea, other separations must take place. It is thus defined: "Testa bivalvis inæquivalvis, rudis adhærens; cardine edentulo. Fossula cardinalis majoris valvæ ætate crescens. Ligamentum semi-internum. Impressio muscularis unica." The genus may be divided into two sections; the first having the margin of the valves simple, as the common oyster; and in the second the margins are plaited, as in the *O. crista-galli*.

In consequence of this change in the generic character, the ostrea *malleus* of Linnæus, (Lister, tab. 219, f. 54.,) has been formed into the genus Malleus. The shell is free, gapes a little at the beaks, produces a byssus, has no teeth in the hinge but a conical pit for the insertion of the ligament, placed obliquely on the margin of each valve. It was for a long time highly prized by collectors.

The genus Pecten is one of the best characterised, most natural, and most beautiful, in the system. The shell is inequivalve and regular, the hinge is destitute of teeth, and the internal ligament is fixed to a triangular cardinal cavity. There are fourteen species natives of our shores.

From the ostrea *perna*, *ephippium*, and *isogonum*, Bruguière formed the genus Perna. The hinge is linear, and cut into a number of lengthened parallel veins, which receive the ligament. The interstices are formed into teeth, which simply oppose those of the other valve. In the anterior side of the valve, near the beaks, there is a callosity, and an opening for the byssus of the animal.

Lamark has constituted another genus, nearly allied to the pernæ, which he styles CRENATULA. The hinge in this genus presents only a row of pits for the ligament, which makes it appear crenulated. The intermediate spaces are not formed into teeth, neither is there any callosity, or opening for the byssus. He has figured two new species, which he terms *avicularis* and *mytiloides*, and a third is the ostrea *picta* of Gmelin, (Chemn. *Conch.* vii. p. 243. tab. 38. f. 575.)

Nearly related to the pectens is the genus LIMA of Bruguière. The species differ, however, in the ligament being in a great measure on the outside. They are all of a white colour. The ostrea *lima* is considered as the type of the genus.

The genus PEDUM of Bruguière differs from the preceding in the ligament being external, and attached to a long straight fissure. The ostrea *spondiloidea* of Chemn. (*Conch.* viii. t. 72. fig. 669, 670,) is considered as the type of the genus.

To this family we must add two genera, possessed of very singular characters. They have neither hinge nor ligament. The first, instituted by the celebrated botanist, Commerson, is termed ACARDO. The valves are depressed and nearly equal, and held together by the adductor muscle. The species at present known come from the eastern coast of Africa. The second is termed *radiolites*, and was instituted by Lamark. It differs from the former in the form of the valves, the inferior being turbinated, and the superior convex or conical. The species occur only in a fossil state, and have been long known to geognosts under the title *ostracites*.

15. ANOMIA. In the Linnæan system, this genus is equally faulty as the last. It contains many species, which

differ greatly from one another and from the generic character. Some are found recent on our shores, while others occur only in a fossil state. Lamark, having rectified the Linnæan character of the genus, has separated many species, now grouped, into distinct genera. In the restricted genus ANOMIA, the under valve has a hole or groove near the beak, which is closed by a testaceous operculum. This appendage is fixed to rocks or stones, and has a ligament attached to it.

In the genus CRANIA, represented by the Anomia *cranolaris* of Linnæus, the under valve is pierced by three holes, which are oblique and unequal. The genus GRYPHÆA was constituted from the Anomia *Gryphus* of Linnæus. The inferior valve is concave, terminating in a spirally involuted beak, projecting upwards ; the upper valve is small, and resembles a lid. A transversely striated pit at the hinge contains the ligament. The only recent species known is called *G. angulata*. Many species are found in a fossil state in the rocks of this country.

Among the Anomia, Linnæus placed the shells which compose the genus TEREBRATULA, the characters of which are so obvious and distinct. In this genus, which is inequivalve and regular, the beak of the larger valve is produced, and pierced with a hole, through which the ligament of adhesion passes. From the great extent of this genus in fossil species, several subdivisions have been proposed.

From the Anomia placenta of Linnæus, Lamark has formed his genus PLACUNA. The hinge is remarkable for two teeth on the one valve, placed like the letter V, the base toward the beak, and two impressions on the other valve. It occurs in the Indian Seas. The natives polish it for ornaments.

To Lamark we are also indebted for having formed the genus CALCEOLA from the anomia *sandalum* of Linnæus. The largest valve is sandal-shaped, and has at the hinge two or three small teeth. The other valve is small, flat, semi-orbicular, and resembles an operculum. It is frequent in a fossil state in Germany.

Mr. Sowerby, in his valuable work on *British Mineral Conchology*, has made us acquainted with several new genera of fossil shells, which, by the older naturalists, would have been inserted in the genus Anomia. The genus PENTAMERUS is an equal-sided inequivalve bivalve, with one valve, divided by a longitudinal internal septum into two parts, the other by two septa into three parts or valves. Beaks incurved, imperforate. He has figured three species of this curious genus.

The genus PLAGIOSTOMA of Sowerby, is represented by the Pectenites *Plagiostomus* of Luid, (tab. 10, f. 639,) and is thus defined: "An oblique eared bivalve, hinge destitute of teeth or internal pit. Line of the hinge straight in one valve, in the other deeply cut by an angular sinus." He gives figures of two species in his first volume, the *gigantea* and the *spinosa*; and many others have been subsequently detected.

The genus DIANCHORA is nearly related to the preceding, but in this the shell is fixed, and the attached valve has an opening in place of a beak. The other valve is beaked and eared.

The anomia *spinosa* of Linnæus probably belongs to Mr. Sowerby's genus PRODUCTUS, which he thus defines: "An equilateral unequal-valved bivalve, with a reflexed, more or less cylindrical margin; hinge transverse, linear; beak imperforate; one valve convex, the other flat or concave externally." But many new genera must be instituted, to embrace all the fossil species which would have been referred by Linnæus to the genus Anomia.

16. MYTILUS. Before proceeding to notice those new genera which have been formed from the Linnæan mytili, we may state, that the three parasitical species of the *Systema Naturæ*, belong to the genus Ostrea, to which they have been transferred by late authors. But improvements of a more important kind have been effected. Linnæus had associated together in this genus both fluviatile and marine shells. The former now constitute a very natural genus termed ANODONTA, formerly referred to, of which the British rivers furnish several species. The muscular impressions are three in number.

It was easy to perceive that the mytilus hirundo of Linnæus did not belong to the true mussels, it being an inequivalve shell. Accordingly Lamark has constituted a new genus for its reception, which he terms AVICULA. The mytilus *margaritiferus* of Linnæus is of this genus.

Lamark, by restricting the characters of the genus mytilus to include such species as have the beak terminal, has in this manner separated the transverse species to form the genus MODIOLA. The mytilus modiolus of Linnæus is the type of the genus. It is common on the British shores, together with the modiola *discors* and *discrepans*. We are at a loss to account for the scruples of Lamark (*Annales de Museuss*, vol. x.) about considering this genus as byssiferous. Had he ever examined the figure of the type of the genus in tab. 53 of *Zoologia Danica*, all his doubts would have been removed.

17. PINNA. No changes have taken place in this Linnæan genus, except that a few new species have been added.

In the course of our review of the Linnæan genera of bivalves, we have exposed some of those errors which the Swedish naturalist committed in associating discordant species under the same genus. Perhaps our examination of the univalves will make us better acquainted with the imperfections of that system, and dispose us to prize those improvements which subsequent naturalists have introduced.

18. ARGONAUTA. This genus, which contains but few species, is highly prised by collectors, who call the principal species by the name of paper nautilus. By restricting the characters of this genus, so as to embrace only those species in which the opening is interrupted by the involution of the spire, and in which the dorsal ridge is double, Lamark has been able to form the genus CARINARIA. In this the mouth is entire, and the dorsal ridge single. It is represented by the argonauta *vitrea* of Gmelin.

18. NAUTILUS. Since the days of Linnæus, our knowledge of the *multilocular* testacea has been greatly enlarged. He contented himself with arranging all the species with which he was acquainted under one genus, but, in consequence of modern industry, even the genera exceed the number of Linnæan species. Many recent species have been discovered by the aid of the microscope, among the sand on the sea shore, and a still greater number in a fossil state among the calcerous strata. These newly discovered kinds exhibit many different characters, and have compelled conchologists to institute so many new genera for their reception, that the genus Nautilus of Linnæus appears rather as the head of a family or order, than as a separate genus of univalve shells. In this department the names of Bruguière, Lamark, Montfort, Parkinson, and Sowerby, deserve respectful notice ; and it is from their writings that the fol-

lowing remarks concerning the multilocular testacea have been extracted. The multilocular testacea may be divided into three sections; the first including those which are obviously spiral; the second, those which are produced; and the third, those which are of a globular or lenticular form. These sections are merely provisional, and are only intended to render more obvious and intelligible our notices of the genera.

1. *The spiral multilocular testacea.* At the head of this first division stands the modern genus NAUTILUS, in which the turns of the spire are contiguous, and the last whorl incloses the others. The partitions are perforated by a tube. We possess on our shores several species of this genus, of which the *N. crispus* is the most common.

In form, the genus LENTICULINA is nearly related to the former. The margin of the mouth reaches to the centre of the shell on both sides, and the partitions are destitute of a syphon. Lamark is in possession of a recent shell of this species from the sea near Teneriff.

The shells which Mr. Sowerby, in his *Mineral Conchology*, has figured under the genus ELLIPSOLITHES, have the whorls conspicuous, although the mouth clasps the body whorl. But it is easily distinguished from the other genera with which it is related by its elliptical form.

The genus DISCORBIS of Lamark (formerly called by him Planulites) bears a considerable resemblance to the nautilus in form, but the whorls are all apparent, and the partitions entire.

In the genus ROTALIA, the spires approach to a conical shape, and the marginated trigonal aperture is reflected towards the base of the shell. It consists of shells which are now found in a fossil state.

The nautilus spirula of Linnæus has afforded characters for the construction of a new genus termed SPIRULA. The whorls are separate, the mouth orbicular, the partitions perforated by a tube, and the last turn of the spire prolonged in a straight line. This last character was unknown to Linnæus, who had only seen the spiral body of the shell.

The genus SPIROLINA has the last turn of the spire produced like the preceding, but the whorls are contiguous. The partitions are perforated by a tube.

The genus LITUOLA is allied to the spirula and spirolina in the production of the last whorl. The spires of the body are contiguous, and the partitions are pierced by a number of holes.

In the preceding genera the inner walls of the cavity are simple ; but in the two following, the walls are formed into joints by sinuous sutures. The first of these is the AMMONITES, including those shells which have been termed *cornua ammonis*. The origin of this name is, by some, sought for in their resemblance to the horns of a ram ; by others, to their having been found near the temple of Jupiter Ammon in Upper Egypt. By the Indians, the *ammonites sacer* is considered as a metamorphosis of the god Vishnu, and termed by them *salgram* or *salgraman*. It is found among the peebles of the Gandica where it joins the Ganges. In this genus the whorls are contiguous, spiral, depressed, and obvious.

The ORBULITES of Lamark differs from the ammonites in the circumstance of the last whorl embracing and concealing the others. In both the syphon is marginal.

Nearly allied to the preceding is the TURRILITES of Montfort. It is similar in internal structure, but while the shells of the former are spirally discoid, those of the present genus are spirally turreted, resembling a Turbo or Turricula. Several species are figured by Sowerby in his *Mineral Conchology*.

The genus SCAPHITES, formed by *Parkinson*, possesses very peculiar characters. It commences with a depressed volution, the last turn of which, after being enlarged and elongated, is diminished and reflected inwards.

2. *Multilocular testacea with the shell produced.* It must be confessed, that the genera of this section are but imperfectly understood. The recent kinds are too small to admit of any investigation of the animal, so that we are left entirely to conjecture.

The genus HIPPURITES is of a conical form, and either straight or crooked. Within it is transversely chambered, and furnished with two lateral, longitudinal, obtuse, converging ridges. The last chamber is closed by an operculum.

In the ORTHOCERA the shell is straight or slightly bent, and conical. The chambers are distinct, and pierced with a tube. We possess on our shores many minute species of this genus.

The genus BACULITES of Faujas St. Fond possesses a structure similar to the ammonites, the inner walls being articulated with sinuous sutures, and the partitions perforated. The shell is fusiform or bent into two parallel limbs. Mr. Parkinson has contributed greatly to our knowledge of this genus, and has termed it *Hamites*. We prefer the name of the original discoverer to that of our English naturalist, which is very faulty. For, according to Pliny, "Hammites ovis piscium similis est."

In the BELEMNITES the shell is straight, conical, pointed, solid at the summit, and furnished with a lateral gutter. There is seldom more than one of the cells apparent, of a conical form, the older ones having been effaced in succession. The genus *Tulaxodes* of Guettard is not, perhaps, entitled to be considered as distinct.

The AMPLEXUS of Sowerby belongs to this division. It is nearly cylindrical, divided into chambers by numerous transverse septa, which embrace each other with their reflected margins. It contains one species from the limestone rocks of Ireland, but we may add that it has been supposed to belong to the zoophytes rather than the mollusca.

3. *Multilocular testacea of a globular form.* The first genus of this section is the MILIOLA. The shell is composed of three or four oval cells, turning round an axis parallel to their longest diameter. Many recent species of this genus are common on our shores; they were included by Montagu in his genus vermiculum.

In the RENULINA the cells are narrow, linear, unilateral, curved into a part of a circle, and all situate on the same plane. The smallest cell forms a little arch round a marginal axis, and the others are placed contiguous to this on the same side. The species are all fossil.

The GYROGONA was for many years viewed as a shell of a spheroidal form, composed of linear, curved, grooved, pieces, terminating in two poles, the external surface obliquely spiral, the spires terminating at each pole, and as found only in a fossil state. But more recent observations have connected it with the seed vessel of the genus chara.

The shells of the genus NUMMULITES are remarkable for their lenticular form. The external surface is smooth, and the cells concealed, but internally the transverse shells are disposed in a spiral discoid form. The cells are imperforate; they are the camerinæ of Bruguière, the helecites of Guettard, and the discolithes of Fortis. This last author supposes, that they are formed in the interior of an animal analogous to the sepia. The same opinion may, with propriety, be entertained of many other genera of multilocular testacea. Faujas St. Fond found a recent specimen of a nummulite among the fragments of the corallina officinalis, brought from the island of Corsica.

It is probable that the genus LAGENA, formed from the serpulæ *lagenæ* of Walker's *Testacea minuta Rariora*, belongs to the multilocular testacea; as in some of the species we have observed the appearances of internal divisions.

As connected with this division of the Linnæan genera, we may take notice of the British shell called by Lightfoot *Nautilus lacustris*, (*Phil. Trans.* lxxvi. tab. 1). The very circumstance of its being a fresh water shell, distinguishes it sufficiently from all those which we have been considering, and its other characters are likewise peculiar. The partitions are distant, and consist of three testaceous plates, not united, which leave a sufficient opening between them to allow the animal to protrude and withdraw itself. It constitutes a distinct genus, which has been termed SEGMENTINA, from the trivial name bestowed on it by Solander, which refers to the structure of the septa. Its place in the system is next to the genus planorbis.

These genera of multilocular shells which we have enumerated, are those which have been established with the greatest attention. Many other genera might have been enumerated, particularly those formed by Montfort, but the character given of them by Cuvier will satisfy the curiosity of the reader. When speaking of the *Conchyliologie Systématique* of that author, in reference to this subject, he says, "*Où presque toutes les espèces et même des variétés sont erigées en genres.*"

19. CONUS.—This genus is so very natural, that it has undergone no changes since the days of Linnæus, except by the addition of new species. That author was acquainted with thirty-five species and a few varieties; but M. Hawss communicated to Bruguière descriptions of one hundred and forty-six, from specimens existing in his own cabinet. We cannot boast of any British species.

20. CYPRÆA.—This genus is equally natural as the former. It has undergone no change since the days of Major.

21. BULLA.—This genus presents to the mere conchologist a source of great perplexity. It displays at once the absurdity of dividing the molluscous animals into testaceous and naked, since no such distinction is observable in nature. Many of the shells which were formerly included in this genus are found to be contained within the common integuments of the animal. It was this circumstance which induced Linnæus to separate the limax and the aplysia from the vermes testacea. Both of these have shells, but they are concealed. In imitation of the same principle, Lamark has formed a new genus among the naked mollusca, called BULLÆA, for the reception of those bullæ in which the shell is concealed. The bulla *aperta* is the type of the genus. The bulla plumula of Montagu is another shell included in the animal, which is very closely connected with the genus *Pleurobranchia* of Cuvier. (*Annales du Mus.* v. 269). It may be asked, are all the other bullæ found in similar situations, and consequently do they belong to the naked mollusca? Lamark considers, and apparently with reason, that all those which are distinctly spirally involuted, and ornamented with colours, are not entirely inclosed in the cloak of the animal, and ought therefore to be ranged with the testaceous mollusca. How few British species does this character include.

As originally constituted, the genus of Linnæus contained species of very different characters, so that many new genera have been formed. To Bruguière, Lamark, and Draparnaud, we owe all the improvements which have taken place.

The modern genus BULLA includes those shells which correspond with the following character :—" Testa univalvis, convoluta, ovato-gibbosa vel cylindracea: spira non exserta, apertura longitudine testæ, labro acuto." The B. ampulla is the type of the genus.

The genus OVULA, instituted by Bruguière, is more nearly related to the cyprea than to the bulla. It differs, however, from the former, in the left margin of the lip being smooth; and from the latter, in the edges of the mouth being rolled inwards, and in the shell being produced at both ends. The B. ovum of Linnæus is the type of the genus; the B. patula of Pennant.

The bulla terebellum has been employed by Lamark to constitute his genus TEREBELLUM. The canal at the base of the mouth, and the truncated pillar, furnish the generic characters.

Linnæus was for some time uncertain where to place those shells which he at last inserted in the genus bulla, under the trivial names ficus and rapa. These, with a few of the *murices* of the same author, constitute the genus PYRULA of Lamark. Its canaliculated base removes it from the bullæ, while the short spire, the swelling of the last whorl, the smooth pillar, and pyriform shape, distinguish it from all those with which it is apt to be confounded. It is more nearly allied to the Fusus than to any other.

The preceding genera consist of species which live in the sea. The B. virginea is a terrestrial shell, and ought to form a distinct genus next the bulinius. The B. fontinalis, hypnorum, and rivalis, reside in fresh water. They have, with much propriety, been formed into a distinct genus by Draparnaud, which he calls PHYSA. They are all sinistral shells, and will require further division when the form of the animal shall become the basis of generic distinction. The *fontinalis* and *hypnorum* are natives of Britain.

In the genus ACHATINA of Lamark, the pillar is truncated as in the terrebellum, but the base of the mouth is entire. It is represented by the bulla achatina of Linnæus. To this genus we may refer the *Buccinum acicula* of Müller, which is found in England, and the *Helix octona* of Linnæus, erroneously considered as a native of Britain.

22. VOLUTA.—This genus, as originally formed by Linnæus, depended, as he informs us, on the plicæ of the pillar, "volutæ genus facillime distinguitur columella plicata." But as this character belongs to many shells otherwise very different in form, succeeding conchologists have separated many species from the genus, and reduced it within more natural limits. As it now stands it is thus defined, "Testa univalvis, ovata, subventricosa, apice papillari; basi emarginata. Columella plicata; plicis inferioribus, majoribus, vel longioribus." The type of the genus is the voluta musica.

Bruguière removed from the Linnæan genus those species which are destitute of a groove at the base of their mouth, and of which Lamark formed the genera AURICULA, TORNATELLA, and VOLVARIA. In the latter the spire is not produced; in the former it is produced. To the genus auricula, which contains land-shells, the *V. auris-midæ* and *auris-judæ* belong. The *V. tornatilis* is the type of the genus tornatella. In his reference to the genus volvaria, Lamark quotes the bulla *cylindracea* of Pennant and Da

Costa, as if they were one and the same. But Pennant's shell is a true bulla, while that of Da Costa is regarded as the voluta *pallida* of Linnæus, and probably belongs to this genus.

In the genus OLIVA, the turns of the spire are separated externally by a very distinct gutter or canal, and the pillar is obliquely striated. The *voluta oliva* of Linnæus contains many different species of this genus, which are remarkable for the smoothness of their surface and the brilliancy of their colours.

The ANCILLA, which, like the former, is of a sub-cylindric form, is destitute of the groove which separates the whorls, and is characterised by an oblique callous ring at the base of the pillar.

In the genus MITRA of Lamark, the spire is pointed instead of ending in a small knob, as in voluta, and the plicæ of the pillar increase in size from the base upwards, which is the reverse in that genus. The *V. episcopalis* of Linnæus is the type of this genus, which contains many species much sought after by collectors.

In the COLUMBELLA, the shell is oval, the spire short, and the inner edge of the right lip is swollen. The *V. mercatoria* is the type of the genus.

The MARGINELLA is very distinctly marked by the prominent callous collar which surrounds the outside of the right edge of the shell. The opening of the mouth at the base is scarcely grooved. The *V. glabella* is the type of the genus.

The CANCELLARIA is nearly related to the genus columbella, but the absence of the swelling of the lip, and the presence of the compressed sharp plicæ of the pillar, furnish sufficiently obvious characters of distinction. The *V. cancellata* of Linnæus is the type of the genus.

In the genus TURBINELLUS the shell is turbinated, subfusiform, and canaliculated at the base, having from three to five transverse compressed plicæ on the pillar. The *V. pyrum* is the type of the genus.

23. BUCCINUM.—This is another of the Linnæan genera of shells, which has undergone great alterations. As originally constructed, it embraced many distinct groups of shells, which Bruguière and Lamark have since formed into genera. The restricted character of the genus Buccinum is thus defined by the last mentioned author : "Testa univalvis, ovata vel elongata. Apertura oblonga, basi emarginata, nudata, canali nullo. Collumella convexa plana."

Bruguière separated the genus CASSIS, in which the opening is oblong and denticulated on the right side, with a short canal towards the back of the shell. The right margin has a callous border. The *Buccinum cornutum* of Linnæus is the type of the species.

The genus TEREBRA was likewise formed by the same author. It is remarkable for its turreted form, the spire being at least twice as long as the mouth, and the pillar at the base twisted.

In the genus NASSA the groove in which the mouth terminates is reflected as in Cassis, but the left edge of the mouth is callous, and forms upon the pillar a transverse fold.

The PURPURA is readily distinguished from the Buccinum and Murex, with which it has often been associated by its naked compressed pillar, ending in a point at the base.

The genus DOLIUM is distinguished by its bellied forms and transverse rings, together with the margin on the right side being denticulated its whole length.

The genus HARPA is well known, and is distinguished by its sharp parallel longitudinal ribs. The pillar is smooth and pointed at the base.

In the genus EBURNEA, the shell is smooth, and the pillar umbilicated and subcanaliculated at the base. The buccinum *glabratum* is the type of the genus.

24. STROMBUS. This Linnæan genus is now converted into a family, distinguished by the right margin changing its form with age, and having towards the base an indenture or sinus. It contains four genera, strombus, rostellaria, pterocera, and hippocrenis.

In the genus STROMBUS, the canal is short, the right margin is simple, and ends in a sinus. The *S. pugilis* of Linnæus is the type of this genus.

In the ROSTELLARIA the canal is produced into a long beak, the right edge of the mouth is entire, and rests above on the spire, and is sometimes decurrent. The sinus is contiguous to the canal. The *R. cornuta* of Mart. (*Conch.* iv. tab. 158. f. 1495,) is the type of the species.

In the PTEROCERA the canal is also lengthened, but the right margin is dilated and digitated with a sinus near the base. The strombus pes-pelicani of our shores is of this genus.

25. MUREX. The modern genus of this name is thus defined by Lamark: "Testa univalvis, ovata vel oblonga; basi caniculata; suturis varicoso-tumudis, sub asperis, longitudinalibus, et persistentibus." In consequence of this restriction, the following genera, among others, have been instituted.

In the genus FASCIOLARIA, the spires are destitute of those longitudinal ribs which the murices always exhibit, while the pillar is furnished with two or three oblique folds. The murex *tulipa* of Linnæus is the type of this genus.

The shell of the genus FUSUS is lengthened, generally fusiform, destitute of longitudinal ribs, and bellied in the middle or lower part with a smooth pillar and lengthened canal. The *F. longicauda*, (Lister, tab. 918, f. 11. A.) is the type.

The PLEUROTOMA is distinguished from the preceding by a sinus or groove, which appears on the margin of the right edge of the mouth, near its summit. It is represented by the M. Babylonicus of Linnæus.

The genus CLAVATULA differs from the former, in possessing a short canal, and ought never to have been separated.

In the genus CERITHIUM, the mouth is oblique, terminating below in a short truncated or recurved canal, and having at the upper part a gutter more or less produced. The *Tympanotonos asper* of Mart. (*Conch.* 4. p. 314. Tab. 156. f. 1473,) is the type of the genus.

26. TROCHUS. This is a very natural genus in the Linnæan system, and has undergone few alterations in the hands of modern conchologists. The T. perspectivus has given rise to a new and very obvious genus, termed SOLARIUM, characterized by the internal spiral edge of the umbilicus being crenulated. Another species, the *T. labio*, is the type of the genus MONODONTA, which contains shells of an oval form, with a rounded mouth, furnished with a tooth, formed by the truncated projecting base of the pillar: the two margins are separated. The turreted trochi of Linnæus constitute the genus PYRAMIDELLA.

The T. terrestris of British writers is so imperfectly described and figured, that it is impossible to assign it a place in the system. It is nearly allied to the helix.

27. TURBO. This very extensive genus has been greatly

dismembered by modern conchologists, in consequence of Lamark having restricted the character in the following terms: " Testa univalvis, conoïdea vel subturrita. Apertura integra rotundata, edentula; marginibus superne semper disjunctis; columella basi planulata." Our T. littoreus is now considered as constituting the genus LITTORINA.

In the genus SCALARIA, the mouth is circular and bordered, with the margins united. The spires are covered with raised edged, slightly oblique, longitudinal ribs. The famous wentletrap is the type of the genus.

Lamark thus defines his genus DELPHINULA: " Testa univalvis subdiscoïdea vel abreviato conica, solida, margaritacea, umbilicata; anfractibus subasperis. Apertura rotundata, marginibus orbiculatim connexis." The *T. delphinus* is the type of the genus. There are many species of turbines common on our shores, which are excluded by the preceding characters from the genera turbo and delphinula, such as the striatus, cingellus, bryereus and others. They are distinctly turreted, with the margins of the mouth united, and constitute a genus termed CINGULA.

The Turbo terebra of Linnæus serves as the type of another genus, termed TURRITELLA, in which the margins of the mouth are disjoined, the spire regularly turreted, and the lip emarginated by a sinus. Nearly allied to the preceding is the genus PHASIANELLA, which Lamark thus defines: " Testa univalvis, ovata vel conica, solida. Apertura longitudinalis, ovata, integra; labro simplici acuto. Columella lævis basi attenuta. Operculum calcareum vel corneum animali adherens."

Perhaps a rigorous examination of the turbines of British writers might justify the formation of one or two new genera. In the genus ODOSTOMIA, the columella is furnished with a tooth. The Turbo interstincta, unidentata, plicata, Sandivicensis and insculpta of Montagu, are of this genus. They have no resemblance in their structure to the Linnæan volutæ; although they have been inconsiderately associated with them by the authors of the *Descriptive Catalogue*. The preceding genera are formed of marine shells; those that follow live on the land.

In the genus CYCLOSTOMA, the mouth is circular, with united, and often reflected margins. The animal is furnished with an operculum. The *T. elegans* of Montagu is the only British species of the genus.

The species which are related to the Turbo bidens perversus and muscorum of Linnæus, constitute a very natural family, which may be termed PUPACEA, distinguished by the mouth being furnished with teeth or testaceous laminæ, and the last whorl nearly the same or less than the preceding. Perhaps the most convenient way of dividing them is into two sections, the first including the dextral, and the second the sinistral shells.

The dextral pupacea form two genera. The PUPA, as originally constructed by Lamark, was equally faulty with many of the old Linnæan genera. As it has been restricted to include dextral shells, with the animal possessing four tentacula, with eyes at the tips of the two longest, it can embrace the *muscorum*, *sexdentatus*, *tridens*, and *juniperi* of Montagu. In the genus CARYCHIUM, formed by Müller, the tentacula are only two in number, with the eyes placed at the base. It is represented by the *T. carychium* of Montagu.

The sinistral pupacea form likewise two genera. The first, which is the Clausilia of Draparnaud, contains sinistral shells, with the animal furnished with four tentacula, with eyes at the tips of the two longest. This contains the following British species, viz. *bidens, perversa, biplicata, plicatula*, and *labiata*. The other genus, called Vertigo, was formed by Müller. The animal possesses only two tentacula, with the eyes on their tips. The *T. vertigo* is the type of the genus.

28. Helix. Linnæus, in constructing this genus, attended only to the character of the mouth being contracted or lunated, without regarding the habits of the animals, or even the other forms which the shells exhibited. Hence he has united globose, discoid, and turreted, terrestrial, fluviatile, and aquatic shells ; animals with two and with four tentacula, with and without an operculum, oviparous and viviparous.

The marine species of Linnæus are few in number. The genus Janthina of Lamark, has been formed from the *H. janthina* of Linn. a species of which has lately occurred at several places of the Irish coast. The opening is triangular, and there is an angular sinus at the right edge. The shell, which Linnæus terms *H. haliotoidea*, is completely concealed in the animal. There are many marine shells inserted in the genus Helix by British writers, which either belong to the restricted genus Turbo, or to the Vermicularia.

The further reduction of the Linnæan helices depends on the separation of the terrestrial from the fluviatile shells, and subdividing these according to the characters furnished by the different groups.

Among the terrestrial shells, the restricted genus Helix is by far the most extensive. It contains those shells which are subglobose, with a convex spire ; the opening entire, wider than long, and diminished in its upper part by the projection of the last turn but one of the spire. The animal is furnished with four tentacula, with eyes at the tips of the two longest. The *H. pomatia* is the type of the genus.

The genus BULIMUS, as originally constructed by Bruguière, was faulty in the extreme, but Lamark has new modelled it so as to include those land shells which are turreted or conical, with the mouth larger than broad, and having, in general, the margin reflected with age. Like the Helices, they have no operculum, and possess four subulated tentacula.

From the Helix succinea of Müller (the putris of Montagu and Donovan, not of Linnæus) Draparnaud has formed the genus SUCCINEA. The mouth is large in proportion to the size of the shell, and effuse at the base with the outer lip thin, and the pillar attenuated. The H. succinea, although found in damp places, is not amphibious. It never enters the water voluntarily. Indeed, Müller says, " Sponte in aquam descendere nunquam vidi, a contra quoties eum aquæ immisi, confestim egrediebatur." The same remark is made by Montagu, and we have often witnessed its truth.

The *Helix pellucida* of Müller has been formed into a new genus by Daudebard, which he termed Helico-limax, but which Draparnaud, to avoid the use of a hybrid name, changed for the term VITRINA.

The fluviatile shells, included by Linnæus in his genus Helix, may, for the sake of present convenience, be considered as forming two sections, viz. those with and those without an operculum. To the former belongs the very natural genus LIMNEA, containing conical or turreted shells, with the right lip joined to the left at the base, and folding back on the pillar. The *H. stagnalis* of Linnæus, is the type of the genus, of which we possess many British species. Two of these are truly amphibious, the octona and fossaria.

The genus PLANORBIS, instituted by Geoffroy or rather by Petiver, is remarkable for its discoid form, the spire revolving nearly in a horizontal line, so that all the whorls are obvious on both sides. Cuvier observed that the *P. cornea* was a sinistral shell, and it remains to be ascertained whether the whorls in the other species have a similar direction. We possess several British species of this genus.

The operculated divisions of fluviatile helices, is more numerous than the preceding, containing at least six genera.

The genus VALVATA was instituted by Müller to include depressed shells with an orbicular mouth, the animal, furnished with three tentacula and a plumose appendage, considered as the branchiæ. The *V. cristata* (Helix crist. of Montagu), and *piscinalis* (the Turbo fontinalis of Montagu,) are natives of this country.

The genus, now denominated PALUDINA, instituted by Geoffroy, and afterwards employed by Montfort, is represented by the *H. vivipara* of Linnæus. The shell is ovate or oblong, with a regularly elevated rounded spire. The aperture is entire, with the two lips united angularly at the summit. The type of the genus, together with *P. tentaculata* and *acuta*, are natives of Britain.

In the genus AMPULLARIA of Lamark, the shell is globose, the base umbilicated, and the mouth longer than broad. The *H. ampullacea* is the type of the genus.

In the genus HELICINA of Lamark, the mouth is semilunar, the pillar callous and compressed below. The *H.*

neritella, (Lister, *Conch.* tab. 61. fig. 59), is the representative of the genus.

In the genus MELANIA of Lamark, the shells are turreted, longer than broad, effuse at the base, with a twisted solid pillar. The *H. amarula* is the type.

The genus MELANOPSIS was instituted by Daudebard to include the shells termed melaniæ by Olivier in his voyage to the Levant. The mouth is lanceolate, the pillar truncated and emarginated above with a callosity at the base.

29. NERITA.—This genus has been subdivided by Adanson and Bruguière into NERITA and NATICA. In the former there is no umbilicus as in the *N. exuvia*, and, in the latter, there is an umbilicus, as in the *N. canrena*. Of the restricted genus nerita, we possess two species; the *littoralis*, common on our shores, and *N. virginea*. There are several species of natica of British growth, the largest of which is the *glaucina*. The fresh water species have been formed by Lamark, with great propriety, into a distinct genus, under the title Neritina. The *N. fluviatilis* occurs in the English rivers.

30. HALYOTIS.—This genus has been dismembered of those species which are destitute of the perforations on the disc. These have been formed into a new genus termed STOMATIA.

31. PATELLA.—This genus, which at first sight appears so very natural, contains shells which exhibit considerable differences, both in form and structure, when narrowly examined. Geoffroy, with great propriety, separated the fluviatile species under the generic title ANCYLUS, a genus afterwards employed by Müller. The animal is essentially distinct from the marine patellæ. There are two species

of this genus, the *lacustris* and *fluviatilis*, natives of Britain.

The genus PATELLA, as circumscribed by Lamark, has been already sufficiently noticed. The common limpit may serve as the type of this genus.

In the genus FISSURELLA, established by Bruguière, there is always an opening like a key-hole, near the summit of the shell. The *F. græca* and *apertura* are found on our coasts.

The genus EMARGINULA is readily distinguished by the slit or indentation which occurs on the posterior margin of the shell.

In the genus CAPULUS of Montfort, the shell is conical, with the summit produced into a beak, more or less recurved, and twisted. The *P. hungarica* of Lister is the type.

The genus CONCHOLEPAS is furnished with an operculum, and in form and habits approaches the buccinum. It is represented by the *P. integra* of Da Costa's *El.* tab. 2. fig. 7.

In the genus CREPIDULA, the cavity of the shell is partially interrupted by a simple diaphragm. The *P. porcellana* is the representative of this genus. The *C. chinensis* inhabits the British seas.

In the preceding genus, the first approach to the turbinated shell makes its appearance, which becomes more obvious in the genus CALYPTRÆA, in which the cavity is furnished with a spiral diaphragm. The *C. equestris* is the type of the genus, which is related in part to the trochi. From this genus of Lamark, Montfort has separated the INFUNDIBULUM, as possessing a central spiral pillar. Sowerby has figured several species of this last genus in his

Mineral Conchology as occurring in a fossil state in Britain.

The patella unguis now ranks as a bivalve, and constitutes the genus LINGULA in the acephalous family brachiopoda of Lamark. Linnæus, who never saw more than one valve, placed it among the patellæ. Chemnitz, who examined both valves, considered it as a pinna. These writers had overlooked the figure of the perfect shell, with its tube or stalk, as given by Seba, vol. iii. fig. 16. No. 4. This specimen, which belonged to Seba, passed into the museum of the Stadtholder, and afterwards reached, in company with the spoils of the other Continental collections, the museum of Paris. Here Lamark examined it, and formed his new genus. And the same specimen enabled Cuvier to investigate its anatomical structure, which he has explained in detail in the first volume of the *Annales de Museum.* Science, in this instance, as well as several others, profited by the successes of the late emperor of the French. This genus is destitute of a hinge. The valves are supported on a peduncle, and the shell is opened partly by the relaxation of the adductor muscle of the animal (and not by the external membrane, as stated by Mr. Sowerby), and partly by the issuing forth of its spiral arms, which push asunder the valves like a wedge.

Another genus was constituted and termed ORBICULA, from the Patella *anomala* of Müller, *Zool. Dan.* vol. i. p. 14. t. 5. The under valve is very thin, and fixed; the upper is orbicular, and depressed. It is a member of the same family as the preceding in the system of Lamark.

32. DENTALIUM.—This very natural genus of Linnæus has undergone no alterations, nor has our knowledge of the

inhabitant been satisfactorily enlarged. The Dentalium *imperforatum*, *trachea*, and *glabrum* of Montagu's *Testacea Britannica*, do not accord with the essential character of the Linnæan genus in being "utraque extremitate pervia."

33. Serpula.—This genus has undergone several changes in the hands of modern conchologists. The *S. seminulum* has been transferred to the genus miliola, and the *S. filogranum* to the tubipora. Besides these trivial alterations, the character has been greatly circumscribed, so as only to include shells which adhere to other bodies, and are tubular, entire and flexuous, with a simple mouth, as represented by the S. contortuplicata of Linnæus. The species which are regularly spiral, discoid, and fixed, as the S. spirorbis, now constitute the genus Spirorbis. But as there are both dextral and sinistral shells with this character, the dextral species may form the genus Spirorbis, while the Heterodisca may receive the reversed species.

The genus Vermicularia is formed from those species which, in appearance, resemble the spirorbis, but are not adherent, such as the *S. lumbricalis*. The shell at the mouth is, in general, somewhat produced. There are two or three minute British shells of this genus.

The genus Siliquaria, represented by the *S. anguina*, is distinguished from the serpula by a longitudinal, lateral, subarticulated fissure, which extends the whole length of the shell.

The genus Penicillus is formed from that curious shell the *S. penis*, and well known by the name of the watering-pot. The disk is perforated by a number of small holes.

34. Teredo.—From this genus, now considered as a bivalve (the tube being regarded as an accessory covering), the Fistulana, of which *T. clava* of Gmelin is the repre-

sentative, has been separated. The external tube in this genus is closed at the posterior extremity, while in teredo it is open. The *S. polythalamia* forms, according to Lamark, the genus SEPTARIA, and the two genera XYLOPHAGA and CLAVAGELLA have more recently been instituted.

35. SABELLA. This last genus of the Linnæan vermes testacea has been degraded from its rank in conchology. The covering consists of agglutinated particles of sand and fragments of shells, and bears no resemblance to the testaceous coverings of the true mollusca. It is now placed in company with the terebella, and the three preceding Linnæan genera among the ANNELIDES.

In the preceding brief review of the Linnæan genera of shells, the reader will probably have been astonished at those changes which have taken place. In this country we are so much accustomed to the artificial method both in zoology and botany, that we often reject, without sufficient consideration, the improvements which the study of the natural method has suggested. In the time of Linnæus, perhaps, the genera of the shells, with a few exceptions, were sufficiently numerous and commodious to embrace all the known species; but since the science has been cultivated with more zeal, in consequence, we must say, of the introduction of the natural method, the number of species has increased tenfold. New genera and orders, and other conventional divisions, have been formed, suited to the state of improvement of the science. The merit of all these improvements did not originate with Bruguière or Lamark, whose names we have so often had occasion to mention. Many of the modern genera may be traced to the systems which prevailed before the days of Linnæus; systems which the Swedish naturalist, in his desire to simplify, when simplicity was impracticable, too incautiously disregarded.

CHAPTER III.

SYSTEMATICAL DISTRIBUTION OF THE MOLLUSCA.

The successful methodical disposition of molluscous animals, could not have been accomplished previous to labours similar to those of Cuvier and Lamark; or until the shell and the contained animal were studied as connected objects. When thus contemplated, molluscous animals admit of arrangement into two great classes, or divisions, which may be distinguished from each other by well-defined characters. In the one, the presence of a head may be recognised, together with eyes, and even ears in some of the groups. In the other, containing animals much less perfect in their organization, there is no head, neither vestige of eyes or ears in any of the species. The former have been termed *Mollusca Cephala*, the latter *Mollusca Acephala*. This arrangement was first employed by Baron Cuvier, and afterwards by Lamark and other modern systematical writers. In the last work of the former naturalist, this method is departed from, and the six classes to which we have already referred, are constituted of equal rank, instead of being placed in subordination to the two primary divisions under which they can be suitably distributed.

DIVISION I.—MOLLUSCA CEPHALA.

Head distinct from the body, bearing the lips or jaws.

The head, or the anterior part of the body on which Zoologists have bestowed that denomination, possesses more or less freedom of motion, and, on the dorsal aspect, supports either tentacula or eyes, frequently both. The animals of this division exhibit so many modifications of form and structure, in all the series of organs, that the positive characters which they possess in common are few in number. They easily admit, therefore, of subdivision into inferior groups which exhibit well-marked characters of distinction. Two of these groups occupy a primary rank, and admit of the others being included under them as subordinate sections. In the first of these, the animals are all inhabitants of the water, and perform their progressive motion through that element by organs fitted for swimming. They are destitute of any ventral disc on which to crawl. In the second group, including animals which inhabit the land, as well as those which live in fresh water and in the sea, progressive motion is performed by means of crawling along the surface of objects, the body resting on a ventral disc termed a foot.

SECT. I.—NATANTIA.—*Organs of progressive motion fitted for swimming.*

The organs of motion are situate near the anterior extremity of the body, and consist either of flexible tentacula or membranaceous expansions. All the species reside in the sea. They are nearly of the same specific gravity with the surrounding fluid in which they float about, having their motions in a great measure regulated by its changes. It is, however, probable, that, by means of some contractile movements, they are capable of varying their density, and of rising or sinking in the water. They swim slowly, even with their utmost efforts. The animals of this section belong to the classes which Cuvier has termed *Cephalopoda* and *Pteropoda*.

Class I.—Cephalopoda.

Fins in the form of tentacula, surrounding the mouth.

The Cephalopoda, in reference to their external appearance, may be regarded as consisting of two parts; the tunic or sac, which contains the viscera, and the head, surrounded by the tentacula. The skin is usually mottled with minute coloured spots, the colour varying in intensity in different spots, and even in different parts of the same spots. These are confined to a thin layer on the outer surface of the true skin. In a living state these spots change their colour in rapid succession as if a coloured fluid was expelled from them or replaced in variable quantity. The sac is, in some species, in the form of a purse, destitute of any appendages, while in others, it exhibits fin-like expansions. It varies considerably in its consistence: in some, it is strengthened on the back internally, by corneous ribs or testaceous plates, and in others, it is protected externally by spiral shells. In some species, it is connected with the head by an intervening space, which may be regarded as a neck, but in others, the tunic and head are continuous behind. In all, it exhibits, after death, great changes of colour.

On the summit of the head there is a flattened disc, in the centre of which is seated the mouth. Round the margin of this oral disc, which is strengthened by a band of muscular fibres, are placed the *arms* or tentacula. Beyond this circle of arms, in some species, there are situated two organs, larger in their dimensions than the arms, which may be denominated *feet*. Both the arms and feet are covered on their central aspect with numerous suckers, by which they are enabled to attach themselves to different bodies, and to seize their prey ; and in their axis, both a nerve and artery may be observed. These arms and feet are capable of being moved, at the will of the animal, in every direction, and are the organs by which progressive motion is performed. In the space between the head and tunic in front, there is an opening or *funnel* with a projecting aperture. This funnel opens into the cavity of the sac, and serves both to convey water to the gills, and to carry off the different excreted matters.

The brain in the Cephalopoda is contained in an irregular hollow ring, in the cartilaginous border of the oral disk. This cartilage is thickest on the dorsal aspect, and contains the parts which have been denominated *cerebrum* and *cerebellum*, the remaining part of the canal being occupied with the collar, which surrounds the esophagus. The nerves, which proceed directly from the brain to the parts which they are destined to influence, are few in number. From the cerebrum a few small nerves issue, which go to the mouth, and the base of the feet, while some proceed to form ganglia at the mouth, and others supply the feet. The cerebellum, besides furnishing the collar which encircles the gullet, contributes to the formation of the large ganglia which supply the arms, the optic and auditory nerves, those for the funnel, the tunic, and the viscera. From the size of the animals, the ganglia of the nerves are very distinctly displayed. The anastomosing branches of the nerves of the arms are likewise conspicuous. Each nerve, at the base of each arm, sends out two filaments, one to the nerve of the arm on each side. In this manner a chain of nerves is formed round the base of the arm, probably calculated to enable them to act more readily in concert. From the abundant distribution of nerves to the different parts, it appears probable that the sense of touch exists in a tolerably perfect manner. There is no proof of the development of organs for the display of the senses of smell and taste.

The Cephalopoda are furnished with two eyes, one on each side of the head. The external membrane on the inner side, which may be compared to the *sclerotica*, differs in many particulars from the covering of the same name in the eyes of the vertebral animals. While it surrounds the contents of the eye from the entrance of the optic nerve to the pupil, it is greatly separated from the choroides. Immediately within its cavity, there is a bag, with a peculiar membranaceous covering, which contains numerous glandular bodies, similar to the milt of fishes, by which the eye is supported, and which probably act as secreting organs (although M. Cuvier could not detect any excretory canals), and likewise an expansion or ganglion of the optic nerve. The concave or anterior surface embraces the *choroides*. This membrane, after enclosing the vitreous humour, forms a zone or diaphragm, which may be compared to the ciliary processes, with an aperture in the centre for the reception of the crystalline lens. The circular margin of this aperture is lodged in a circular groove of the lens, and intimately united with it, so that the lens is divided into two unequal hemispheres. Its central surface is coated, as in the higher classes of animals, with the coloured mucous pigment which has been denominated *pigmentum nigrum*. In the cephalopoda, however, it is of a purplish-red colour.

The optic nerve, after entering the sclerotica, expands into a large ganglion, from the peripheral surface of which, issue numerous nervous filaments. These pierce the choroides by as many holes, and go to form, by their reunion, the retina. This important membrane extends to the ciliary zone, and, like it, appears to unite itself with the groove of the lens.

The vitreous humour is contained in a peculiar vesicle, having the lens seated in a concavity on its external surface. The lens divides easily into two parts, the line of separation being the groove which receives the ciliary ligament. The separated surfaces are flat, and the outer portion is in the form of a planoconvex lens. Each portion consists of a number of concentric layers of variable thickness, composed of radiated fibres, becoming less and less distinct towards the centre, near which the laminated and radiated appearances cease to be perceptible. An imperfect representation of this structure is given by Sir E. Home, probably from preparations by Mr. John Hunter, in the *Phil. Trans.* vol. lxxxiv. tab. 5. p. 26.

The conjunctiva supplies the place of a cornea, and covers directly the crystalline lens, as there is no aqueous humour. This membrane, in some, is continuous with the skin, but in others, there are imperfect eye-lids formed by its duplicature, previous to passing over the lens. The skin, at the opening of the pupil, formed by the sclerotica, in the absence of an *uvea* and *iris*, is strengthened by a membrane which appears to be muscular, and probably assists in the contraction or enlargement of the aperture.

The animals of the cephalopodous class, besides containing complicated eyes, are likewise furnished with ears. These are situate in the annular cartilage which supports the arms. In this cartilage, there are two cavities, in each of which there is a bag filled with a gelatinous, transparent fluid, and containing a calcareous substance, differing in its consistence according to the species, from the brittleness of starch to the hardness of bone. The auditory nerve penetrates the walls of this labyrinth, and ramifies on the membranous bag which it contains. There is no external opening, nor any apparent alteration in the thickness of the investing integuments.

The digestive system of the Cephalopoda exhibits several appearances by which it may be distinguished. The arms which surround the mouth, seize the animals which are to serve as food, and bring them to the mouth. The mouth is situated in the centre of the disc, round which the tentacula are arranged. It is surrounded with a slight fold of the skin, which may be compared to lips, and which is rough on the central aspect. Within the lips are the two mandibles, of a deep brown colour, hard, horny consistence, and in form resembling the beak of a parrot. Where free, they are conico-tubular, but where covered, they are open at the central side. The under beak, unlike the same organ in birds, is the largest, the most crooked, and embraces the upper, or the one on the dorsal margin of the mouth. These jaws are merely able to open and shut, as they possess no lateral motion. They are supported by the muscular bed of the mouth, which serves as a mould to fill the cavity towards the point. The tongue is situate between the beaks, and is armed with reflected teeth. These teeth, in consequence of the undulatory motion of the substance of the tongue, expedite the progress of the food into the gullet.

The salivary glands are four in number, and are placed in pairs. The glands of the first pair, seated on each side of the muscular bed of the mouth, are divided into numerous lobes, the excretory ducts of which pour their fluid into the beginning of the gullet. The second pair, seated lower down and below the eyes, are not so much divided, and send out separate canals, which unite and pour their contents into the mouth.

The gullet is furnished with a lateral expansion, not unlike the crop of gallinaceous birds. The stomach is muscular, like the gizzard of fowls, and the cuticle is thick, and separates easily from the other membranes. At the pyloric opening of the stomach, there is another aperture equally large, which leads into the *spiral stomach*, or cæcum, as it has been improperly termed by some anatomists. It may with greater propriety be denominated the duodenum, as it performs some of the offices of that part of the gut in the higher orders of animals. This stomach is conical, closed at the distal extremity, and performs about a turn and a half, like a spiral shell. Its inner surface is covered with a ridge, which traverses it in a closely spiral direction. The bile flows into it near the apex, and towards its base glandular orifices, pouring out a thick, yellow fluid, may be observed. The intestine, after leaving the pylorus, in some species, makes one or two turns, in others, it proceeds directly to the anus. This opening is seated at the base of the funnel, on its posterior or dorsal side.

The *liver* is of considerable size, of an orange-yellow colour, and of a soft and spongy texture. It gives rise to two hepatic ducts, which proceed to the extremity of the spiral stomach, where, by a common orifice, they empty the orange-coloured bile which they contain.

The organs of circulation consist merely of veins and arteries. The veins which have their origin in the feet, mouth, and annular cartilage, coalesce, and form two branches, which afterwards unite into a common trunk. This vessel, after descending through part of the viscera into the abdomen, divides into two branches, each of which may be considered as a *vena cava*, conveying the blood to the lateral hearts. Each vena cava, at its origin, is joined by an equally large vessel, which empties its contents in a direction nearly at right angles with the former. These veins arise in the stomach, intestines, liver, and organs of generation. The vena cava receives a second large vessel, nearly in the same direction as the first, which has its origin in the tunic and the supports of the branchiæ. From the size of the vena cava, in consequence of the union of these two branches, and the appearance of muscular ridges on its inner surface, it has been compared by some to an auricle.

On each side, in the common cavity of the tunic, and near the gills, an aperture may be observed, the entrance to a bag or cavity. Each cavity is traversed by the vena cava of that side, and in its passage exhibits a curious conformation. The surface of the vein is covered with spongy, glandular bodies of different shapes. These, upon being pressed, pour out an opake, yellow, mucous fluid. Within, these glands communicate by very wide ducts with the cavity of the vein. Indeed, when air is blown into the vein, it readily passes through the glands into the bag, and thence into the cavity of the tunic ; and when air is blown into the bag, it likewise penetrates the gland, and passes into the veins. The arteries with which these glands are furnished are comparatively minute.

It appears probable that these glands separate some principle from the blood, and that this is conveyed away by the ejection of the water from these venous bags into the common cavity. Were it practicable to analyse the yellow mucus which these glands contain, some light might be thrown on the subject. Indeed, it appears not improbable, that this arrangement is analogous in its functions to the urinary system in the most perfect classes.

Each vena cava enters its corresponding lateral heart or ventricle, through an intervening valve. Each lateral heart is situate at the base of each gill, is pear-shaped, black, and moderately thick, with numerous pits on its inner surface. Its narrow end terminates without any valvular structure in the pulmonary artery. In the genus octopus, the lateral hearts are naked; but in the genera Loligo and Sepia, there is suspended from each, by a slender footstalk, a spongy round body, which is concave beneath. The footstalk consists of fibres, which are attached to the surface of the heart, but there is no communication by ducts or vessels. The use of this organ is unknown.

The animals of this class continually reside in the water, and respire by means of gills or branchiæ. These are double, one on each side, corresponding with the lateral pulmonic ventricles. Each gill is connected at its opposite sides to the tunic, by means of fleshy ligamentous bands. Between these, the double leaves of the gills are arranged in an alternate series. Each leaf is supported by a footstalk from the band, and is subdivided into smaller leaves, to expose a greater surface to the water.

The pulmonary artery passes along this band, sends a branch into each footstalk, which, penetrating the substance of the gills, conveys the blood to its different divisions.

The systemic veins depart from the gills at the opposite extremity. These unite at the inferior band, and from each gill a vessel proceeds to the single central or systemic heart or ventricle. In some of the animals of this class the systemic veins are somewhat enlarged, and assume the appearance of auricles. The two pulmonary, or rather the systemic veins, enter the heart at the opposite side, each at the termination being furnished with a valvular organization.

The systemic heart is white and fleshy, and differs according to the genera, in its form, being in the Octopus semicircular, but in the Loligo and Sepia lobed. Besides giving rise to a large aorta, or principal artery, two smaller ones likewise proceed from its cavity. These arteries are furnished at their entrance with valves.

The sexes in the Cephalopoda are distinct, the male and female organs being found on different individuals. There is not, however, any external mark by which they may be distinguished. M. Cuvier found that the males of the Octopus were scarcely a fifth part so numerous as the females.

The male organs of generation consist of the following parts: The *testicle* is a large white glandular purse, containing numerous fringed filaments, from which the seminal fluid is secreted. This fluid passes out of the testicle by a valvular opening, into the *vas deferens*. This canal is slender, and greatly twisted in its course, and opens into a cavity which has been compared to the *seminal vesicle*. The walls of this last cavity are strong and muscular, and disposed in ridges. Near the opening at the distal extremity of this sac is an aperture leading into an oblong glandular body, regarded as exercising the functions of a *prostate gland*. Beyond this lies a muscular sac, divided at the top, where it opens by two ducts, but connected at the base. In this sac are numerous white thread-like bodies, terminated by a filament, but unconnected with the sac. In the interior they consist of a spiral body, connected at each extremity with a glandular substance. When these bodies are put into water, they twist themselves in various directions, and throw out at one of their extremities an opake fluid. These motions are not excited by placing them in oil or spirit of wine, but they may be exhibited by immersing in water those which have been kept for years in spirits.

These bodies, first observed by Swammerdam, and afterwards by Needham, have been regarded by some as demonstrating the truth of the vermicular theory of generation; by others, they have been considered as analogous to the pollen of plants, their tunic is in part soluble in water, and when they are thrown into that fluid, they speedily burst, and spread their impregnating contents over the eggs of the female. Although this last conjecture is plausible, and countenanced by the circumstance that these vermicular bodies are only found at the season of reproduction, the subject is still involved in obscurity. Are these bodies produced in the testicle, and only brought to this bag when nearly ready for exclusion; or, if the product of the bag itself, by what means are they nourished?

The male organs terminate in a cylindrical fleshy body termed the Penis. This is hollow within, and ribbed with muscular bands. Near its base it receives one of the ducts of the vermicular sac, continuous with the one from the prostate gland, forming its canal, and toward the apex the other duct. It projects but a short way into the cavity of the great bag, into which it empties its contents. These pass out of the body at the funnel-form opening in the throat.

The female organs of generation consist of an ovarium and oviduct. The ovarium is a glandular sac, to which the ova are attached by footstalks. The opening by which they issue from the ovarium is wide, and the oviduct (in the *Octopus vulgaris* and *Loligo sagittata,)* after continuing a short way simple, divides into two branches, each having its external aperture near the anus. The oviducts are furnished within with muscular bands and a mucous lining, and encircled with a large glandular zone, destined, probably, to secrete the integuments of the eggs. In the *Loliga vulgaris*, and the *Sepia*, the oviduct continues single. Besides these organs, the *Loliga vulgaris* and *sagittata*, and the *Sepia*, have two large oval glandular bodies, divided by transverse partitions, with their excretory ducts terminating at the anus, the use of which is unknown. The eggs, of the peculiar form already noticed, pass out of the funnel, after which they are supposed to be impregnated by the male, according to the manner of fishes.

The *inky fluid* now remains to be considered, as the most remarkable of the productions of this tribe of animals. The organ in which this fluid is secreted is spongy and glandular. In some species it is contained in a recess of the liver, which has given rise to the opinion, that the coloured fluid which it secreted was bile. In other species, however, this gland is detached from the liver, and either situate in front or beneath that organ. The excretory canal of this gland opens in the rectum, so that the fluid escapes through the funnel. It mixes readily with water, and imparts to it its own peculiar colour. When dried, it is used as a pigment, and is considered as the basis of China ink. It is regarded by Signior Bezio as a peculiar substance which he has denominated *Melaina*. It is obtained by digesting the ink with very dilute nitric acid, until it become yellowish, washing it well, and separating it by the filter; it is then to be frequently boiled in water, one of the washings to be a little alkalized; and, finally, with distilled water. The melaina is a tasteless, black powder, insoluble in alcohol, ether, and water, whilst cold, but soluble in hot water; the solution is black. Caustic alkalis form with it a solution even in the cold, from which the mineral acids precipitate it unchanged. It contains much azote. It dissolves and decomposes sulphuric acid. It easily kindles in the flame of a candle. It has been found to succeed as a pigment in some respects, better than China ink. *(Dub. Phil. Trans.* Nov. 1825.)

The Cephalopoda are all inhabitants of the sea. They are widely distributed, occurring in the arctic as well as the equatorial seas. In the latter, however, they grow to the largest size. It is reported, that in the Indian seas, boats have been sunk by these animals affixing to them their long arms, and that they are dreaded by divers.

The two Linnæan genera, Nautilus and Sepia, comprehend all the animals which are at present considered as belonging to this class.

Order I.—Nautilacea.

Furnished with a multilocular shell.

This order is involved in the greatest obscurity. None of the recent species have been subjected to an accurate examination, so that their connection with the order Sepiacea may still be considered doubtful. Enough is known of the animals of two of the genera, to furnish some hints for those who are fond of classifying animals from their analogies. These genera are SPIRULA and NAUTILUS.

In the *Spirula*, the shell, which is concealed under the skin of the back, is spiral, with the whorls separate, the mouth orbicular, the chambers perforated by a pipe, and the last cell produced into a tube. The position and use of this terminal tube are unknown. The *S. vulgaris* is the most common species, and inhabits the seas in the West Indies. In the restricted genus *Nautilus*, the shell is supposed to be external, and the body of the animal to be lodged in the last chamber, and to be fixed by a ligament which descends into the central pipe. In the shell itself, the turns of the spire are contiguous, and the last whorl embraces the others on the sides. The *N. Pompilus* of RUMPHIUS is the only species in which the animal has been detected.

The other genera which have been formed in this order depend exclusively on the characters furnished by the shells; and the resemblance which these bear to the preceding genera, constitutes all their claim to be included in the present order.

ORDER II.—SEPIACEA.

Destitute of a multilocular shell.

The sac is strengthened by horny or testaceous plates, unless where the habits of the animal render such support unnecessary.

1. *Head surrounded with eight arms and two feet.*

The two feet are nearly similar in their structure to the arms, or tentacula, but considerably larger in their dimensions. They have their origin on the ventral side of the mouth, between that organ and the funnel. The suckers are pedunculated, with their margin strengthened by a corneous ring, furnished with teeth. The sac is furnished with fin-like expansions, and strengthened internally by corneous or testaceous ribs or plates. The head is divided from the sac on all sides by a neck. The margin of the anus is surrounded with tentacula.

GENUS SEPIA. The sac is furnished on each side throughout its whole length with a narrow fin.

The suckers are irregularly scattered on the arms and feet. The back is strengthened by a complicated calcareous plate, lodged in a peculiar cavity. This plate has been long known in the shop of the apothecary under the name *Cuttle-fish bone*, which was formerly much prized in medicine as an absorbent, but is now chiefly sought after for the purpose of polishing the softer metals. It is somewhat ovate, flatly convex on both sides, and thickest where broadest. The superior half, or the one next the head, is the longest, rounded at the extremity, and thin. The inferior portion becomes suddenly narrow, and ends in a point. It may be considered as consisting of a dermal plate, concave on the central aspect, having its concavity filled up with layers which are convex on their central aspect.

According to our observations, the dermal plate appears to consist of three different laminæ, arranged parallel to one another. The external or dorsal layer is rough on the surface, and marked by obscure, concentric arches towards the summit, formed by minute knobs, which become larger towards the base, where they appear in the form of interrupted transverse ridges. It is uniform in its structure, and the tubercles possess a polish and hardness equal to porcellaneous shells, although they blacken speedily when put in the fire, and contain a good deal of animal matter. On the central side of this layer there is one flexible and transparent, similar to horn, and smooth on the surface. The third layer is destitute of lustre ; and, in hardness and structure, resembles mother-of-pearl shells.

The layers which fill the concavity of this dermal plate are slightly convex on the central aspect, and are in part imbricated. Each layer is attached to the concave surface of the dermal plate, by the upper extremity and the two sides, while the inferior or caudal extremity is free. The inferior and first formed layers are short, occupy the base and middle, and rise from the plate under a more obtuse angle than the new formed layers, which are both the longest and the broadest.

Each layer, which is about one-fiftieth of an inch in diameter consists of a very thin plate, the dermal surface of which, when viewed with a magnifier, exhibits numerous brain-like gyrations. From the ventral surface of this plate arise numerous perpendicular laminæ, which, when viewed laterally, appear like fine parallel threads, but when examined vertically, are found to be waved, and fold upon themselves. Next the plate they are thin, and not much folded ; but towards their other extremity they become thicker, striated across, and more folded, with irregular margins. On the thick, tortuous even ends of these laminæ, the succeeding plate rests, and derives from them the peculiar markings of its surface. These laminæ are closely set, irregularly interrupted, and occasionally anastomose. M. Cuvier states, erroneously, (*Mém. sur la Seiche*, p. 47.) that these laminæ are hollow pillars disposed in a quincunx order.

The term *bone* has been improperly applied to this complicated plate; "for," according to Mr. Hatchett, *(Phil. Trans.* vol. lxxxix. p. 321.) "this substance, in composition, is exactly similar to shell, and consists of various membranes, hardened by carbonate of lime, without the smallest mixture of phosphate."

The most remarkable species of this genus is the *Sepia officinalis*, which is distinguished from the others by its smooth skin. It inhabits the British seas, and although seldom taken, its bone is cast ashore on different parts of the coast, from the south of England to the Zetland isles.

GENUS LOLIGO. Calamary. Sides of the sac only furnished partially with fins.

The suckers are disposed on the arms and feet in a double row. The dorsal plate is flexible and corneous, imbedded in the substance of the sac, and is multiplied with years. Dr. Leach has described three new species of the genus Loligo, which were collected by Mr. Cranch during the voyage to the Congo, in that unfortunate expedition under the direction of Captain Tuckey. These species belong to a group which have the suckers produced into hooked processes. In two of these species, *L. leptura* and *Smithii*, the suckers on the arms, as well as the feet, are produced into hooks, while, in one species, *L. Banksii*, the feet only are armed with hooks.

The same distinguished naturalist has instituted a new genus nearly allied to Loligo, from two species collected during the same voyage. The following characters are assigned to it.

"GENUS CRANCHIA.—Body oval, sac-shaped; fins approximating, their extremities free; neck with a frenum behind, connecting it with the sac, and with two other frena, connecting it with the sac before.

"Sp. 1. *Cranchia scabra.*—Sac rough, with hard, rough tubercles.

"Sp. 2. *Cranchia maculata.*—Sac smooth, beautifully mottled with distant ovate spots." (*Narrative of an Expedition to explore the river Zaire, usually called the Congo in South Africa, in* 1816, under the direction of Captain J. K. Tuckey, R. N. London, 1818, p. 410.)

Head surrounded with Eight Arms without Feet.

The suckers have soft margins. The sac is destitute of fin-like expansions, and is either simple or strengthened in the interior by two short corneous processes. The head is united with the sac behind, without the intervention of a neck.

a. Arms all equal in Size.

Genus Octopus.—Suckers arranged in a double row.

The suckers are sessile. The oviduct is double. The margin of the anus is simple. The *Sepia octopodia* of Lin. is the type of the genus.

Genus Eledona.—Suckers on the arms disposed in a single row.

M. Lamark has figured and described two species of this genus, in the *Mém. de la Soc. d'Hist. Nat.* One of these is a native of the Mediterranean, and is remarkable for giving out an odour like musk.

b. Arms unequal.

Genus Ocythoe.—Two of the arms at their inner extremities furnished with membranaceous expansions.

In this genus, which was instituted by M. Rafinesque, the suckers are in a double row, and supported on footstalks. In the specimens of the *Ocythoe Cranchii*, procured during the expedition to the Congo, Dr. Leach observed "four oblong spots on the inside of the tube, resembling the surfaces for the secretion of mucus, two inferior and lateral, and two superior, larger, and meeting anteriorly. On the rim of the sac, immediately above the branchiæ, on each side, is a small, short, fleshy tubercle, which fits into an excavation on the opposite side of the sac." (*Phil. Trans.* 1817.)

This animal was long considered as the fabricator of the shell termed Argonauta or Paper Nautilus. The observations of Mr. Cranch, the zoologist to the Congo expedition, were supposed to have demonstrated that the shell is merely the temporary residence of this animal, which it quits at pleasure. The body of the animal does not conform in shape to the cavity of the shell, nor to all its irregularities of surface ; neither is there any muscular attachment between them. "On the thirteenth of June," (says Dr. Leach, when publishing the notes of Mr. Cranch,) "he placed two living specimens in a vessel of sea-water ; the animals very soon protruded their arms, and swam on and below the surface, having all the actions of the common *Polypus* (octopus) of our seas ; by means of their suckers, they adhered firmly to any substance with which they came in contact, and when sticking to the sides of the basin, the shell might easily be withdrawn from the animal. They had the power of completely withdrawing within the shell, and of leaving it entirely. One individual quitted its shell and lived several hours swimming about, and showed no inclination to return into it ; and others left the shells as he was taking them up in the net. They changed colour, like other animals of the class Cephalopoda ; when at rest, the colour was pale flesh-coloured, more or less speckled with purplish; the under parts of the arms were bluish-grey; the suckers whitish." The specimens which furnished an opportunity for making the preceding observations, were met with in the Gulph of Guinea, and afterwards on the voyage, swimming in a small argonauta, on the surface of the sea. The reader, who is desirous of farther information on this subject, may consult Dr. Leach's *Observations on the Genus Ocythoe of Rafinesque,* Sir E. Home on the *Distinguishing Characters between the Ova of the Sepia, and those of the Vermes Testacea that live in water*, in the *Philosophical Transactions* for 1817, art. xxii. and xxiii., (both of which are added to the appendix of Captain Tuckey's *Narrative,*) and a paper by Mr. Say, on the genus Ocythoe, in the *Phil. Trans.* 1819, art. vii. More recently, however, naturalists seem disposed to reunite the Ocythoe with the Argonauta, though the question cannot be considered as determined.

Class II.—Pteropoda.

Fins formed of membranaceous expansions.

This class was instituted by Cuvier, for the reception of a few genera, the peculiar characters of which indicated the impropriety of suffering them to remain in any of those categories which had been previously established. All the species are small in size; and the attempts hitherto made to investigate their internal structure, have, in a great measure, failed in explaining the functions of the organs which are exhibited. The valuable papers of Cuvier, on the Clio, Pneumodermon and Hyalea, include nearly all the accurate information on the subject, of which naturalists are in possession.

The general form of these animals is somewhat ovate. The tunic appears in some genera, as the Clio and Pneumodermon, to be double, the external one soft and thin, the internal exhibiting a fibrous structure, corresponding to the muscular web of the skin of the higher classes. In these animals, however, the two layers are unconnected throughout the greater part of their expansion. In some, as the Cymbullia, the tunic is cartilaginous, while in others it is strengthened by a shell. In these last, the shell in the Limacina is a spiral univalve, covering the abdominal viscera, and in the Hyalea, where it serves the same purpose, it approaches in character a bivalve shell. It is, however, destitute of a hinge, the two valves being united together at their caudal margins, and there is no appearance of a transverse adductor muscle.

The organs of motion in all the genera consist of two fins, or membranaceous expansions, one being seated on each side of the head. They have no foot wherewith to crawl, nor any suckers by which they can adhere to objects. They are, therefore, free animals moving about in the water by means of their fins, and probably possessing, at the same time, a power of varying their specific gravity, as they are capable of varying, to a certain extent, the form of their bodies, and of enlarging or reducing their dimensions. There is nothing peculiar in their nervous system.

The organs of digestion differ greatly from those of the Cephalopoda, which we have already considered. They are generally regarded as destitute of eyes and ears. Their tentacula are either seated on the head, forming two complicated branches of filaments, or spread along the margin of the tunic. There are no arms for seizing the food. The mouth, however, is furnished with lips; and in some there is an appearance of a tongue at the entrance of the gullet. The salivary glands are two in number, lengthened, descending a considerable way into the abdomen, and pouring their contents, by means of their excretory canals, into the cavity of the mouth. The gullet, after being encircled by the nervous collar, suffers an enlargement, which has been termed a crop, contiguous to which is the stomach. Both these cavities exhibit muscular ridges on the inner surface. The liver surrounds the stomach, is intimately united with its contents, and pours in its bile by numerous pores. The intestine is short, and, after making one or two turns, ascends and terminates in the neck near the mouth.

The circulating system in this class has been but very imperfectly investigated. The pulmonic vessels are unknown, but systemic veins, a single auricle, ventricle, and aorta, have been detected. The heart, in some, is situate on the left, in others, on the right, side of the body.

The aërating organs exhibit very remarkable differences. In the Clio they are in the form of a fine net-work on the surface of the fins; in the Pneumodermon they are conjectured to form leaf-like ridges on the caudal extremity of the body; or if these ridges are to be considered as particular kinds of fins, the gills may be sought for on the membranaceous expansions of the neck. In the Hyalea the branchiæ form a complex band on each side of the body, at the lateral opening of the shell.

The animals of this class are all hermaphrodites. There is a common cavity, a vesicle, penis, vas deferens, and testicle, together with an oviduct and ovarium. These open near the mouth on its ventral margin. There is nothing known with respect to the appearance of the eggs, the period of propagating, or the form of their young.

All the animals of this class inhabit the sea. Some, as the Clio and Limacina, frequent the arctic regions, and afford the whale a great part of its sustenance. None of the species have hitherto been detected in the British seas.

M. Cuvier divides the animals of this class into cephalous and acephalous. In the latter division he places the genus hyalea. The head of the animal of this genus, with its inferior neck, may, however, be sufficiently recognised to remove all doubt of its existence.

The characters which may be employed in the classification of this group are numerous ; but the influence which their different forms exercise on the habits of the species is still unknown. The following disposition of the genera, though it has no claims to a natural division, may be useful to the student in his investigations.

(1.) *Tunic Strengthened by a Shell.*

GENUS LIMACINA.—Posterior extremity of the body covered by a spiral shell.

The shell, which is very tender, makes one turn and a half, is flat on one side, with a large pillar cavity on the other. The fins are two in number, one on each side of the neck. When the animal swims, the head with the fins are protruded.

This genus was instituted by Cuvier, for the reception of the *Clio helicina* of Captain Phipps, or *Argonauta arctica* of Fabricius. According to Mr. Scoresby, it is found in great quantities near the coast of Spitzbergen.

GENUS HYALEA.—Posterior extremity of the body protected by two connected shelly valves.

In the animals of this genus, the body is lodged between two plates or valves, united at the base, where they inclose the caudal extremity. The ventral valve is nearly flat, with an uneven margin, narrow anteriorly, but expanding behind, and terminating in three projecting points. From the middle point four ribs diverge forward, and a muscle arises, which, fixed in the superior viscera, enables the animal to withdraw into the shell. The dorsal valve is shorter than the preceding, the margin flat and circular, and the middle convex outwardly. The branchiæ are situate in the space between the lateral margin of the two valves, on each side, in a duplicature of the tunic, the sides of which are furnished with filaments. The fleshy neck supports the two membranaceous expansions; between which and the base the mouth is situate, surrounded by two lips, and strengthened within by two fleshy cheeks. The opening of the anus and oviduct are at the base of the right fin.

The *Hyalea tridentata*, the best known species of the genus, was first noticed by Forskäl, in his *Descriptiones Animalium*, p. 124, as an Anomia, and inhabiting the Mediterranean. The same species was likewise taken in abundance in the Gulf of Guinea, by the expedition under Captain Tuckey.

(2.) *Tunic destitute of a Shell.*

A. Fins double.

Posterior extremity with leaf-like ridges.

GENUS PNEUMODERMON.—Head with two bundles of tentacula.

The body is oval, with a narrow neck, and a fin on each side. The mouth is nearly terminal, furnished on each side with a fleshy lip, and beneath, with a fleshy chin. Each tentaculum consists of a filament, with a tubercle at the end, pierced by a small hole, and considered as exercising the office of a sucker. Cuvier, in his *Mémoire sur l'Hyale et le Pneumoderme*, considered the leaf-like ridges which occur on the caudal extremity of the body, as the branchiæ, and even describes the pulmonary vein which conveys the blood from these to the heart. But, in his *Règne Animal*, he states it as the opinion of M. Blainville, that the fin-like expansions of the neck contain the branchiæ on their surface, as in the case of Clio. The rectum and oviduct terminate under the right wing. Cuvier has figured and described the only known species, which he terms *Pneumodermon Peronii*, the trivial name being in honour of the discoverer, M. Peron.

Posterior extremity simple.

Genus Clio.—Body ovate, with the tunic elongated and membranaceous.

The head is divided into two lobes, the summits of which are furnished with tentacula. The existence of eyes has not been ascertained. The mouth is transverse, with two lateral longitudinal lips. On each side of the neck arise two blunt, conical, fin-like expansions, with a fine reticulated surface, considered as serving the double purpose of fins and branchiæ. The anus and orifice of generation terminate under the base of the right branchia. The viscera do not fill entirely the cavity of the inner bag. The gut makes only one fold.

The genus Clio was originally instituted by Brown in his *Natural History of Jamaica*. It was afterwards embraced and modified by Linnæus and Pallas, in such a manner as ultimately to exclude the species for the reception of which Brown originally formed it. It contains two species, the most remarkable of which is the *Clio borealis*. Mr. Scoresby, in his valuable work on the Arctic Regions, states, (vol. i. p. 544), that it occurs in vast numbers in some situations near Spitzbergen, but is not found generally throughout the arctic seas. In swimming, it brings the tips of the fins almost into contact, first on one side and then on the other.

GENUS CLEODORA.—Body covered with a triangular pyramidal tunic.

The fins are membranaceous. The mouth is situate between these, and is furnished with a semicircular lip. This genus was instituted by Peron, for the reception of the Clio of Brown. The *C. pyramidata* is the best ascertained species. Brown's *Jamaica*, p. 386, tab. 43, f. 1. Two other species were taken by the Congo expedition, in S. lat. 2. 14., and E. long. 9. 55., and S. lat. 2. 41., E. long. 9. 16., "both having a spinous process on each side of their shell, near its opening. One species is beautifully sulcated transversely, and the other but slightly so."—*Tuckey's Narrative*, p. 412.

B. Fin single.

GENUS CYMBULIA.—Tunic cartilaginous and trough-shaped.

The fin is single, divided into three lobes, one of which is small, with two tubercles, and a minute fleshy beard. This genus was instituted by Peron, in *Annales du Museum*, t. xv. t. 3, f. 10, 11.

SECT. II.—GASTEROPODA.—*Organs of Progressive Motion fitted for Creeping.*

This is one of the most extensive groups of molluscous animals. The marks by which it is distinguished are well defined, and the external and internal characters of the species have been successfully illustrated.

The Gasteropoda may be considered as having the body protected dorsally by the cloak, and ventrally by the foot.

The *cloak* is either *continuous*, and usually more or less arched, for the reception of the viscera underneath, or it is *interrupted* by a projecting bag, in which are contained the principal digestive and reproductive organs. This projecting bag is tapering and spiral, and always protected externally by a shell. When the cloak is continuous, the surface is variously marked, and frequently exhibits a particular portion more elevated than the rest, in some cases concealing a testaceous plate, which has been termed the *shield.*

The *foot* situate on the ventral aspect, and in opposition to the cloak, exhibits a flat, soft surface, consisting of interlaced muscular fibres. Its central surface serves as a support to the viscera, while externally it constitutes the organ of progressive motion. It is a *sucker* rather than a foot, and enables the animal to adhere to objects when at rest, and to crawl from one place to another by a succession of adhesions, not unlike the leech. It is also used as a fin in swimming.

By the union of the cloak and foot laterally and posteriorly, a sac is formed, which is open in front for the protrusion of the neck and head. The line of junction between the cloak and foot is marked, in general, by peculiarities in the condition of the margins of both.

The *neck* is usually divided from the cloak by a *collar*, or thickened margin belonging to the cloak, or rather to the shield, while in other cases it is continuous. Underneath, the neck is frequently attached to the foot.

The *head* supports the tentacula and eyes, is free dorsally, but frequently intimately connected with the foot on its ventral side. The portion between the tentacula and the mouth is termed the *snout*, *(le mufle* of the French, and its margin *le chaperon)*. The mouth exhibits various modifications of fleshy lips and corneous jaws. The inside of the cheeks are covered in some species with reflected teeth, to aid deglutition. The *tongue* can scarcely be detected in some of the genera; while, in others, it is a simple tubercle, or a strap-shaped, spiral organ, armed with transverse rows of teeth. This spiral tongue, where it is fixed to the base of the mouth, is broadest, and there also the spinous processes are strongest. The spiral part is narrowest and softest, and folded up behind the pharynx. M. Cuvier conjectures, and apparently with plausibility, that the spiral portion comes forward into the mouth to act as a tongue, in proportion as the anterior part is worn by use and absorbed. (See his *Mémoire sur la Vivipare d'eau douce*, p. 12; and *Mém. sur la Patelle*, p. 17).

The organs of respiration exhibit the two modifications of lungs and gills, to enable us to divide the Gasteropoda into two classes, which we have termed Pulmonifera and Branchifera. M. Cuvier appears to have been in some measure aware of the importance of the distinction, when he instituted his order *Pulmonés;* but he afterwards suffered himself to be more influenced by the presence of an operculum, the shape of the aperture of the shell, and the supposed separation of the sexes, than by the characters of the respiratory organs.

Some shells are simply tubular or conical; but the greater part are variously convoluted, the volutions being termed *whorls* or spires. These whorls are in general visible and distinct, the boundary between each being termed the *line of separation*. The whorls in some species are simply placed in a lateral position, while in others the whorls are formed upon a *pillar*, or columella, which runs in the direction of the axis of the shell, the inferior whorl in this case embracing the superior one. The pillar is in some cases nearly solid, in other instances tubular, with its base either open or covered. When the base of the tube of the columella is uncovered, the opening is termed the *pillar cavity*, or umbilicus.

In general, when a spiral shell is placed upon its base or mouth, with the apex towards the observer, the mouth will be found situated on the right side, and the whorls will be observed revolving in a direction from right to left, or corresponding with the motion of the sun. These shells are termed *dextral.* A few species have this order reversed, as the observer will readily perceive. For upon placing the shell in the above-mentioned position, the mouth will be found situated on the left side, and the whorls will revolve from left to right. These shells are termed *sinistral*, heterostrophe, or heteroclite.

Class I.—Pulmonifera.

The pulmonary cavity is single and lateral. Its orifice is capable of being closed at the will of the animal. The bloodvessels are spread, chiefly on the walls and roof, like delicate net-work. The opening of the cavity is usually on the right side, with the anus behind it, and the sexual orifice is in the front near the head. In some of the genera, these openings are situate on the left side. The shells of the former are denominated *dextral*, of the latter *sinistral.* This change in the position of the external openings is accompanied by a corresponding alteration in the arrangement of the internal organs. The heart, for example, is always placed on the side opposite the pulmonary cavity. In the dextral shells, therefore, it is sinistral. In both kinds, however, all the organs preserve the same relation to the back and belly, the head and tail. It is impossible, therefore, to conceive a dextral animal changed into a sinistral, by any circumstance which could take place at the period of hatching, as M. Bosc was inclined to believe. This arrangement of the organs must have been not merely congenital, but coeval with the formation of the embryo. In some species all the individuals are sinistral, while in others the occurrence is rarely met with in a solitary example. The former are in their natural state, the latter ought to be regarded as monsters. Where the character is permanent, it should constitute a generical difference.

The reproductive system of the animals of this class exhibits the sexual organs, in general, united in the same individual. Mutual impregnation, however, is necessary. All the species are oviparous. The eggs are either naked, as in the terrestrial genera, or enveloped in a gelatinous mass, like the aquatic kinds. The embryo acquires nearly all its members while in the egg, and the shell is of a proportional size previous to hatching. Sir Everard Home, when treating of the distinguished characters between the ova of the sepia, and those of the vermes testacea that live in water, (*Phil. Trans.*, 1817, p. 297), and when referring to the ova of the vermes testacea, says, "If the shell were formed in the ovum, the process of aërating the blood must be very materially interfered with, for this reason, the covering or shell of the egg, first drops off, and the young is hatched before the shell of the animal is formed; this I have seen take place in the eggs of the garden snail, but in the testacea that live in water, the young requires some defence in the period between the egg being hatched and the young acquiring its shell, which is not necessary in those that live

it has been found among human beings

on land; for this purpose the ova are enclosed in chambers of a particular kind." The assertion here made, and founded on *a priori* considerations, that the shell is not formed until after the egg is hatched, is opposed by every observation which we have been able to make on the subject; and what is more surprising, it is at variance with his own observations on the garden snail, the very example produced in its confirmation. The eggs of a snail, laid on the 5th of August 1773, were hatched on the 20th of that month, and their condition at this time distinctly stated. "On the 20th," he says, "the young were hatched, and the shell completely formed." It is much more becoming in a philosopher to observe how nature operates, than to pronounce what she *must* do.

ORDER I.—TERRESTRIAL.

The animals of this order reside constantly on the land. When by accident they fall into the water, they appear to be incapable of using their foot as a sucker or as a fin, and die after a few writhings. The species in general prefer moist places, and are seldom very active in dry weather. After a shower they speedily leave their hiding places, and at this time they may be readily collected. The eggs are hatched on land.

1st Subdivision.

Cloak and foot parallel, and containing the viscera between them.

In this group are included those animals denominated slugs in this country. They possess four retractile tentacula, of unequal length, though in some cases one pair is obsolete. The eyes are two in number, in the form of black points, seated at the tips of the posterior tentacula.

In some of the genera the cloak is furnished with a shield, which is, in general, strengthened internally by a deposition of earthy matter, in the form of grains, or a shelly plate.

The shield in several of the genera is placed anteriorly, or the shield is placed nearer the head than the tail. The group thus distinguished contains four genera, two of which have compound tails, or furnished with peculiar organs, while in the remaining genera the tails are simple. The mouth consists of lips, which are capable of small extension, and above, the entrance is armed with a concave corneous jaw, with a notch in the middle. The tongue is merely armed with soft transverse ridges, pointed before, and terminated by a short cartilaginous cone. There is a sensible dilatation of the gullet, which marks the place of the stomach, at the under extremity of which is the rudiment of a cæcum at the pyloric opening. The intestine makes several folds, chiefly on the liver, before it reaches the anus. The salivary glands reach to the extremity of the gullet. The liver is divided into five lobes, which give rise to two ducts that open into the pylorus.

The circulating system consists of two venæ cavæ, which give out numerous branches to the pulmonary cavity. The aërated blood is conveyed by several ducts to a simple membranaceous systemic auricle. Between the auricle and ventricle there are two valves. The ventricle is more muscular than the auricle. The arteries, which take their rise from a single aorta, are characterised by a peculiar opacity, and whiteness of colour, as if they were filled with milk.

The organ of viscosity nearly encircles the pericardium.

it consists of regularly pectinated plates. Its excretory canal terminates at the pulmonary cavity.

The organs of generation consist, in the female parts, of an ovarium, oviduct, and uterus; and in the male, of a testicle, vas deferens, and penis, together with the pedunculated vesicle; and, as common to both the sexual organs, there is a cavity opening externally, in which, by separate orifices, the uterus, penis, and vesicle, terminate.

As it would be impracticable to give, even in the most condensed form, the characters of the numerous genera which have been instituted, from our limited space, we shall rather call the attention of the reader to the structure of a few of the more remarkable genera.

Genus Arion.—A mucous orifice at the termination of the cloak.

This genus was instituted by M. le Baron D'Audebard de Férussac, in his *Histoire Naturelle Générale et Particuliére des Mollusques Terrestres et Fluviatiles*, folio, Paris, 1819, 3e. liv. p. 53. The species of which it consists were formerly confounded with those which now constitute the restricted genus Limax. It differs, however, in possessing the mucous pore, in the pulmonary orifice being near the anterior margin of the shield, with the sexual orifice underneath, and in the soft state of the calcareous matter, in the shield. The author now quoted, has described four species, and illustrated their characters by beautiful and expressive figures. The *Limax ater* (together with its variety *rufus)* of British writers may be regarded as the type of the genus. The genus Plectrophorus, distinguished by a conical protuberant shell at the termination of the cloak, was likewise instituted by M. Férussac, and nearly resembles the preceding in form. Three species have been described and figured, which, however, differ remarkably from one another.

Genus Limax.—Pulmonary orifice near the posterior margin of the shield. This genus, as now restricted by M. Férussac, differs from the Arion in the absence of the caudal mucous pore, the position of the pulmonary cavity, and by the orifice of the sexual organs being placed under the superior right tentaculum. The calcareous matter of the shield is more solid, and appears as a shelly plate.

In the following genus the shield is placed nearer to the tail than in the preceding group, and is fortified internally with a subspiral plate.

Genus Parmacella.—Posterior extremity of the shield containing the shell. The pulmonary cavity is placed underneath the shell of the shield. This arrangement occasions a corresponding posterior position to the heart. Along the back, from the shield to the head, are three grooves, the middle one of which is double. The shield itself adheres only at the posterior portion, the anterior part being free. The internal structure is similar to the slugs. The only marked difference, indeed, consists in two conical appendages of the sexual cavity, by which there is an approach to the species of *Helix*.

The *Parmacella Olivieri* is the best known species, and was first described, and its structure unfolded, by M. Cuvier. It was brought from Mesopotamia by M. Olivier.

In the two following genera the cloak is destitute of a shield, and the pulmonary cavity is situated near the tail.

Genus Testacella.—Tail covered with a single spiral shell, underneath which is the pulmonary cavity. The vent and pulmonary cavity are, from the position of the protecting shell, on which they are dependent, nearly terminal.

The foot extends on each side beyond the body. From the manner in which the blood is aërated, the auricle and ventricle are placed longitudinally, the latter being anterior.

GENUS ONCHIDIUM.—Cloak tuberculated. Snout enlarged and emarginate. Tentacula two in number, with eyes at the tips. This genus was instituted by Dr. Buchanan, (now Hamilton), in *Lin. Trans.*, vol. v. p. 132, for the reception of a species which he found in Bengal, on the leaves of *Typha Elephantina.* It is not, according to this naturalist, "like many others of the worm kind, an hermaphrodite animal; for the male and female organs of generation are in distinct individuals. I have not yet perceived any mark to distinguish the sexes, while they are not in copulation; as, in both, the anus and sexual organs are placed in a perforation, (cloaca communis), in the under part of the tail, immediately behind the foot; but, during coition, the distinction of sexes is very evident, the penis protruding to a great length, considering the size of the animal."

2d Subdivision.

Cloak and foot not parallel; the viscera contained in a spiral, dorsal protuberance, protected by a shell.

This group includes the animals usually denominated SNAILS. They bear a very close resemblance to the slugs. The shield, however, has a thickened margin in front, destined to secrete the matter of the shell. In the part corresponding with the centre of the shield in the slugs, there is, (as Cuvier has characteristically termed it), a *natural rupture*, through which the viscera are protruded into a conical bag twisted spirally. In this bag are contained the principal viscera, the liver occupying its extremity. The body of the animal is attached to the pillar of the shell by a complicated muscle, which shifts its place with the growth of the animal.

The mouth is furnished above with a thin-arched corneous mandible, notched on the edges. The whole body, including the foot and head, are, in general, capable of being withdrawn into the cavity of the shell. In two genera the aperture is closed by a lid.

GENUS CYCLOSTOMA.—Aperture of the shell circular. The tentacula are linear and subretractile. The primary ones have subglobular, highly-polished extremities, considered by Montagu as the eyes. The true eyes, however, are placed at the exterior base of the large tentacula, and are elevated on tubercles, which are the rudiments of the second pair. The aperture of the pulmonary cavity is situated on the neck. The sexes are likewise separate; the penis of the male being large, flat, and muscular. The mouth is formed into a kind of proboscis, and the upper lip is deeply emarginate.

GENUS HELIX.—Snail. Aperture of the shell lunulated; the width and length nearly equal. The snails differ from the slugs chiefly in the organs of reproduction. The vagina, previous to its termination in the sexual cavity, is joined by the canal of the vesicle, and by two ducts, each proceeding from a bundle of multifid vesicles. Each bundle consists of a stem or duct, and numerous branches, with blunt terminations. These organs secrete a thin milky fluid, the use of which is unknown.

Connected with the sexual cavity is the bag in which the darts are produced. The bag itself is muscular, with longitudinal grooves, and a glandular body at the extremity. This glandular body secretes the dart, which is in the form of a lengthened pyramid, consisting of calcareous filaments nearly resembling asbestus. Previous to the sexual union, the two snails touch each other repeatedly with the mouth and tentacula, and at last the dart of the one is pushed forth by its muscular bag, and directed against the body of the other, into which it enters, never penetrating through the integuments, and even, in many cases, falling short of its mark. Whether the use of the dart is merely to stimulate, or whether it is subservient to any other purpose, can scarcely be said to be determined.

The species belonging to this genus are numerous, and exhibit, in the form, the markings, and the coverings of the shell, numerous characters for their subdivision.

The species which are related to the Turbo *bidens perversus* and *muscorum* of Linnæus, constitute a very natural family, which may be termed Pupadæ, distinguished by the mouth being, in general, furnished with teeth, or testaceous laminæ, and the last whorl nearly the same as the preceding. Perhaps the most convenient way of dividing them is into two sections, the first including the dextral and the second the sinistral shells.

Genus Vitrina.—Margin of the shield double. The upper fold of the shield is divided into several lobes, which are capable of being reflected over the surface of the shell. The shell itself is not capable of containing the whole body of the animal. The *Helix pellucida* of Müller is the type of the genus. It is a common British species, and was hastily regarded by Montagu as the fry of the *Helix lucida*.

Genus Succinea.—Termination of the pillar rounded. The mouth is large in proportion to the size of the shell, with the outer lip thin, and the pillar attenuated. The genus was first characterized by Draparnaud and named Succinea. Afterwards Lamark proposed the term Amphibulina, but latterly adopted that of Draparnaud. The name first employed indicates one of the most striking characters of the type of the genus; whereas the term *Amphibulina*, is founded on a mistake, and is apt to mislead. The *Helix succinea*, (the type of the genus), although found in damp places, is not amphibious. It never enters the water voluntarily. Indeed Müller says, "Sponte in aquam descendere numquam vidi, e contra quoties eum aquæ immisi, confestim egrediebatur." The same remark is made by Montagu, and we have often witnessed its truth.

Order II.—Aquatic.

The aquatic pulmoniferous Gasteropoda have their residence constantly in the water. They possess two tentacula only. These are usually flattened, incapable of being withdrawn, and having the eyes at the internal base. The food consists of aquatic plants. Respiration can only take place at the surface of the water, to which the animals occasionally ascend, to expel from the pulmonary cavity the vitiated air, and replenish it with a fresh supply. The sexes are united. The spawn, which is in the form of a rounded gelatinous mass, containing many ova, is deposited on aquatic plants under water. Previous to hatching, the fœtus must be aërated by means of some branchial arrangement.

Genus Limnea.—Aperture of the shell having the right lip joined to the left at the base, and folding back on the pillar.

The tentacula are lanceolated and depressed. The mouth is furnished with three jaws; the lateral ones simple; the upper one crescent-shaped, and emarginate. The male and female organs, though intimately connected internally, have their external orifices separated to a considerable distance, the former issuing under the right tentaculum, the latter at the pulmonary cavity. In consequence of this arrangement, the individuals of *L. stagnalis* have been observed by Geoffroy and Müller to unite together in a chain during coition, the first and last members of the series exercising only one of the sexual functions, the intervening individuals impregnating and receiving impregnation at the same time. Whether this is the constant or only accidental practice of this species, does not appear to be determined. We know that many other species of the genus are mutually impregnated, as usual, in pairs only.

The species of this genus are numerous. They reside in pools, lakes, and rivers, and furnish a favourite repast to the different kinds of trouts and water-fowl.

With regard to the *Limnea auricularia*, it would appear, from the observations of Draparnaud, (*Histoire des Mollusques*, p. 49,) that it exhibits a very singular structure of the respiratory organs. We shall quote his own words: "L'animal est pourvu de quatre filamens ou tubes qui partent de la partie supérieure du cou, près du manteau; ce sont des trachées. Ces tubes sont longs, blancs et très transparens, et on ne les distingue bien qu' à la loupe. Leur surface est comme rugueuse, et leur extrémité est un peu renflée. Ils sont rétractiles. L'animal les fait sortir à volonté, un, deux, trois ensemble: il les agite et les contourne sans cesse en divers sens: ce qui fait qu'on les prendroit pour de petits vers. Je présume que par ce movement ces organes séparent de l'eau l'air que y'est contenu et l'absorbent. Cet animal est très sujet, ainsi que les autres gastéropodes fluviatiles, à être infesté par le *nais vermicularis*, qui se loge ordinairement entre le cou et le manteau, au-dessous des tentacules, et s'agite sans cesse d'un movement vermiculaire." But little doubt, we think, can be entertained that this naturalist had been deceived by some of the parisitical leeches which infest the aquatic pulmonifera, and that, instead of breathing by means of tubular gills, the animal of the *L. auricularia* possesses, like those which it resembles in other characters, a pulmonary cavity.

GENUS PHYSA.—Pillar-lip destitute of a fold, and the whorls are sinistral. (*Zool. Journ.* vii. 363.) The external appearance of the animal is similar to the Limnea; but the margin of the cloak is loose, divided into lobes, and capable of being reflected over the surface of the shell near the mouth. This genus was instituted by Draparnaud. The *Bulla fontinalis* of British authors is regarded as the type of the genus.

GENUS APLEXA.—Pillar-lip, with a fold. This genus was instituted by us for the reception of the *Bulla hypnorum* and *rivalis* of British writers. The shell is more produced than in the Physa. The cloak of the animal is incapable of being reflected on the shell, and its margin is destitute of lobes.

GENUS PLANORBIS.—Cavity of the shell entire. This is another sinistral genus; the vent, pulmonary cavity, and sexual organs, being on the left, and the heart on the right side. The *P. corneus*, the type of the genus, pours forth, when irritated, a purple fluid from the sides, between the foot and the margin of the cloak.

GENUS SEGMENTINA.—Cavity of the shell divided. Externally, the shell appears similar to Planorbis; but internally, it is divided by testaceous, transverse partitions, into several chambers, which communicate with each other by triradiated apertures. It is uncertain whether the animal is to be considered as dextral or sinistral. This genus was instituted by us several years ago, for the reception of the *Nautilus lacustris* of Lightfoot, first described and figured in *Phil. Trans.* vol. lxxvi. p. 160. tab. 1. f. 1, 8.

Genus Peronia.—The body is destitute of the external protection of a shell. The head is furnished with two long retractile tentacula. The snout is divided into two broad appendages. Between the tentacula, towards the right side, is the opening for the penis. The anus is terminal, immediately above which is the entrance to the pulmonary cavity; and on the right is the opening to the female organs, from which a groove runs towards the right lobe of the snout. The mouth is destitute of a proboscis or jaws. The tongue is merely a cartilaginous plate grooved transversely. The gullet is long in proportion, with a villous surface. There are three stomachs, each distinguished by its peculiar characters. The first is a true gizzard, covered internally with a cartilaginous cuticle, and its walls formed of two strong muscles, with connecting ligaments. The second stomach is funnel-shaped, with prominent ridges both on its external and internal surface. These ridges, at their origin internally, are highest, and project considerably into the cavity, acting like a valve in retarding the progress of the food. The third stomach is short and cylindrical, covered internally with equal longitudinal fine ridges. The intestine is nearly of equal thickness throughout, and upwards of twice the length of the body. The salivary glands are much branched, and pour their contents into the entrance of the gullet. The liver, in the animals of this genus, is distributed into three separate portions, each of which may be regarded as a distinct liver, an arrangement which is not known to take place in any other animal. The first liver is situate near the middle of the body, on the right side; while the second is placed near the posterior extremity. The ducts enter the cardiac opening of the stomach, each by a separate aperture, and seem to occupy the place of the zone of gastric glands observed in birds. The third liver is placed at the posterior end of the gizzard, into which it pours its contents by a short duct.

The most remarkable feature of the circulating system, is the position of the lungs at the posterior extremity of the body, which occasions a corresponding arrangement in the connecting organs. The entrance to the pulmonary cavity is immediately above the anus. The vessels in which the blood is aërated, are distributed on the roof and sides of the cavity. The pulmonic veins consist of two receptacles, one on each side, extending nearly the length of the body, which may considered as venæ cavæ. These receive the blood by numerous vessels, and convey it directly to the lungs. The aërated blood is conveyed by a systemic vein into a large auricle, seated in front of the lungs, of considerable size, with the walls fortified on the interior by branched ligaments. The ventricle is placed at its anterior extremity, and separated by two valves. The aorta arises from the opposite side of the ventricle, its main trunk passing on towards the head.

The male and female organs of generation, although occurring in the same individual, appear to occupy different parts of the body. The opening of the male organs is at the tentacula, which leads to a cavity terminating in two unequal recesses. The anterior is the smallest, and receives the termination of a vessel three or four times longer than the body, which takes its rise at the external base of the cavity, apparently from the cellular substance, and, after a variety of convolutions in the neighbourhood of the mouth, opens into the recess. The second recess is the largest, and the vessel connected with it is most complicated. Its origin is in a mass which occupies a considerable portion of the abdominal cavity, and which consists of a vessel forming a great number of complicated convolutions, liberally supplied with bloodvessels. The duct proceeds from this mass, undergoes for a short space a sudden thickening of its walls, after which it again contracts, and, before it terminates in a perforated glandular knob in the recess, it contains a pedunculated fleshy body, with a sharp-pointed corneous extremity, probably capable of being protruded into the recess and cavity. The parts which are considered as forming the female organs, or those which are connected with the sexual cavity on the right side of the anus, consist of an ovarium, divided into two lobes, each of which may be perceived to be again minutely subdivided. The oviduct is tortuous, and passes through a glandular body, which, in the other gasteropoda, is regarded as the testicle. The pedunculated vesicle gives out two ducts, one of which goes to the testicle, the other to the uterus. It is difficult to form even a conjecture regarding the uses of all this complicated sexual apparatus. The subject can only be elucidated by an attentive examination of the condition of the organs at different seasons of the year, and by studying, at the same time, the habits of the animals.

The preceding description of the characters of the genus is taken from the anatomical details of a species found creeping upon the rocks under water in the Mauritius, by M. Peron, which Cuvier referred to the genus Onchidium of Buchanan, already noticed. We have ventured to institute the genus, and to name it in honour of the discoverer of the first ascertained species. Cuvier conjectures that it breathes free air, and has accordingly inserted it among the *pulmones aquatique*. Some doubts, however, may reasonably be entertained as to the truth of this supposition. It would certainly be an unexpected occurrence, to find a marine gasteropodous mollusca obliged to come to the surface, at intervals, to respire. It will probably be found that it is truly branchiferous.

Class II.—Branchifera.

The molluscous animals of this class are more numerous than those of the preceding. They chiefly inhabit the waters of the ocean, a few genera only being met with in fresh water lakes and rivers. The branchiæ which constitute their aërating organs, exhibit numerous varieties of form, position, and protection, and furnish valuable characters for their methodical distribution.

Order I.—Branchiæ external.

The branchiæ are pedunculated, and more or less plumose. They are moveable at the will of the animal, and, in general, are capable of great alteration of form.

Genus Doris.—Oral tentacula two; vent without scales. The cloak is covered with retractile papillæ, and separated from the foot by a distinct duplicature. Towards its anterior margin are placed the two superior tentacula. These are retractile, surrounded at the base with a short sheath, and supported on a slender stem, having an enlarged compound plicated summit. The neck is short, and above the mouth there is a small projecting membrane, connected at each side with the oral tentacula, which are in general minute, and of difficult detection. The mouth is in the form of a short trunk, leading to fleshy lips, within which the tongue is placed. This last organ is covered with minute reflected hairs, and, from its motion, appears to be destined exclusively for deglutition. The gullet is a simple membranaceous tube, terminating in a stomach, which presents on the interior a few longitudinal folds. It is furnished with a small cæcum, the extremity of which receives the bile from the liver. The stomach likewise receives the secretion of another gland, which is not connected with the liver, in the form of a small bag, the inner surface of which is covered with numerous papillæ. The intestine is lodged in a groove on the surface of the liver, and proceeds directly to the anus. The liver itself is divided into two lobes, and gives rise to numerous biliary ducts, which proceed to the stomach. But it likewise gives rise to a duct which proceeds to a small bag plaited on the inside, and afterwards opens on the surface at a small hole near the anus. It yet remains to be determined, whether the fluid carried off by this conduit be excrementitious matter, separated by the liver, or whether the gland which produces it be distinct from that organ, but so interwoven therewith as to elude the observation of the anatomist.

It is obvious, from the structure of the digestive organs, that the species subsist on soft food, requiring neither cutting nor grinding, and in this respect, differ remarkably from the species of the genus Tritonia, which were formerly arranged along with them.

The organs of generation differ little from the other hermaphrodite gasteropoda. The vesicle furnishes two canals, one of which goes to the testicle, the other to the penis. There is likewise a minute bag connected with the canal of the latter. The spawn is deposited on sea-weeds and stones. It is gelatinous, of a white colour, and in appearance resembles the sponge denominated *Grantia compressa*.

Genus Tritonia.—Branchiæ destitute of basilar sheaths. The branchiæ are in the form of plumes, or imbricated productions, placed in a row on each side the back. The tentacula, which are partially retractile, have a sheath at the base. In some of the species there are indications of eyes. The mouth consists of two lips, which are placed longitudinally, and open into a short canal. The jaws consist of two corneous plates, united at the upper dorsal edge, slightly arched, and meeting at their upper margin, for the purpose of cutting. Within these is the tongue, which differs remarkably from the same member in the doris. In the latter, the spines with which it is beset are reflected, and draw the food to the gullet, while in the former, the spines are deflected, and serve to keep the food within the reach of the jaws. The tongue of the doris, therefore, serves for deglutition, that of the tritonia for mastication. M. Cuvier describes the functions of both as similar. The salivary glands are placed on each side the gullet, and empty their contents behind the jaws. The gullet has a few longitudinal folds; the stomach is simple, scarcely differing from the gullet; and the intestine proceeds almost directly to the anus, situate on the right side. The liver is small, and situate behind, enveloping the stomach, and intimately united with the ovarium. The organs of generation exhibit nothing remarkable. The pedunculated vesicle has a simple canal. The external opening of the organs of generation is situate a little before and beneath the anus. The *T. Hombergii arborescens*, *pinnatifida*, and *bifida*, are examples of British species.

Genus Scyllea.—Branchiæ seated dorsally on the fins. Tentacula two. On each side of the back are two membranaceous expansions, and one on the tail, supporting on their dorsal surface scattered plumose branchiæ. Each of the tentacula is furnished with a large funnel-shaped sheath. The foot is very narrow, with a mesial groove, used in climbing up the stalks of sea-weeds. The mouth is placed at the base of the tentacula, and surrounded with a semicircular lip. The tongue is in the form of a tubercle, with reflected points. The gullet is plaited longitudinally. The stomach is short and cylindrical, with a ring of hard, longitudinal scales. The liver consists of six unequal globules, and the bile is poured into the cardiac extremity of the gullet. The *Scyllea pelagica* has been long known to naturalists, and appears to be very common in the equatorial seas, adhering to the stems of the *Fucus natans*.

GENUS THETHYS.—Branchiæ forming a row on each side of the back, consisting of fringed processes, alternately larger and smaller. The body is ovate, with the cloak and foot continuous. The neck is distinct from the foot, and is narrow. Above, the neck is continuous with the cloak, from which arises a large semicircular expansion, used probably as a fin. The margin of this expansion is fringed with numerous filaments, and on the upper surface, within the border, is a row of conical tubercles. The true tentacula are placed towards the base of this fin near the neck. Each of them consists of a small fleshy cone, striated across, with a semicircular sheath behind. The branchiæ consist of a tapering, fleshy stalk, spirally twisted towards the summit with a series of filaments on one side. They are fourteen in number on each side, alternately and oppositely small and large. The anus opens in front of the third branchia on the right side. The orifice of generation is exhibited under the first branchia of the same side. In front of each of the larger branchiæ, is a small cavity with a small filament in the centre. The mouth is situate underneath the tentacula. It consists of a large funnel, covered within with soft papillæ, destitute of jaws or tongue. The gullet is short, the stomach simple, fleshy, and covered with a thick cuticle. The salivary glands are slender and branched, and open into the gullet. The intestine is likewise short, and proceeds directly to the anus. The liver pours the bile into the canal at the pylorus; and likewise sends out another duct, which opens externally near the anus. The organs of generation are similar to the Doris. The *T. fimbria* is the type of the genus, a figure of which, with its anatomical details, is given by M. Cuvier, in his *Mémoire sur le Genre Thetys.*

Genus Valvata.—In this genus are included several species which resemble in aspect the aquatic pulmoniferous gasteropoda. The branchiæ appear in the form of a feather, with a central stem, and a row of compound branches on each side, decreasing in size from the base to the free extremity. This stem issues from the neck near the middle, a short way behind the anterior tentacula. Near this plume, but towards the right side, is a single simple filament, like a tentaculum. The anterior tentacula occupy the usual position, are setaceous, and have the eyes placed at the base behind. The spiral shell is capable of containing the body, and the aperture can be closed by a spirally striated operculum attached to the foot. The internal structure is unknown.

Genus Patella.—Shell entire. Mouth with tentacula. This genus differs from the others of the order to which it belongs. The back is covered by a conical shell, within the cavity of which the animal is capable of withdrawing itself. The cloak is large, covering both the head and foot. It is united with the shell along its superior margin. The foot is fleshy, and furnished with numerous muscular filaments, which unite, in the superior part of the cloak, to form a strong muscle, by which the body adheres to the shell. The action of this muscle brings the shell close to the surface to which the foot adheres, or removes it to a distance. The head is furnished with a large, fleshy snout, supporting at the base two pointed tentacula. The eyes are placed on a small elevation at the external base of the tentacula. A little way behind the head, and below the cloak, on the right side, are two apertures, being the anus and orifice of generation. The gills occupy the same position as in the preceding genera. In some, the branchiæ form a complete circle; in others, the circle is interrupted anteriorly at the head.

Within the trunk, the mouth is fortified by two cartilaginous cheeks, which, at their union anteriorly, support the base of the tongue. This last is a most singular organ. It is longer than the whole body, narrow, and covered with three rows of short reflected spines, interrupted longitudinally and transversely. Its fixed end only can be exercised in deglutition, its free end being coiled up the abdomen. On the upper side of the mouth is a semicircular osseous plate, or upper jaw. The gullet is furnished with a dilatable pharynx. The stomach is elliptical, with the cardia and pylorus at opposite extremities. The intestines are variously folded, and are several times longer than the body. The salivary glands are minute. The liver is intimately united with the stomach and intestines. The heart is situate on the left side, in the anterior part of the body. The auricle receives the aërated blood from one vein when the circle of the gills is complete, and by two when interrupted. This auricle is placed on the anterior side of the heart. An aorta arises from each side, to convey the blood to the body. The ovarium is placed underneath the liver; and, as it exhibits some differences of organization, M. Cuvier infers that it likewise contains the male organs. The species belonging to this genus are numerous, and appear to admit of distribution into sections; the first having the branchial circle complete, the second interrupted.

Genus Chiton.—Shell constituting a series of imbricated dorsal plates. The body is elliptical. The cloak is firm and cartilaginous, and variously marked on the margin. The dorsal plates are arched, and occupy the middle and sides of the back, where they are implanted in the cloak, in an imbricated manner, the posterior margin of the first valve covering the anterior margin of the second. The foot is narrow. The mouth is surrounded with a semicircular curled membrane, and is destitute of tentacula. The anus consists of a short tube, placed at the posterior extremity of the cloak. The external orifice of generation has not been detected.

The mouth is capable of forming a short proboscis. The tongue is short, and armed with strong, reflected spines. The gullet is short, and the stomach, which is lengthened and folded, is membranaceous. The intestine is several times longer than the body, and much folded. The liver is divided into numerous lobes, and intimately united with the stomach and intestines. The heart is situate at the posterior part of the body. The auricle is placed posteriorly, and receives the aërated blood from two veins. Each vein descends along the base of the gills, collecting the aërated blood from the particular side of the body to which it belongs; and, what is most remarkable, when opposite the ventricle, it is suddenly enlarged, and sends off a branch which communicates with it, and again contracts and unites with its fellow from the opposite side, to form the auricle. A single aorta arises from the anterior side. The ovarium is conical, and divided into numerous lobes. Behind, two ducts seem to arise, and to proceed one to each side; but it has not been determined whether they open externally. No male organs have been detected; nor is there any thing accurately known with regard to the peculiar nature of their hermaphroditism.

GENUS PHYLLIDIA.—Anus placed dorsally near the extremity of the cloak. The body, in the animals of this genus, is ovate. The foot is narrow in front. The cloak is broad, coriaceous, and destitute of a shell. Towards its anterior extremity are two cavities, from which issue the retractile superior tentacula, as in the genus Doris. Nearly at the posterior extremity is another cavity, containing the anus. This opening, though similar in situation to that of the Doris, is merely a short simple tube. The head is immediately above the anterior margin of the foot, above which is the mouth, having a small conical feeler on each side. Under the margin of the cloak on the right side, and about half way between the mouth and the middle of the body, are two openings, in a tubercle, for the organs of generation. The branchiæ consist of slender complicated leaves, which surround the body between the foot and the cloak. The circle is interrupted at the head and at the tubercle of generation. The mouth is destitute of jaws. The gullet is simple, ending in a membranaceous stomach. The pylorus is placed near the cardia, and the intestine goes directly to the anus. The salivary glands are small, and placed near the mouth. The liver is large in proportion. The heart is situate in the middle of the back. The auricle is simple, placed on the side next the tail, and supplied by the two systemic veins which collect the aërated blood from the branchiæ on each side. There is a simple aorta arising from the opposite side of the heart. The organs of generation appear to be similar to those of the preceding class ; but they have not as yet been minutely examined. The existence of eyes is not satisfactorily determined. The animals of this genus appear to be inhabitants of the tropical seas. Cuvier has given descriptions and figures of three species, which differ remarkably from one another in the protuberances of the cloak.

Genus Aplysia.—Branchiæ with a corneous lid. The body of the Aplysia is ovate, acuminated behind, and produced before to form a neck. The foot is narrower than the body. In the middle of the back is a corneous plate inclosed in a bag in the skin, and on each side, and behind, there is a fold by which this part may be concealed. The head is slightly emarginate, with a feeler on each side. The superior feelers are situate on the neck. In front of each of these is a small black point or eye. The branchiæ are situate underneath the dorsal plate, on the right side, and exhibit a complicated plumose ridge, capable of expansion beyond the edge of the plate. The anus is situate immediately behind the branchiæ, and before these is the orifice of generation, from which proceeds a groove along the neck to the inferior base of the fore feeler, on the right side, where there is an opening for the penis. Within the longitudinal lips there are two smooth, corneous plates, the substitutes for jaws ; the tongue is rough, as in many of the other gasteropoda. The gullet is short, and suddenly expands into a large subspiral crop, with membranaceous walls. To this, a gizzard with muscular walls succeeds, the interior of which is armed with numerous pyramidal teeth, with irregular summits, of a cartilaginous nature. The connection between these teeth and the integuments is so slender, that they are displaced by the application of the smallest force. They, however, project so far into the cavity, as to offer resistance to the progress of the food. There is yet another stomach, armed on the one side with deflected, pointed, cartilaginous teeth. At the pyloric extremity are two membranaceous ridges, between which are biliary orifices, and the opening into a long narrow cæcum, with simple walls, which is contained within the liver. The intestine is simple, and after two turns ends in a rectum. The salivary glands are very long, and, as usual, empty their contents into the pharynx. The liver is divided into three portions by the folds of the intestine, each of which consists of several lobes. The biliary vessels are very large, and open at the mouth of the cæcum into the last stomach. The food of the Aplysia consists of sea-weeds and minute shells.

The circulating organs are remarkable. On each side the body, in the region of the dorsal plate, there is a large vessel, which receives blood from different parts of the body, and which likewise, by various openings, has a free communication with the cavity of the abdomen. In this respect there is a resemblance to the spongy, glandular bodies of the venæ cavæ of the Cephalopoda. These two vessels, or *venæ cavæ*, unite posteriorly, and transmit their contents to the gills. The aërated blood is now conveyed to an auricle, of large dimensions, and uncommonly thin walls, situate beneath and towards the front of the dorsal plate, and emptying its contents through a valve, into the right side of the ventricle. The aorta, which issues from the left and anterior side, divides into two branches, the smallest of which proceeds to the liver on the left. The larger branch is again divided, the smaller branch proceeding to the stomach. The largest trunk that remains, before it leaves the pericardium, has two singular bodies attached to it, consisting of comparatively large vessels, opening from this aortic branch. The use of these glands is unknown. The organs of generation likewise exhibit some remarkable peculiarities. The ovarium is situate in the posterior part of the abdomen. The oviduct is tortuous in its course, passes along the surface of the testicle, and, after uniting with a clavate appendage, opens into a common canal. The testicle is firm, apparently homogeneous in its texture, of a yellow colour, with spiral ridges on its surface. The vas deferens arises from a complex, glandular body, and unites with the common canal. This common duct, before it reaches the external orifice, receives the contents of the pedunculated vesicle, and has attached to it a botryoidal, glandular organ, the use of which is unknown, but which some suppose to be employed to secrete an acrid liquor regarded as venemous. It is obvious from this structure, that the seminal fluid and eggs must come in contact in the common canal, and at the single orifice, provided they are both ejected at the same time. From the orifice to the right fore-feeler there is a sulcus, leading to the pore containing the retractile penis. This organ, like those of the other mollusca, is solid. It terminates in a small filament. The external groove is the only connection between it and the other sexual organs.

There is a peculiar secretion of a purple fluid which here deserves to be recorded. It issues from a spongy texture, underneath the free side of the dorsal plate. Connected with this cellular reservoir is a glandular body of a considerable size, which is supposed to secrete the coloured fluid.

This gland is supplied by a large branch of the glandular aorta, and gives out two very large veins to the left vena cava. The fluid itself has never been carefully investigated. It is not altered by the air after drying, nor is its colour destroyed by acids or alkalis, although the tint is a little changed, and rendered less pure. Both these reagents precipitate white flakes from the fluid. This liquor is poured out by the animal when in danger or constrained, and colours the water for several yards around. It ejects it readily when put in fresh water; and when entangled in a net, several yards of it in the neighbourhood are sometimes stained, greatly to the amazement of the unsuspecting fishermen.

The Aplysia has been long known in the records of superstition under the name of the *Sea Hare*. Its flesh, and the inky fluid it pours out, have been regarded as deleterious to the human frame. Even to touch it was supposed to occasion the loss of the hair; while the sight of it would not fail to subdue the obstinacy of concealed pregnancy. The progress of science has exposed the errors, or perhaps tricks, of the earlier observers, and proved the innocence of an animal formerly invested with every repulsive and noxious attribute. The *A. depilans*, the type of the genus, is of frequent occurrence on the British shores. The *A. punctata* of Cuvier may be regarded merely as a variety.

GENUS DOLABELLA.—Dorsal plate a solid shell.

This genus differs from Aplysia, in the dorsal plate being calcareous and hard. The fore part of the body is narrow; behind it is larger, and obliquely truncated. The disc thus formed is circular, surrounded with a fringe of fleshy filaments. From the centre of this disc, a longitudinal slit extends forward, a little way beyond the anterior margin, and contains the branchiæ. The position and structure of the other organs are precisely similar to those of the Aplysia. This genus was instituted by Lamark, from characters derived exclusively from the dorsal plate or shell. Cuvier afterwards examined a species brought from the Mauritius by Peron, which he considers as the one figured by Rumphius in his *Amboinshe Rariteitkamer*, tab. x. No. 6, and which he has consecrated to his memory, naming it Dolabella Rumphii.

GENUS PLEUROBRANCHUS.—Tentacula two in number. Cloak and foot expanded, between which, on the middle of the right side, the branchiæ are placed. The cloak is strengthened in the middle, above the branchiæ, by a thin expanded subspiral shell. The neck is short, and in some contracted, with the front emarginate, exhibiting the commencement of the inferior tentacula. The upper tentacula are tubular and cloven. The gills occur at the edge of the dorsal plate. In front of these are the orifices of the organs of generation, and the anus is situate immediately behind the gills. The mouth is furnished with a short retractile proboscis. The tongue occupies both sides of the mouth, and is covered with spines. The gullet is enlarged into a kind of crop before it enters the stomach; this is folded, and is divided by contractions into three parts. The first stomach has muscular walls of moderate thickness, with a single longitudinal band. The second has membranaceous walls, with longitudinal internal ridges, and the third has thin and simple walls. The gut is short. The salivary glands are situate at the folds of the stomach, and by two canals empty their contents into the mouth. The liver is placed on the stomach, and empties itself into the lower part of the crop.

The heart is nearly in the middle of the back. Its auricle is on the right side, at the base of the branchiæ; and the ventricle sends out at the opposite side three arteries.

M. Cuvier has figured and described the P. Peronii with its anatomical details. Two species likewise appear to be known as natives of the British seas.

Genus Bulla.—The head is destitute of tentacula and the body of the animal, protected by a convoluted shell, is oblong, becoming a little narrower in front. Below, the foot is broad, thin, and waved on the margin, expanded on each side behind, and capable of being turned upwards. At the posterior part of the foot, but separated from it by a groove, there is a broad, membranaceous appendage, a part of which is folded upwards, and a part spread over bodies, like the foot. It assists in closing the mouth of the shell, and in its position and use is analogous to the operculum, in the following order. Above the foot, in front, also, but separated from it by a groove, there is a fat, fleshy expansion, which Cuvier terms the tentacular disc, considering it as formed by the union of the inferior and superior tentacula. In the centre of the disc, in the *Bulla hydatis*, (*Lin. Trans.*, vol. ix. tab. 6, f. 4), Montagu observed two eyes. Between this portion of the back and the posterior extremity, is the dorsal plate or shell, forming the genus *Bulla* of conchologists. In some species, this shell is covered by the integuments, while in others it is exposed. But in all, the part containing it is partially concealed by the animal, by means of the reflected margins of the foot, and its appendage. Along the right side of the body there is a groove, formed by the foot and its appendage, on one side, and the dorsal plate and tentacular disc on the other. The branchiæ are situate in a cavity under the shell or dorsal plate, and resemble those of the *Aplysia*. Behind the gills, in the lateral groove, is the anus; and in front of these, the orifice of the united organs of generation. The penis is removed as in the *Aplysia*, and connected by a similar slit.

The mouth is, as usual, in front, above the foot and beneath the tentacular disc, both of which serve as lips. The cheeks are strengthened on each side by a corneous plate. The tongue is well developed in some, as the *B. ampulla*, while in the *B. aperta* it is reduced to a small tubercle. The gullet is large, and in the *B. lignaria* makes two folds before entering the gizzard. This last organ is fortified by three testaceous plates, convex and rough on the inner surface, and attached to strong, muscular walls. These plates exhibit in the different species considerable varieties of form and markings. The intestine, before terminating in the anus, makes several convolutions in the substance of the liver. The salivary glands exhibit considerable differences. In the *B. ampulla* they are long and narrow, and their inferior extremity fixed to the gizzard. In the *B. aperta* and *lignaria*, they are short, with the extremity free. In the *B. hydatis* they are long, unequal, and the extremity of the one, belonging to the left side, is forked. The liver forms a part of the contents inclosed in the spire of the shell. It envelopes the intestine, and empties the bile into its pyloric extremity. The auricle and ventricle appear to occupy the same relative position as in the *Aplysia*, but the structure of the arteries is unknown. The organs of generation have also so near a resemblance as to forbid a detailed description. Some species are said to eject a coloured fluid, like the *Aplysia*, from the lid of the branchiæ. A gland is observed in the *Bulla lignaria*, similar to the *Aplysia*, in which it is probable the fluid is prepared.

The species of this genus have not been sufficiently investigated in a living state. When preserved in spirits, it is impossible to form a correct idea of their true appearance, as exhibited when alive in sea-water, since they usually exist as a shapeless mass. Cuvier has given delineations of such preserved species, but they bear no resemblance to the figures of Montagu, of the same species, taken from living objects. M. Lamark is inclined to divide the genus into two, distinguishing those who have the shell concealed, by the term *Bullæa*, from such as have the shell in part exposed, which he retains in the genus *Bulla*. The shells of the genus *Bullæa* are thin and white, as *B. aperta;* those of *Bulla* stronger, more opake, and covered with an epidermis, which, after the death of the animal, is easily detached, as *B. lignaria*.

Genus Doridium (of Mekel). Destitute of a dorsal plate or shell. There is a cavity in the cloak, with a spiral turn. The branchiæ, and accompanying organs, are placed far behind. There is here no appearance of a spinous tongue; the gullet is simple, and the stomach is membranaceous. *D. carnosum*, a native of the Mediterranean, is the type of the genus.

Order II.—Branchiæ internal.

The aërating organs are contained in a cavity, and appear in the form of sessile, pectinated ridges.

1st Subdivision.

Heart entire, and detached from the rectum.

This group, forming the *Pectinibranchia* of Cuvier, in cludes nearly all the marine Gasteropoda, which have spiral univalve shells. It likewise contains a few species which inhabit the fresh water.

The foot is usually fortified above, on its posterior extremity, with a corneous plate, which acts as a lid to the shell, when the animal is withdrawn into the cavity. The anterior extremity is in some of the species double. The anterior margin of the cloak forms a thick band, or arch, rising from the foot, behind which is the portion of the body that is always contained in the shell, and which is covered with a very thin skin. Between the margin of the cloak and foot is situate the head, supported on a short neck. The tentacula are two in number, bearing eyes at their base, or on short lateral processes, which have some claims to be considered as tentacula. The hood is frequently emarginate, and sometimes fringed. The mouth is more or less in the form of a proboscis, in some cases armed within with spinous lips, or furnished with a long narrow spiral tongue, armed with spines, as in the common periwinkle. The nature of this kind of tongue, the spiral extremity of which is free and lodged in the abdomen, is not well understood.

The entry to the gills is by a large aperture between the margin of the cloak and neck, at the middle, or towards the right side. These are contained in a cavity on the back of the animal, and consist of leaves arranged in one or more rows, which adhere to the walls of the cavity. At the entrance of this cavity is the anus and oviduct. The male and female organs are considered not only as distinct, but as occurring on different individuals. The evidence in support of this opinion is in many cases complete. The penis is in some external, and incapable of being withdrawn, while in others it is retractile, and situate in a cavity in the right tentaculum. The body of the animal is attached to the shell by means of two muscles, which adhere to the pillar near the same place, and shift their position, by an arrangement not well understood, in proportion as the individual increases in size. These muscles terminate in the foot and mouth.

The animals of this order have not been examined sufficiently in detail, to admit of their distribution into natural groups, distinguished by characters founded on important differences of organization. The form of the shell has been resorted to, with the view of assisting arrangement. The characters thus furnished would be useful and valuable, were they the index of any peculiar internal structure. But, unfortunately, animals widely different in structure inhabit shells of the same form, and *vice versa*, so that, however useful the mere conchologist may find the form of the shell to be in his arrangements, it can only be regarded by the zoologist as occupying a subordinate place. Without, therefore, entering into any details regarding the structure of the few species which have been examined anatomically, we shall merely point out the tribes and families which have been contemplated, the characters of which in a great measure depend on the shape of the shell.

1st Tribe.

Shell external.

The shelly covering exhibits all the variations of the spiral form. The internal structure has hitherto been in a great measure neglected, so that the characters employed in the methodical distribution of the species and genera are derived from the shelly appendage of the cloak. The groups, therefore, are merely artificial, temporary combinations, to a very few of which only we shall make reference.

Genus Janthina.—Foot with an adhering spongy body. In this genus, represented by the *Helix janthina* of Linnæus, the spongy body is capable of changing its dimensions, and enabling the animal to sink or rise in the water at pleasure. When irritated, the animal ejects a purple fluid from the cellular margin of the cloak above the gills, not unlike the Aplysia. This species was added to the British Fauna by the late Miss Hutchins.

Genus Velutina.—Foot simple. This genus was formed by us for the reception of the *Bulla velutina* of Müller, (*Zool. Dan.* tab. ci. f. 1, 2, 3, 4), the *Helix lævigata* of British writers. The foot is destitute of lid or appendage, and is broad before, and pointed behind. The tentacula are two in number, short and filiform, with eyes at their external base. The head is broad and short. In addition to these characters given by Müller, we have been enabled to add the following, from a specimen, somewhat altered, which was found in the stomach of a cod-fish. The animal adheres to the shell by two linear muscles, one on each side the cloak. The branchial cavity is towards the left side. The tongue is spinous, narrow, with its free extremity spiral. Eyes rather behind the tentacula. Penis exserted on the right side of the neck, immediately behind the eye. Cloak large in proportion to the size of the foot. We have termed the genus *Velutina*, bestowing on the species the trivial name *vulgaris*.

In the following groups the anterior margin of the aperture of the shell is canaliculated. This groove in the aperture of the shell is produced by the anterior margin of the cloak being extended over the opening into the gills, for the purpose of acting like a tube or syphon, in conveying the water to and from the branchial cavity. The species are considered as oviparous, with distinct sexes in separate individuals.

1. *Shell convoluted.*—The shell has an oval or linear mouth parallel with its length. The whorls, which are small segments of large circles, are wrapped round the pillar, and the one rising a little above the other, embrace or inclose the preceding ones. The four following families appear to belong to this division.

Family 1. *Conusidæ.*—Furnished with a long proboscis, and produced tentacula, with the eyes near the summit on the outside. The lid is placed obliquely on the foot, and is too small to fill the mouth of the shell. The genera Conus and Terebellum form this family.

Family 2. *Cypreadæ.*—Cloak enlarged, and capable of folding over the shell. There is no lid. The genus Cyprea is the type.

Family 3. *Ovuladæ.*—Both extremities of the aperture canaliculated. The inhabitants of all the genera, Ovula, Calpurna, and Volva, are unknown. The last genus includes the *Bulla patula* of Pennant.

Family 4. *Volutadæ.*—Canal of the aperture abbreviated. Pillar-lip plaited. The foot appears to be destitute of a lid. The genera are numerous; Voluta, Oliva, Cymbium, Marginella, Cancellaria, Mitra, Ancilla, Volvaria, and Tornatella. The last genus contains the *Voluta tornatilis* of British writers.

2. *Shell turreted.*—The whorls of the shell, the revolving spire of which is subconical, scarcely embrace one another, but are merely united at the margins. Three families may here be established.

Family 1. *Buccinidæ.*—Canal short, scarcely produced beyond the anterior margin of the lip, and bent towards the right. The tentacula are remote, and the head is destitute of a hood. The mouth has a retractile proboscis. The following genera belong to this family: Buccinum, Eburna, Dolium, Harpa, Nassa, Purpura, Cassis, Morio, Ricinula, and Monoceros.

Family 2. *Muricidæ.*—Canal produced, and straight. The tentacula approach the head and mouth as in the preceding family. The genera are Murex, Typhis, Ranella, Fusus, Pleurotoma, Pyrula, Fasciolaria, Terebra, Tritonalia, and Turbinella.

Family 3. *Cerithiadæ.*—Canal short and recurved. Head with a hood. This family contains the marine Cerithium and Strutheolaria, and the fluviatile Potamidum, Melanopsis, and Pirena.

Family 4. *Strombusidæ.*—Canal short, and bent towards the right. The outer margin of the aperture becomes palmated with age, and exhibits a second canal, generally near the former, for the passage of the head. The following are the genera: Strombus, Pterocera, Hippocrenes, and Rostellaria.

2d Tribe.

Shell internal.

This tribe consists at present of only one genus, termed *Sigaretus*, two species of which are natives of Britain. The foot of the animals belonging to this genus, or rather of the species which constitutes the type, is oval, with a duplicature in front. The cloak is broad, with an indentation on the left side, in front, leading to the branchial cavity. A ring of transverse muscles unites the cloak with the foot. On the back is placed the shell, which does not appear on the outside, as it is covered by a thick cuticle. It is lodged in a sac, and united by a muscle, which adheres to the pillar. The hood is produced, at each side, into a flattened tentaculum, with an eye at the external base. The anus is situate at the branchial indentation on the left side. The penis is situate on the right side of the neck; it is external, with a crooked, blunt, lateral process near its extremity.

The mouth is in the form of a short proboscis. The tongue is armed with spines, and is long and spirally folded. The salivary glands are large. The stomach is membranaceous, giving off the intestine near the cardia. The intestine makes two folds. The liver, with the testicle in the male, and the ovarium in the female, occupy the posterior part of the body, under the spire of the shell.

2d Subdivision.

Heart traversed by the rectum.

This group includes the order Scutibranchia of Cuvier. In general form, and in the structure and position of the branchiæ, the resemblance to the genera of the preceding subdivision is very great. The animals differ, however, in many particulars. The heart is furnished with two auricles, and is perforated by the intestine. The sexes appear to be incorporated in the same individual, or rather the male organs are unknown. The body is protected by a shell, the aperture of which is wide, and never closed by a lid.

1st Tribe.

Shell ear-shaped, flat, with a lateral, and nearly concealed spire.

Family *Haliotidæ*.—The genera of this group exhibit well-marked characters in the shell. In the *Haliotis*, the left margin of the shell is pierced by a row of holes. In *Padola* these holes are nearly obliterated; but there is an internal groove and external ridge in the line of their direction. In *Stomatia*, there are neither holes nor ridges. In the *Halyotis*, the foot is oval and large. The sides of the body, all round, are ornamented with one or more rows of simple or branched filaments. The shell is placed on the back with the spiral part behind, and the row of holes on the left side, through which some of the filaments are protruded. The animal is attached to the shell by a single large muscle. The entry to the branchial cavity, which likewise contains the termination of the rectum and oviduct, is on the back. The gills are in two ridges, consisting of complicated branched filaments. At the entrance of the cavity, the cloak is furnished with a slit, the left margin of which rests upon the pillar of the shell. The edges of this slit are furnished with filaments, which pass through the anterior holes of the shell. The use of this singular arrangement is unknown. The branchial cavity likewise contains the viscous organ, in common with the Pectinibranchiæ.

The hood is emarginate, with a long tentaculum on each side, behind which, towards the side, is a cylindrical protuberance, bearing the eye at the top. The mouth is in the form of a short proboscis, with two corneous plates as cheeks, and a long narrow tongue extending backwards, and covered with spines. The pharynx is dilatable, with internal folds. The salivary glands are very small. The gullet is very short. The stomach is divided into two portions, the first of which is striated longitudinally with a glandular structure, and receives a biliary duct. The second is separated from the former by a valve, is smaller, with transverse striæ, and a double ridge. It likewise receives bile through two apertures. There is another valve at the pylorus; and the intestine, after making some turns, is surrounded by the heart. There is an auricle on each side, receiving the aërated blood from each of the gills.

2d Tribe.

Shell conical, simple, or slightly revolute at the apex.

A. Cavity of the shell interrupted by a testaceous plate. This division consists of five genera, each of which may be regarded as the type of a family, although, for the present, they are all included in one. In the Crepidula, the gills form a transverse ridge on the roof of the cavity, consisting of filaments extending beyond the margin. The eyes are at the base of the tentacula. There is only one fluviatile genus, termed Navicella.

B. Cavity of the shell entire.

In the Capulus, the shell is entire, the foot is complicated on its anterior margin. The shell adheres to the animal by a circular muscle, leaving an opening in front, for the issue of the head and entrance to the branchial cavity. The gills form a single ridge across the roof. The mouth is in the form of an extended proboscis, with a deep groove above. The tentacula, which are two in number, have the eyes at the external base. The anus is on the right side of the branchial cavity. In the Carinaria, the foot appears to be compressed, and formed for swimming. The head is covered with a group of tubercles. The mouth is furnished with a proboscis. Near the middle of the body the shell is attached. The surface of the body above is closely covered with small tubercles. It is probable that the species here alluded to is the same with the *Pterotrachea coronata* of Forskäl.

Fissurelladæ. Shell with a slit or perforation. In the Fissurella, the apex of the shell is perforated, and united to the cloak by a circular muscle open in front. The cloak forms a duplicature in front for the branchial cavity, which extends to the perforated apex of the shell. The gills consist of two ridges ; at the dorsal extremity of which is the anus. It is probable that the excrements are ejected at the perforation in the apex of the shell, and likewise the water which enters the branchial cavity in front. The head is furnished with two tentaculæ, bearing the eyes at the external base. The *Patella græca* and *apertura* may be quoted as British examples of the genus.

The genus Emarginula differs from the former in the apex of the shell not being perforated. Its place, however, is supplied by a slit on the anterior margin, which is the entrance to the branchiæ and anus. The foot is surrounded with a row of filaments, and the eyes are supported on short footstalks, characters in which it approaches the genus Halyotis. The *Patella fissura* of conchologists is considered as the type of the genus.

Division II.—Mollusca Acephala.

Destitute of a distinct head, or neck.

The animals of this group are much more simple in their organization than those of the preceding division. In none of the species are there any rudiments of organs of hearing or of sight. They are destitute of jaws or other hard parts about the mouth. They all inhabit the water, and possess branchiæ. The organs of the two sexes are incorporated in the same individual, and reciprocal union is unnecessary. They are either oviparous, or ovoviviparous. The presence or absence of a shelly covering, furnish characters for a twofold distribution of the groups.

Sect. 1.—*Acephala Conchifera.*

The shell in all cases is external and bivalve ; and exhibits very remarkable differences in the form, relative size, and connection of the valves. The cloak is likewise in the form of two leaves, corresponding with the valves which protect it.

Order I.—Brachiopoda.

Mouth with a spiral arm on each side fringed with filaments.

The genera included in this group constitute the Brachiopoda of Cuvier. The lobes of the cloak are free anteriorly. From the body, between the lobes, the arms have their origin at the margin of the mouth. These arms are capable of folding up spirally. All the species are permanently attached to foreign bodies, and inhabit the sea. Their nervous and reproductive systems have received but little elucidation.

1st Subdivision.

Shell supported on a fleshy peduncle.

Genus Lingula. Valves equal, the apex of both attached to the peduncle.

The peduncle is nearly cylindrical, cartilaginous, and covered with a membrane consisting of circular fibres. The valves are oval, flat, and destitute of teeth, or elastic ligaments. The adductor muscles are numerous, obliquely placed, and appear capable of giving to the valves a considerable degree of lateral motion. The cloak is thin, and has interspersed muscular fibres. Its margin is thickened, and fringed with fine hairs of nearly equal length. The arms are fleshy in their substance, conical, elongated and compressed in their form, and ornamented on the external surface with thick set fringes or tentacula. The mouth is simple, and situate between the arms at their base. There is no enlargement of the alimentary canal, which can be regarded as a stomach, and the anus is a simple aperture situate on the side. There are marked indications of salivary glands and a liver. The blood is conveyed to the gills by two vessels, which are divided at the separation of the lobes into two branches, one of these going to the half of one lobe, and another to the opposite half of the other lobe. Two systemic veins occupy a similar position, and return the aërated blood to the two lateral systemic ventricles. The gills themselves are arranged in a pectinated form, on the inner surface of each lobe of the cloak. There is nothing known of the nervous or reproductive systems of this animal.

The *Lingula unguis* is the only species of the genus, and appears to be confined to the Indian seas. The valves were first figured by Seba, together with the peduncle by which they are supported. Linnæus having seen only one valve, conjectured that it belonged to Patella, and named it *P. unguis.* Chemnitz examined both valves, without the peduncle, and pronounced them connected with the genus Pinna. Bruguière, aware of Seba's figure, contemplated the formation of the new genus for its reception, which Lamark executed. M. Cuvier afterwards dissected one of the individuals, which Seba had possessed, and unfolded characters in its organization, sufficient not only to warrant the construction of a new genus, but a new class.

Some petrifactions have recently been referred to this genus; but, in the absence of all vestige of the peduncle, we do not consider the mere form of the shell as furnishing characters sufficiently obvious and precise to warrant such distribution.

TEREBRATULA. Valves unequal, the peduncle passing through an aperture in the largest valve.

The following interesting information, from the dissections of Mr. Owen, will be read with pleasure by the student of the anatomy and physiology of the mollusca.

The mantle adheres very closely to the valves : the lobe which corresponds to the perforated valve is traversed longitudinally by four large vessels ; the opposite lobe is similarly traversed by two such vessels. Its margins are thickened, not as in the Lamillibranchiate Bivalves from contraction, but owing to a peculiar structure connected with respiration. They are puckered at regular distances, the puckerings being apparently caused by the insertion of delicate *cilia*, which pass as far within the mantle as they project out of it, but which are so minute as to be observable only by means of a lens. In the interspaces of the cilia the margin of the mantle is minutely fringed, and within the fringe is a canal, which extends along the whole circumference. From this canal the large vessels of the mantle lobes take their origin : they may be regarded as the branchial veins conveying the aerated blood to the two hearts, which are situated exterior to the liver, and just within the origin of the internal calcareous loop : they are accompanied in their course by much smaller vessels, probably the branchial arteries. Such is apparently the system of respiration in Terebratula.

The *viscera* occupy a very small space near the hinge. The alimentary canal commences by a small puckered mouth, situated immediately between the folded extremities of the arms. It passes backwards, and expands into a membranous stomach, surrounded by the liver, a bulky gland of a green colour and minute follicular texture, which communicates with it by many orifices. The intestine passes down to the hinge, and then turns to the right side and terminates between the two mantle-lobes. No trace of a salivary gland was found.

The generation of Terebratula is that of the ordinary Bivalves. In two of the larger specimens the ova had insinuated themselves between the layers of the mantle, and partly surrounded the branchial vessels. When so far advanced they obscure the organization of the mantle which adapts it for respiration: this organization is consequently most satisfactorily observed in very young individuals.

The peculiar internal testaceous apparatus or loop connected with the hinge and supporting the arms, possesses some elasticity, and when acted on by the muscles, becomes in its reflected part sufficiently convex to press upon the perforated valve and separate it slightly from the opposite one; thus compensating for the absence of the thick arms of Lingula, which, in their protrusion, push open the valves, and also for that of the elastic fibres, constituting the ligament of ordinary Bivalves.

In the *Orbicula lamellosa* the same intelligent observer traced along the whole circumference of the valves, shining cilia projecting for an extent varying from two to four lines: they are consequently much longer than in Terebratula and in Lingula anatina, and are rather longer than in Lingula Audebardii, Brod. On examination under a higher power they are observed to be beset with smaller setae, which probably give them greater power in determining the respiratory currents. The mantle is similarly vascular to that of Terebratula, there being, in the upper lobe, four principal trunks (comparatively, however, much shorter than in that genus); and two in the lower. These trunks terminate in sinuses, situated close, and two strong tendinous membranes, which circumscribe the visceral mass, and to which the mantle-lobes firmly adhere. Here the veins of both mantle-lobes join, and the common trunk or sinus passes obliquely through the membrane, and may be plainly seen distributing ramuli over the liver and ovary.

The muscles and viscera form a rounded mass, situated in the posterior half of the shell. The mouth is seated between the base of the arms. The oesophagus passes obliquely through the tendinous wall of the viscera in a direction towards the upper valve: it becomes slightly dilated, and is then surrounded by the liver. The intestine is continued straight to the opposite end of the visceral cavity, is there again contracted, makes a sudden bend upon itself, and returns to the middle of the right side of the visceral belt, which it perforates obliquely, and terminates between the lobes of the mantle a little below the bend of the arms. The liver is of a beautiful green colour, and consists of a congeries of elongated follicles, closely compacted together, which communicate by numerous orifices with the stomach. As in Terebratula, there is no salivary gland.

In *Lingula Audebardii*, Brod., there is also no salivary gland; and Mr. Owen is therefore disposed to believe, that the gland described as such in Lingula anatina by Cuvier, was only a portion of the liver, from which the colour had probably been removed by long maceration in spirit.

In the want of salivary glands the Brachiopoda would seem to agree with the ordinary Bivalves. Destitute, like them, of any hard parts about the mouth for comminuting alimentary substances, glands for pouring in a fluid to blend with the food during that operation, are not wanted.

The nervous system in Terebratula was not detected by

Mr. Owen. In Orbicula two small ganglia were found on the side of the oesophagus next the perforated valve; from which two filaments, accompanying the oesophagus through the membranous wall, immediately diverge and pass exterior to the anterior shell muscles, proceeding with corresponding arteries to near the heart, beyond which he could not trace them. A single small ganglion is situated on the opposite side of the oesophagus, but on a plane posterior to the preceding; this is probably the cerebral ganglion for giving off nerves to the free spiral extremities of the arms, close to the base of which it is situated.

Order II.—Bivalvia.

Mouth destitute of fringed spiral arms.

The animals of this group form the class Conchifera of Lamark, the Bivalvia of the older naturalists.

The shells exhibit great variety of form and relative size. They are joined together at the hinge, which is either plain or toothed, and corresponds in position with the back of the animal. The connection of the two valves is secured by the intervention of an elastic horny *ligament*, the office of which is to keep the valves open. It is either external or internal. The valves are closed by means of *adductor muscles*, intermixed with tendons, and, passing traversely through the animal, adhere to the corresponding places in the inside of each shell. By the contractions of these muscles the free edges of the valves are brought into contact, at the same time that the ligament is compressed or stretched, according as it is internal or external. The number of muscular impressions is employed by Lamark in the division of the Bivalvia into two orders, *Dimyaires* and

Monomyaires. This distinction, however, he has not attended to with care, as in his family *Mytilacées*, which he includes in his second order, or those having one adductor muscle, there are obviously two adductor muscles, although the one is certainly much larger and more complicated than the other. Besides these impressions of the adductor muscles, there are others connected with the foot and byssus. The cloak lines the inside of the shells. In some cases it is entirely open, when the border corresponding with the free margin of the shell is thickened, and more or less fringed with contractile irritable filaments. In other cases the cloak in front is more or less united, and even forms tubular elongations, which are termed *syphons.*

Locomotion is denied to many species of this order. Among these some are immoveably cemented to rocks and stones, as oysters; a few are attached by a cartilaginous ligament, as the Anomiæ; while others are fixed by means of a *byssus.* This last organ consists of numerous filaments issuing from a complicated apparatus in the breast, connected with a secreting gland and with the shell by the intervention of tendinous bands. The *foot* is seated a little towards the mouth, is usually tongue-shaped, capable of considerable elongation, with a furrow on its posterior surface. This organ, where a byssus is present, is considered as employed in spinning and fixing the threads. When there is no byssus, it either acts as a sucker, enabling the animal to crawl among the surface of bodies, or as a paw, to dig holes in the sand or mud. None of the species can float in the water. They either crawl or leap, the last kind of motion being effected by suddenly opening and shutting the valves. In securing a residence, some of the species *bore* into different substances by means of a rotatory motion of the shell. It was at one time supposed that the dwelling was formed by a secretion affecting the solution of the surrounding substance. But the very different substances penetrated by the same species, as limestone, slate-clay, and wood, forbid us to entertain such a supposition.

The nervous system is here but little developed. The superior and inferior ganglia, surrounding the gullet, give rise to all the nervous filaments which proceed through the body.

The digestive organs are scarcely less simple. The food is soft and swallowed entire, and either brought to the mouth by accident, or by eddies produced in the water by the opening and shutting of the shells, aided in some cases by the syphons.

It may be proper here to state, in order to understand the relative situation of the parts, that, upon laying the animal upon its back, and opening the cloak, the abdomen appears to occupy the middle longitudinally, and the branchia to be arranged on each side. The mouth is situated at the anterior extremity, and consists of a simple aperture entering into the gullet, or rather stomach. It is surrounded by four flattened moveable tentacula, two of which in some are in part united with the cloak, while in others they are free to the base. In their structure they resemble the branchiæ. The stomach is full of cells, the bottom of each pierced with a biliary duct. A singular organ, termed the *crystalline process*, cylindrical, cartilaginous, and transparent, is found in some species projecting into the cavity of the stomach. The liver is large, surrounds the stomach, and pours out its contents by numerous openings. The intestine terminates posteriorly by a tubular anus.

The branchiæ consist of two ribbands on each side, extending the length of the body, free on the sides and margin, and striated transversely. These plates are frequently of unequal size. The blood is brought to these by means of pulmonic veins, without the intervention of the heart. The aërated blood is transmitted to a systemic heart, consisting of one or two auricles, and a ventricle.

The reproductive organs of the Bivalvia, hitherto examined, consist of an ovarium occupying the sides of the body, and penetrating the membranes of the cloak. They appear to have the organs of both sexes incorporated, and to propagate without intercourse. Lamark is disposed to consider impregnation produced by the male fluid dispersed through the water; a supposition unsupported even by analogy in the animal kingdom. Many species are ovoviviparous; in which case the eggs when ripe pass into the gills, where they are hatched.

The methodical distribution of the Bivalvia appears to be attended with peculiar difficulties, in consequence of the uniformity which prevails in the structure and disposition of their organs. The characters furnished by the shell, though useful in the construction of generic as well as specific distinctions, have been abandoned by those who prefer a knowledge of the structure, rather than the form of an animal. The characters derived from the presence of a byssus, a foot, or syphons, appear to be nearly of co-ordinate importance. M. Cuvier gives the preference to those founded upon the appearances of the syphon, by the aid of which the genera may be distributed into five families, an arrangement which, though liable to some objections, may be adopted with advantage. These groups, however, may be considered as occupying a much higher rank, and each as including numerous families.

1st Subdivision.

Cloak open.

There are no syphons, the anterior margin of the cloak being as open as the mouth of the shell. When the valves open, the water comes immediately in contact with the branchiæ and mouth. The margin of the mantle has a double fringe of filaments.

1st Tribe.

Valves closed by one adductor muscle.

A. *Pectenidæ.* Animals free or fixed only by a byssus. Furnished with a foot.

Into this family, contemplated by Lamark, the following ill assorted genera may be placed: Pecten, Lima, Pedum, Plagiostoma, Vulsella, Placuna, Gryphæa, Perna, Gervillea, Inoceramus, Malleus, and Crenatula.

B. *Ostreadæ.* Shell cemented to foreign bodies. Body destitute of a foot.

To this family the following genera are related: Ostrea, Anomia, Spondylus, and Plicatula.

2d Tribe.

Shell closed by two adductor muscles.

The two genera, Avicula and Meleagrina (of Lamark), form one family of this tribe; the genus Pinna another; and the Arcadæ a third, including Arca, Pectunculus, Nucula, Cucullæa, Trigonia, and Castalia.

2d Subdivision.

Cloak more or less closed, forming syphons.

The further division of this group depends on the modifications of the syphons, or aperture of the cloak.

1st Tribe.

The union of the cloak forming only one syphon. This is situate posteriorly opposite the anus, and serves for the ejection of the excrements. The other large opening allows the water to enter to the mouth and gills.

This tribe may be divided into two families. The first, *Mytilidæ*, will include the genera Mytilus, Modiolus, and Lithodomus, which are furnished with a byssus. The second, *Unionidæ*, will embrace Unio, Hyria, Anodonta, and Iridina. They want a byssus.

M. Cuvier is disposed to place in this group the genera Cardita, Venericardia, and Crassatella.

2d Tribe.

Cloak closed posteriorly, and anteriorly forming three apertures. The first serves for the passage of the byssus, and is the largest. The second admits water to the branchiæ and mouth ; and the third is opposite the anus. The valves are closed by one adductor muscle. There are only two genera belonging to this tribe, Tridacna and Hippopus.

In the two remaining tribes there are three openings in the cloak. Two of these are posterior, and near each other ; sometimes, indeed, they are tubular and united. There is no byssus, but always a foot.

3d Tribe.

Anterior opening large, allowing the water free access to the mouth and gills, and the feet freedom of motion. The structure of the animals is yet too imperfectly examined to enable any one to establish families on permanent characters. The attempt which Lamark has made may be considered as a complete failure, independent of the wanton changes of nomenclature with which it is chargeable, whilst the efforts of Cuvier have not been attended with greater success. The following are the principal genera belonging to this tribe : Chama, Isocardia, Cardium, Donax, Cyclas, Corbis, Tellina, Loripes, Lucina, Venus, Capsa, Petricola, Corbula, and Mactra.

4th Tribe.

Anterior opening small, and not exposing the mouth or gills.

In this tribe the mantle is closed in front; and even when the valves are open, neither mouth nor gills are visible. The anterior opening serves for a passage to the foot, and the posterior openings, in the form of two long tubes, united by a common membrane, serve for the entrance and exit of the water to the mouth and branchiæ, and the ejection of the fæces, the dorsal syphon serving the latter purpose. The cuticle of the shell covers also the exposed portion of the cloak, so that, when the animal is removed from the shell, it remains as a loose membrane on the margin of the valves, as was first observed by Reaumur. All the genera prefer concealment, burrowing in sand, mud, or wood, with the head downwards, and the syphons rising to the surface. The following genera belong to this tribe: Mya, Lutraria, Anatina, Glycemeris, Panopea, Pandora, Gastrochena, Byssomia, Hiatella, Solen, Sanguinolaria, Pholas, Teredo, Xylophaga, Clavagella, and Fistulana.

Sect. II.—*Acephala Tunicata.*

Covering soft or coriaceous.

The formation of this interesting group of animals was first publicly announced by Lamark in his *Histoire Naturelle des Animaux sans Vertèbres*, tom. iii. p. 80, (1816.) The labours of Desmarest, Lesueur, and Cuvier, aided by the descriptions of Ellis and Pallis, paved the way for the masterly efforts of Savigny, to whom we owe the most extensive, new, and accurate information yet given concerning the animals of this group. His observations are contained in his *Recherches Anatomiques sur les Ascidies composées, et sur les Ascidies simples*, inserted in his *Mémoires sur les Animaux sans Vertèbres*, 8vo, Paris, 1816.

The covering of the animals of this group consists of an external and internal sac or tunic, which are either entirely united or unconnected, except at the apertures. The surface is smooth in some, and rough in others, and in a few species defended by an artificial covering of agglutinated shells and sand. The sacs are furnished with muscular bands, and are capable of contraction. Some of the species, by means of contractile movements, float about in the water; others, receiving that element into the branchial cavity, and ejecting it forcibly at the opposite one, push themselves forward. Many, however, are fixed during life to seaweeds and stones.

The apertures of the tunic are two in number, unless in the doubtful genus Mammaria. The one, frequently the largest, is destined for receiving the water into the cavity to supply the mouth and gills. This is termed the *branchial* cavity. The other is destined for the exit of the water, the eggs, and the fæces, and termed the *anal* opening. These apertures are sometimes placed near each other, at other times at opposite extremities of the body, and variously provided with tentacula or valves.

The mouth is simple, destitute of spiral arms, and opening in the anterior of the cavity of the body between the branchiæ, as in the other Acephala. It possesses neither jaws nor tentacula. The alimentary canal is very simple, and can scarcely be distinguished into gullet, stomach, and intestine. The food is soft, and such as the bounty of the waves bestows. The liver adheres to the stomach, and in many species is divided into distinct lobes.

The circulating system appears to be reduced to a single systemic ventricle. The gills cover the walls of the cavity, in the form of ridges, more or less complicated, and seldom symmetrical.

The reproductive organs consist of an ovarium, either simple or complicated, with some additional glands, the uses of which have not been ascertained. The species are considered as hermaphrodite, and independent of reciprocal impregnation. They appear not only to be oviparous, but to be gemmiparous and compound, many individuals being organically connected, and capable of simultaneous movements. They are all inhabitants of the sea.

1st Subdivision.—Dichitonida.

Interior tunic detached from the external one, and united only at the two orifices.

The branchiæ are large, equal, and spread on the central walls of the inner sac. The branchial orifice has an inner membranaceous denticulated ring, or a circle of tentacula.

1st Tribe.

Body permanently fixed to other bodies.

In this tribe the branchial and anal orifices are not opposite each other, and do not communicate through the branchial cavity. This cavity at its opening is furnished with tentacular filaments. The branchiæ are conjoined anteriorly.

A. Simple.

This division includes the genus *Ascidia* of Linnæus. The individuals are independent of each other, and although they frequently adhere together in clusters, they are destitute of a common covering, or organical connexion.

1. *Apertures furnished with four rays.*

The animals of this group have the external tunic coriaceous, dry, opaque, rough, folded, and frequently covered with extraneous bodies, or inclosing such. The branchial orifice has four rays, the anal one the same, or divided transversely. The branchiæ are divided longitudinally into persistent regular deep folds.

a. Body pedunculated.

The peduncle, in this division, may be said to have its rise in the summit of the body, which it serves to suspend.

The abdomen is lateral. The meshes of the branchiæ are destitute of papillæ.

Genus Boltenia.—The tentacular filaments of the branchial circle are compound. There is no liver, and the ovarium is compound. Only one species is known, *B. fusiforme.* Savigny, *Mem.* tab. i. f. 1., and tab. v. f. 5. It is the *Vorticella Bolteni* of Lin. and the *Ascidia Clavata* of Shaw.

b. Body sessile.

M. Savigny describes this group as a genus, which he terms Cynthia, which he divides into four sub-genera.

(A.) Tentacular filaments of the branchial orifice compound. The folds of the branchiæ more than eight in number. The liver distinct, and surrounding the stomach. Ovarium divided, with one division at least on each side the body. The intestine destitute of a rib.

Genus Cynthia.—Meshes of the branchiæ unchanged by the folds. *C. Momus.* Sav. tab. i. f. 2.

Genus Cœsira.—Meshes of the branchiæ interrupted by the folds. *C. Diona* of Sav. tab. vii. f. 1. The *Ascidia quadridentata* of Forskäl.

(B.) Tentacular filaments of the branchial orifice simple. The folds of the branchiæ eight in number, four on each side, and the meshes uninterrupted. Intestine strengthened by a cylindrical rib from the pylorus to the anus. Liver absent or indistinct.

GENUS STYELA.—Ovarium divided, one division at least on each side. *S. Canopus.* Sav. tab. viii. f. 1.

GENUS PANDOCIA.—Ovarium single, and situate in the fold of the intestine. The *Ascidia conchilega*, a native species is the type.

2. *Apertures with indistinct rays, or more than four.*

The external tunic is here soft, easily cut, and translucent. The rays (when existing) of the branchial orifice amount to eight or nine; and those of the anal to six at least. The branchiæ are destitute of longitudinal folds. The tentacular filaments of the branchial circle are simple. Liver indistinct. Ovarium single.

a. Body pedunculated.

The stalk is here placed at the base, and serves to support the body, being of an opposite character from that of the Boltenia.

GENUS CLAVELINA.—Branchial and anal orifices without rays. Angles of the branchial meshes simple. Intestine destitute of a rib. The *Ascidia clavata* of Pallas, and the *A. lepadiformis* of Müller belong to this genus; the latter of these is now recorded as a British species.

As connected with this group the small Ascidia, figured and described by Mr. Lister in the *Philosophical Transactions* for 1834, deserves particular notice, as the following important observations which he has recorded, sufficiently indicate. They will indeed be perused with peculiar interest by all who are practically engaged in the study of molluscous animals.

This compound animal occurs in groups that consist of several individuals; each having its own heart, respiration, and system of nutrition, but fixed on a peduncle that branches from a common creeping stem, and all being connected by a circulation that extends throughout. Their parts of such transparency that their interior is easily seen. Their external shape is that of a pouch, compressed at the sides, and fixed at the hind part of its base upon the peduncle.

Its two openings are in the form of very short tubes; that of the mouth at the top of the pouch, and that of the funnel in front. The longest diameter, from the peduncle to the space between the openings, is about ·085 inch.

The outer covering is a tough coat, a continuation of the peduncle, more pliable near the openings; lined interiorly with a soft substance or mantle, in which a ramifying circulation is very distinct. A great part of the interior is occupied by the branchial sac, which is subcylindrical, flattened at the sides, and has its axis vertical; its cavity terminating upwards in the oval opening, and being closed at the bottom. It is united to the envelope, or to the mantle above and behind; the juncture, beginning in front of the oval opening, extends backwards on each side of it, and then downwards in two lines; between these, along the middle of the back, is a vertical compound stripe, that seemed to me cartilaginous. At the bottom the sac appears to be enveloped by the soft substance of the mantle, but at its sides and front a vacant space is left between them, that ends in the opening of the funnel. The branchial sac is more compressed towards its lower part; and here are placed, externally to it, the heart on the left, and the stomach and other viscera on the right side, the vent opening upwards at the front into the funnel. On its sides and front the sac is perforated by four rows of narrow, vertical, irregularly oval holes or spiracles, about sixteen in each row, placed at less than the diameter of one apart from each other. Through these the water, which flows constantly in at the mouth when its orifice is open, appears to be conveyed to the vacant space between the sac and mantle, and it then escapes at the funnel. The sac seems extremely thin between the spiracles; but their edges are thickened, as if cartilaginous; and they are lined with closely set ciliae, which, by their motion, cause the current of water. When these are in full activity, the effect upon the eye is that of delicately-toothed oval wheels revolving continually, in a direction ascending on the right and descending on the left of each oval, as viewed from without; but the ciliae themselves are very much closer than the apparent teeth, and the illusion seems to be caused by a fanning motion given to them in regular and quick succession, which will produce the appearance of waves, and each wave here answers to a tooth. The spaces between the rows of spiracles are of much more substance than the intervals of the spiracles; some ligaments are stretched from them across the side cavities to the mantle, which seem intended to keep the branchial sac expanded. These spaces also support finger-like processes, about eight in a row, that project nearly at right angles into the central cavity.

The central cavity I shall venture to call the mouth, though the mouth is said by Cuvier to lie at its bottom. The large short tube at its opening ends in five or six obscure indentations; it can be drawn in and closed at the will of the animal, as can the opening of the funnel. At the bottom of the tube the entrance of the mouth is guarded by simple tentacula, some longer, some shorter, ranged subalternately: their number was not ascertained. Whatever little substances, alive or inanimate, the current of water brings, flows in unless stopped by the tentacula, and they do not appear fastidious, to the mouth, and lodge somewhere on the sides of it. A lively animalcule will sometimes disengage himself by struggling, and dart about in the cavity till he lodges on some other part; or, if a morsel is found unsuitable, it is ejected by the funnel's being closed, and the branchial sac suddenly contracted vertically. Mostly, however, whatever part the food lodges on, it travels from thence horizontally with a steady slow course towards the front of the cavity, where it reaches a downward stream of similar materials, and they proceed together, receiving accessions from both sides, and enter at last at the bottom, the œsophagus: this is a small flattened tube which carries them, flowing on in the same way, without any effort of swallowing, towards the stomach. The tube takes a sharp curve upwards and backwards before arriving there.

It is extraordinary that these particles pass along in the mouth just behind the spiracles, when the ciliae are in full activity, without being at all affected by them. I have, in some positions, seemed to catch a glimpse of a membrane suspended within, too transparent to be commonly seen. One may imagine the water to pass to the spiracles, strained through the meshes of such a membrane, and the food to be carried along it by invisible villi; but this is mere conjecture. The projecting fingers have the effect, whether intended for such a purpose or not, of detaining some prisoners more bulky than the usual food of the animal, for, in several individuals, I met with small shrimp-like crustacea confined between the rows: one escaped during an observation, another, after three days, seemed as lively as when first swallowed.

The stomach runs backward horizontally; its fore-part had an inflated look when seen from the side, and, when from below, that of possessing two lateral lobes. The food after accumulating here was observed to be pressed onward to the hinder portion, leaving a narrow opake line of connexion with the œsophagus; the rest of the fore-part, of which the apparent volume was nearly as before, having an ochreous tint; this was inferred to be the liver, enveloping the stomach above and on the sides, and accords with its place in other ascidiae and mollusca. The line is continued by the intestinal canal that rises and then bends forward, taking the form of a reversed S, and terminates in an ascending rectum and sphincter. The fæces are considerable, as might be expected, where the food is taken with so little discrimination. Transparent vessels, that may be supposed lactaels, ramify along a part of the intestine and meet at a collection of globular bodies, from whence two flattish lobes extend backward; in others these are wanting. From the meeting of the vessels two branches ran, one downwards and backwards, which was lost under the stomach, the other forwards; and from the direction it took, I suppose it might communicate with a main stream of blood near the heart. Some individuals had not the projection above the vent observable in others.

But the part that struck me as most remarkable in this creature was the circulation, of which a good view can be obtained through the transparent coat, for the particles of the blood are numerous, and, though not uniform in size or shape, are mostly between ·00025 and ·0002 inch in diameter, and approaching to globular. They are easily measured, as in the intervals between the spiracles, they pass mostly but one at a time.

The creeping tube, which unites the individuals of a group, is the channel for two separate currents of blood, an upward and a downward one, that are flowing at one and the same time, and that send off each branch to every peduncle: the blood thus passes into the animal by one current, while another carries it back. One of these canals communicates at the termination of the peduncle with the heart, which is placed, as has been mentioned, near the bottom of the branchial sac on the left side, and consists of a transparent ventricle, or boyau, running forward and a little slopping downward, in a channel hollowed to contain it. Along the whole length of the boyau a part on one side of its axis seems fixed to the channel, the rest free and contractile.

When the blood entered the heart from the peduncle, contraction began at the middle of the ventricle, impelling onward the contents of the fore part; and the contraction of the back part followed in the same direction, so as for the whole to have the effect of one pulsation; the heart was then filled again by a flow from the peduncle. The intervals of the pulse were pretty regular in the same individual, but in different ones they varied from two seconds to one and a half second. Part of the blood thus impelled formed a main upward stream along the front of the branchial organ, branching off at each of the horizontal passages between the rows of spiracles, and at one above them on a line with the junction to the mantle on each side. All these again united and formed a downward current behind. The horizontal channels were connected also by the smaller vertical passages between the spiracles; the set of the current in the latter being upwards for the two lower rows, and downwards for the two upper ones.

Another larger portion of the blood, on leaving the heart, immediately divided into many ramifications that spread like a network over the stomach and intestines and the soft substance of the mantle. Of these a part run into the horizontal passages above the branchial sac, a part into the descending back stream; a large portion, after leaving the intestines, took a short course, and, collecting into one channel, flowed into that stream near the bottom, and, all united, then entered the peduncle and constituted the returning current that went to circulate in other animals of the group.

After this circulation had gone on for a while the pulsations became fainter for a few beats, and the flow slower, and suddenly, with but a slight pause, the whole current in all its windings was reversed. The heart gave the opposite impulse; the channel in the peduncle, that before poured in the blood, now carried it back, and the other the contrary, and every artery became a vein. These changes continued and succeed each other alternately, the average time of the currents being the same in both directions, but the period of each varying within a single observation as much as from thirty seconds to two minutes. The phenomenon, like the currents in the *Sertulariae*, was invariably met with in every animal of the species that came under my notice.

Sometimes, when the creeping tube or the peduncle has been injured, the circulation of an individual is in consequence insulated, but without appearing to impair any of its functions. I severed one at the part where it joined the peduncle, when for a few seconds the pulsation ceased; it then began irregularly and with considerable pauses, and increased in steadiness as it went on. At first the impulse given by the heart was towards the front, and the downward back stream, instead of flowing out at the wound, was poured into the hinder end of the ventricle; but when the current was reversed part of the blood was driven for a time through the stump of the peduncle into the water: however, it soon staunched, and all the vital actions went on as before the separation, except that at the beginning of every pulsation there was a slight recoil.

In one case where the circulation did not extend to another animal, one channel, and only one, was open in the peduncle, and in this a small current ran to and fro according to the direction of the impulse given by the heart. Some animals, which had probably been injured, but were still connected with other vigorous ones, seemed to be in course of absorption. One was observed in which the soft parts were so shrunk as to occupy a small part only of the tunic; the currents of its peduncle extended into this mass, but the heart, or motion of branchiae, was visible. Upon looking at the same the next day, the tunic was empty, the soft matter and circulation reaching only to the end of the peduncle. I also once noticed a flux and reflux of the blood in a creeping stem, where the current did not communicate with any animal.

In some of the last mentioned particulars this Ascidia bears a resemblance to the Sertulariae, and, like them, it increases by sprouts: the two streams of the stem run through the bud before its organs are developed. No proper motion was seen in the particles of its blood, like that of the Sertulariae.

In a sessile Ascidia, nearly half an inch in length, of which the coat was too rough and opake to allow an inspection of the branchiae, the circulation was distinctly visible in the mantle near the openings, and the particles in the blood were only of about the same size as above.

b. Body sessile.

The branchial orifice with eight or nine rays, and the anal with six. The angles of the branchial meshes with papillæ. No liver. A cylindrical rib extending from the pylorus to the anus.

(A.) Tunic and branchial cavity straight.

Genus Pirena.—The branchial sac as extended as the tunic. Stomach not resting on the intestine. *P. phusca* of Forskäl is the type, to which Savigny has added three other species. The *Ascidia prunum* of Müller, a native species, may be referred to this genus.

Genus Ciona.—Branchial sac shorter than the tunic, and exceeded by the viscera. *Ascidia intestinalis,* Lin. is a native example of this genus.

(B.) Tunic turned up at the base.

Genus Phallusia.—Branchial sac extending beyond the viscera into the pouch of the sac. Stomach resting on the mass of viscera. The *Ascidia mentula* of Müller, a native species, is the type.

There are two genera supposed to be nearly related to the preceding, which are involved in great obscurity. The genus *Bipapilaria* of Lamark appears to be pedunculated, with two apertures, each furnished with three setaceous tentacula. The *Mammaria* of Müller has only one terminal aperture. One species inhabits the British seas.

B. Compound.

The animals included under this division were formerly inserted in the genus Alcyonium of Linnæus, and placed among the Zoophytes. They are compound animals, many individuals united by a compound integument, and arranged according to a uniform plan.

In some cases, there is only one system of individuals in the mass, in other cases, there are many similarly arranged and contiguous. The tentacular filaments of the branchiæ appear to be distinct. They are destitute of the intestinal rib which occurs in some of the preceding genera.

1. *Branchial Orifice Radiated.*

a. Branchial and anal orifices, with six rays.

(A.) Body sessile. The angles of the branchial meshes furnished with papillæ. The thorax, or cavity containing the branchiæ, cylindrical. The abdomen is inferior, with a stalk. Ovarium sessile, and single.

Genus Diazona.—Body orbicular, with a single system of animals disposed in concentric cirles.

The substance is gelatinous. The ovarium enclosed in fold of the intestine. *D. violacea* of Sav. tab. ii. f. 3.

Genus Polyzona.—Body polymorphous, with many systems disposed subcircularly.

The body is subcartilaginous. The individuals are disposed irregularly around the common centre. Savigny inadvertently termed this genus Distoma, a name long pre-occupied amongst the intestinal worms. The *Alcyonium rubrum* of Plancus, and the *Distomus variolosus* of Gaertner, belong to this genus. The last is a native species.

(B.) Body pedunculated.

Genus Sigillina.—Body a solid cone, consisting of a single system of many individuals, irregularly disposed, one above the other.

The thorax is short, and hemispherical. The angles of the branchial meshes destitute of papillæ. The abdomen is inferior, sessile, and larger than the thorax. The single ovarium is pedunculated. *S. astralius,* Sav. tab. iii. f. 2., brought from New Holland, by M. Peron, is the only known species.

b. Branchial orifice only furnished with six rays.

(A.) Body pedunculated. System single, circular, and terminal.

Genus Synoicum.—Anal orifice rayed.

The body is cylindrical. The anal orifice has six very unequal rays; the three largest forming the exterior margin of the central star. The stomach is simple. The angles of the branchial meshes destitute of the papillæ. Ovarium single, sessile attached to the bottom of the abdomen, and descending perpendicularly. The *S. turgens* of Phipps is the type.

Genus Sydneum.—Anal orifice simple and tubular.

The body is inversely conical. The stomach surrounded with glands. Intestine spirally folded. Ovarium pedunculated. The *S. turbinatum* is the only known species, and was sent to Savigny by Leach from the British seas.

(B.) Body sessile, polymorphous.

(*a.*) Each system with a central cavity.

Genus Polyclinum.—Systems numerous, convex stellular. Individuals arranged irregularly round the common centre. Abdomen inferior pedunculated, and less than the thorax. Ovarium single, pedunculated, and attached to the side of the abdominal cavity, and drooping.

M. Savigny describes one species from the Mauritius, and five from the Gulf of Suez.

(*b.*) Systems destitute of the central cavity, and the angles of the branchial meshes without papillæ.

Genus Alpidium.—Individuals in a single row round the common centre.

The thorax is cylindrical. The abdomen inferior, sessile, and of the size of the thorax. Ovarium single, sessile, placed at the bottom of the abdomen, and prolonged perpendicularly. Savigny divides the genus into two tribes. In the first, the individuals are simply oblong, with an ovarium shorter than the body, as *A. ficus* (*Alcyonium ficus*, Linn.) In the second, the individuals are filiform, with an ovarium longer than the body, as *A. effusum* of Savigny, tab. xvi. f. 3.

Genus Didemnum.—Individuals in distinct systems.

The thorax is short and subglobular. The abdomen inferior, pedunculated, and larger than the thorax. The anal opening is obscure. The ovarium is single, sessile, and placed on the side of the abdomen. *D. candidum* and *viscosum*, from the Gulf of Suez, are the only known species.

2. *Branchial Orifice simple.*

The species form a thin fleshy crust on stones and seaweeds. The individuals are stellularly arranged in distinct systems. The branchial orifice is circular and undivided. The abdomen is sublateral, and fixed at the bottom of the branchial cavity. The intestine is small, and the anus indistinct. The angles of the branchial meshes are without papillæ.

Genus Botryllus.—Systems furnished with a central cavity. The systems are prominent, and consist of one or more regular concentric rows. The ovarium is double, being attached to each side of the branchial sac.

This genus is subdivided by Savigny into *Botrylli stellati*, and *Botrylli conglomerati*. In the first, where the individuals are distributed in a single row, there are some species in which the individuals are cylindrical with approaching orifices, and the limb of the central cavity not apparent after death, and probably short, as the *B. rosaceus*, *Leachii* and *Borlassii*. In other species, the individuals are ovoid, with remote orifices, and the limb of the central cavity is always apparent and notched, as *B. Schlosseri*, *stellatus*, *gemmeus*, and *minutus*. In the botrylii conglomerati, in which the individuals are disposed in several rows, there is only one species, *B. conglomeratus*.

GENUS EUCŒLIUM.—Systems destitute of a central cavity. The individuals are distributed in a single row, and the ovarium is single, sessile, and attached to the side of the abdominal cavity. The *E. hospitiolum* of Sav. tab. iv. f. 4., is the only known species.

2. Tribe.

Body free, and moving about in the water.

GENUS PYROSOMA.—The body is gelatinous, in the form of a lengthened bag open at the widest end. The individuals are arranged perpendicularly to the axis of the central cavity, super-imposed on one another. The branchial orifice is external, without rays, and with an appendage over its upper margin. The anal orifice is opposite, and terminates in the central cavity. Branchial sac destitute of folds, with a membranaceous ring at the entry. The branchiæ are disjoined. The abdomen is inferior to the branchiæ, and not separated by any contraction. Liver distinct, globular, and retained in a fold of the intestine. Ovarium double, opposite, and situate at the upper extremity of the branchial cavity.

M. Savigny divides the species into *Pyrosomata verticilla*, having the individuals arranged in regular prominent rings, as *P. elegans* of Lesueur; and *Pyrosomata paniculata*, having the individuals forming irregular circles unequally prominent, as *P. giganteum* and *Atlanticum*.

2. Subdivision. Monochtonida.

Inner tunic adhering throughout to the external one.

The body is gelatinous, transparent, and simple. The branchial cavity is open at both ends, communicating freely with the anus. The branchial orifice is in the form of a transverse slit, with one edge in the form of a valve, to accelerate the entrance of the water into the cavity. The inner tunic is strengthened by numerous transverse muscular bands, which, by contracting, diminish the diameter of the cavity, and eject the water from the anal orifice, thereby propelling the body through the water. The digestive organs are situate at the inner end of the cavity. The mouth and rectum are simple; the former placed between the two branchiæ, the latter directed towards the anal orifice. The heart is contiguous to the stomach, at the bottom of what may be termed the branchial sac, and is enveloped in a membranaceous pericardium. The branchiæ are double, not incorporated with the walls of the sac, but with two folds of unequal length. The largest is free in the middle, fixed at each extremity, and opposed to the dorsal groove, and traverses the cavity obliquely. The other extends from the base of the first to the extremity of the dorsal groove. The surface of the branchiæ consists of transverse vessels in a single range in some species, and a double range in others.

When young, many individuals often adhere, and form chains and circles. But the fully grown individuals are always detached and single.

This subdivision comprehends the species of the genus Salpa; they are exceedingly numerous, and appear to belong to many different genera. M. Cuvier has given indications of some of these, chiefly derived from the shape. A few are furnished with an elevated crest or fin, as the Thalia of Brown ; a few have both extremities rounded or truncated, as *Salpa octofera* of Cuvier ; others have one extremity produced, as *Holothuria zonaria* of Gmelin ; and even both extremities produced, as *Salpa maxima* of Forskäl. The *Salapa moniliformis*, so common in the Hebrides, and first recorded as a native by Dr. Macculloch, in his valuable *Description of the Western Isles*, vol. ii. p. 188, and imperfectly figured in its young state, at tab. xxix. fig. 2., appears to be closely allied to the S. maxima of Forskäl, and but very remotely with the *S. polycratica* and *confederata* with which it is compared. This observer states, that "It cannot bear to be confined in a limited portion of water, as it died even in a ship's bucket in less than half an hour." With us, in similar circumstances, those taken in the evening were alive at noon on the following day.

CHAPTER III.

ON MOLLUSCOUS ANIMALS AS OBJECTS OF UTILITY.

Although molluscous bodies furnish many articles of value to man, scarcely any naturalist has taken the trouble to enumerate the different purposes to which they have been applied, or to point out in what manner their usefulness might be encreased. To the savage, shells furnish some of his most important instruments. They often answer all the purposes of a knife, and are extensively employed as a substitute for iron: with pieces of the more solid bivalves he points his arrows, and forms his fish-hooks. Even when farther advanced in civilization, the canaliculated univalves sometimes constitute the rustic lamp, while the larger scallops are employed by the dairy-maid to skim her milk and to slice her butter. From the mother-of-pearl shell many useful and ornamental articles are fabricated; and calcined shells were formerly esteemed by physicians as absorbents; and are still regarded by the farmer as furnishing a valuable manure. Also used as musical Instrum

Shells thus appear to be of some importance in the arts of life; but the animals contained in these shells are of far greater value. As articles of food, shell-fish are extensively employed by the poor, and even hold a conspicuous place at the tables of the rich. In many places, they in a great measure support the children of our maritime population, and, in the Western and Northern Islands of Scotland, have, in years of scarcity, prevented the death of thousands.

The kinds chiefly used in this country, as articles of subsistence, are bivalves, belonging to different genera. Among these the *Oyster (Ostrea edulis)* holds the most distinguished place. This shell-fish is very widely distributed in nature, being found in the seas of Europe, Asia, and Africa. But, since the days of the luxurious Romans, the oysters of Britain have been held in the highest estimation. They are found on various parts of our coasts, from the southern shores of England, to the sheltered bays among the Zetland Islands. They prefer a rough or rocky bottom, in from five to twenty fathoms water. They are fished up with a dredge and an open boat; sometimes, when in shallow water, with a rake or tongs. They are either conveyed directly to the market, or are placed in artificial ponds of sea water, where they increase in size, and acquire a fine green colour. In England this process of *fattening*, as it is termed, is chiefly conducted at Colchester, but the oysters are obtained from the little creeks between Southampton and Chichester. This fishery on the coast of England is supposed to give employment to ten thousand people, so that, independent of the addition which it makes to the articles of subsistence, it must be regarded as a valuable nursery for seamen. As an article of food, oysters are light and easy of digestion, and may be eaten in great numbers without inconvenience. They are used either raw or when pickled. In the last form, they are sent to different parts of the country, and even constitute an article of export. In Scotland, the principal oyster fishings are in the

Firth of Forth; but we trust the period is not far distant, when the proprietors on the western coast of Scotland and the Hebrides will propagate this shell-fish more extensively on their shores and sheltered bays. Places fitted for their growth are every where to be met with; they require no superintending care; they would soon furnish an esteemed dish to their tables, and form a valuable addition to their trade.

The next shell-fish, in point of importance, as an article of food, is the *Mussel (Mytilus edulis)*. This animal is equally widely distributed as the oyster, and is found upon our coast in the greatest abundance. It is gregarious, being found in extensive beds, which are always uncovered at low water. It is found likewise in the crevices of the rocks. In this fishery women and children are chiefly employed, and they detach the mussels with an iron hook from the beds or rocks to which they adhere by means of fine cartilaginous threads. In this country they are conveyed directly to the market; but in some places of France they are kept for a time in salt ponds, to fatten like the oyster, into which, however, they admit small quantities of fresh water. The flesh of the mussel is of a yellowish colour, and considered very rich, especially in autumn, when it is in season. It is eaten in this country either boiled or pickled, seldom in soup. To the generality of stomachs it is difficult to digest, and to many constitutions it is deleterious. It is, however, in the spring, during the spawning season, that the greatest danger is to be apprehended. This noxious quality was long considered as occasioned by the *pea crab*, which is often found within the shell of mussels. It is now with more propriety attributed to the food of the mussel, which, at certain seasons, consists chiefly of the noxious fry of the star-fish; and likewise to a disease to which the animal is subject in spring, under the influence of which it melts away, and falls from the rocks. Besides being useful to man as an article of subsistence, the mussel supplies the fisherman with one of his most convenient and successful baits. It is keenly taken both by cod and haddock. To the cod-fish, however, the animal of the horse-mussel (*Modiola vulgaris*) is more acceptable.

The following unsuccessful attempt to plant a colony of mussels is recorded by Mr. Stevenson in his interesting work, (p. 73,) in which he gives the details of the erection of the light-house on the Bell-Rock: "When the workmen first landed upon the Bell-Rock, limpets of a very large size were common, but were soon picked up for bait. As the limpets disappeared we endeavoured to plant a colony of mussels, from beds at the mouth of the river Eden, of a larger kind than those which seem to be natural to the rock. These larger mussels were likely to have been useful to the workmen, and might have been especially so to the light-keepers, the future inhabitants of the rock, to whom that delicate fish would have afforded a fresh meal, as well as a better bait than the limpet; but the mussels were soon observed to open and die in great numbers. For some time this was ascribed to the effects of the violent surge of the sea, but the *Buccinum lapillus*, (Purpura,) having greatly increased, it was ascertained that it had proved a successful enemy to the mussel. The *buccinum*, being furnished with a proboscis capable of boring, was observed to perforate a small hole in the shell, and thus to suck out the finer parts of the body of the mussel; the valves of course opened and the remainder of the fish was washed away by the sea. The perforated hole is generally upon the thinnest part of the shell and is perfectly circular, of a *champhered* form, being wider towards the outward side, and so perfectly smooth and regular as to have all the appearance of the most beautiful work of an expert artist. It became a matter extremely desirable to preserve the mussel, and it seemed practicable to extirpate the *buccinum*. But after we had picked up and destroyed many barrels of them, their extirpation was at length given up as a hopeless task. The mussels were thus abandoned as their prey, and in the course of the third year's operations, so successful had the ravages of the *buccinum* been, that not a single mussel of a large size was to be found upon the rock; and even the small kind which bred there are now chiefly confined to the extreme points of the rock, where it would seem their enemy cannot so easily follow them."

The *Common Cockle (Cardium edule)* would deserve a place in preference even to the mussel, were it not exclusively confined to our sandy coasts and bays. It is found lodged in the sand, a few inches below the surface, its place being marked by a small depressed spot. Women and children easily dig up this shell-fish with a small spade. Cockles are sold by measure, and eaten either raw, or boiled, or pickled. They are deservedly esteemed a delicious and wholesome food in this country, although in France they are little regarded. They are in season during March, April, and May, after which they become milky and insipid. They are not generally used as a bait.

Two kinds of *Razor-fish (Solen siliqua* and *ensis)* are in many places of this country used as food. In Scotland they are indiscriminately termed *Spout-fish.* They are found upon most of our sandy shores, buried about a foot or two below the surface, and near to the low water mark. Their place is known by a small hole in the sand. As it is rather a laborious operation to dig them out, Bosc informs us, that the fishermen of France throw a small pinch of salt into their holes, which always remain open by the action of the respiratory organs; that they speedily rise to the surface, and are thrown out by an iron instrument made for the purpose. The fishermen believe that it is the salt which they wish to avoid; but it is conjectured, with greater probability, that the presence of the salt water, which is thus formed by the solution of the salt, makes the animal suppose that its hole is again covered with the tide. This shell-fish was esteemed by the ancients as a great delicacy. When boiled or fried, it is certainly a very palatable morsel. When kept for a few days, it forms an excellent bait for haddock or cod, and may even be employed for that purpose in a fresh state.

Several species of *Gapers (Myæ)* are used as food both in Britain and on the Continent, as the *Mya arenaria*, known to the fishermen about Southampton by the whimsical name *Old Maids*. These shells reside in the mud or shingle on the shore, and a few inches below the surface. In some parts of England and Ireland, they are much used, but, though common in Scotland, they are never sought after. Another species, the *Mya truncata*, is also very common on the coast. It prefers a hard gravelly bottom, in which it lodges near low water mark. The inhabitants of the northern islands call it *Smurslin*, and employ it, when boiled, as a supper dish. It is not so delicate as some of the shell-fish which we have noticed, but it is by no means unpalatable. The *Mya declivis* of Pennant is, according to that author, very plentiful in the Hebrides, and eaten by the gentry of that country. We suspect that he should have referred to the *Mya truncata*. These shells furnish very good baits to the fisherman.

There are several bivalve shells, besides those which we have mentioned, employed on our coasts as articles of subsistence. The *Scallop (Pecten)* was held in high estimation by the ancients, and still is sought after in Catholic countries. The *Pecten maximus* is frequently used in England. It is found gregarious in moderately deep water, and is taken up by the dredge. It is pickled and barrelled for sale, and esteemed a great delicacy. The fishermen suppose that they are taken in the greatest quantity after a fall of snow. Another species, the *Pecten opercularis*, is employed for culinary purposes in Cornwall, where it is known by the name of *Frills* or *Queens*. In the Firth of Forth this species is frequently dredged up along with oysters, but it is thrown, by the Newhaven fishermen, to the dunghill, along with sea urchins and star-fish. To this list we might add the *Mactra solida*, which is used as food by the common people about Dartmouth; and the *Venus pullastra*, called by the inhabitants of Devonshire, Pullet, and eaten by them, and known to the inhabitants of the Northern Islands by the name of Cullyock, and there used as a bait. According to Bruguiere, the *Anomia ephippium* is used as food at Languedoc, and is there considered as preferable to the oyster.—But it is now time that we turn our attention to the univalve shells, in order to ascertain their value in an economical point of view.

The common *Periwinkle (Turbo littoreous)* is, in this country, more extensively used as food than any of the other testaceous univalves. This shell is easily gathered, as it is found on all our rocks which are left uncovered by the ebbing of the tide. Children are principally employed in this fishery, and the shells are sold by measure. They are in general used after being plainly boiled, and are consumed

hilgrims wore them in the hat, as
token of having been in the Holy Lan
they are still in coat armour

in great quantities by the poor inhabitants on the coast. The *Nerita littoralis* is also frequently gathered along with the periwinkle, as it frequents the same situations. It is, however, much smaller, and its flesh is not reckoned equally good.

The *Limpet (Patella vulgata)* is equally abundant as the periwinkle, and frequents the same situations on the rocks. Although used by the ancients as an article of food, it is seldom brought to market in this country. Among the villages along the coast of Scotland this shell-fish is frequently used, and its juice, obtained by boiling, mixed with oatmeal, is held in high estimation. It is considered in season about the end of May. The chief excellence of the limpet, however, is as a bait. It is very easily obtained from the rocks, from which the fisherman detach it with a knife, and it is eagerly seized by all the littoral fish which are sought after. To the haddock it is very acceptable.

Several species of *Snails (Helix)* are employed for culinary purposes. The largest of these, the *Helix pomatia*, was a favourite dish among the Romans, who fattened them with bran sodden with wine. They are still used in many parts of Europe during Lent, after having been fed with different kinds of herbs. This species was originally imported into Britain from Italy, and turned out in Surry, where it has readily multiplied. The *Helix hortensis* has also been employed as food. But, we believe that these two species are chiefly used medicinally, being administered in consumptive cases. The small species of the genus are the favourite food of the birds of the thrush kind, either in a wild or confined state.

The other univalves which we shall notice are of inferior importance as articles of subsistence. The *Fusus antiquus,* the largest of the British turbinated shells, is frequently dredged up with oysters, and, according to Pennant, "is eaten by the poor, but oftener used for baits for cod, and ray." It is probably the same species which is noticed by the Rev. William Fraser, in his view of the Parish of Gigha and Cara in Argyleshire, vol. viii. p. 48, *of the Statistical Account of Scotland*. He says it is a large white welk called *buckie* or dog-welk, and used as a bait for cod. The method of obtaining these shells for bait being ingenious, and making us acquainted at the same time with several new habits of the animal, we shall here insert it. "At the beginning of the fishing (says Mr. Fraser) a dog is killed and singed, and the flesh, after rotting a little, is cut into small pieces, and put into creels or baskets made of hazel-wands for the purpose. These creels are sunk by means of stones thrown into them. The flesh of the dog, in its putrid state, is said to attract the welk, which crawls up round the sides of the basket, and getting in at the top, cannot get out again, owing to the shape of it, which is something like that of the wire mouse-trap. After the first day's fishing, the heads and entrails of the cod, with skate and dog-fish, are put into the creels, which are visited every day, the welks taken out, and fresh bait of the same kind put in, there being no more occasion for dog's flesh." The *Buccinum undatum*, and the *Purpura lapillus* are also employed as bait, and in years of scarcity as food.

This list of culinary shell-fish is far from complete, even in so far as it is a British list. The uses of these molluscous animals have seldom been taken notice of by conchologists since the days of Schonvelde, more attention having been directed to the formation of new systems of arrangement, and to the discovery of new species, than to the habits and uses of those already known.

Independently of the food which we thus obtain from testaceous animals, they furnish us with the *pearl*, one of the most beautiful ornaments of dress. This substance, equally prized by the savage and the citizen, is composed, like shells, of carbonate of lime, united with a small portion of animal matter. Pearls appear to be exclusively the production of the bivalve testacea. Among these, all the shells having a mother-of-pearl inside, produce them occasionally. But there are a few species which yield them in greater plenty, and of a finer colour. The most remarkable of these is the *Avicula margaritifera.* This shell, which was placed by Linnæus among the mussels, is very widely distributed in the Indian seas; and it is from it and another species of the same genus, termed *Avicula hirundo*, found in the European seas, that the pearls of commerce are procured. The *Pinna*, so famous for furnishing a byssus or kind of thread, with which garments can be manufactured, likewise produces pearls of considerable size. They have seldom the silvery whiteness of the pearls from the Avicula, being usually tinged with brown. But the shell which in Britain produces the finest pearls, is the *Alasmodon margaritiferum*, which was placed by Linnæus in the genus *Mya.* It is found in all our alpine rivers. The Conway and the Irt in England, the rivers of Tyrone and Donegal in Ireland, and the Tay and the Ythan in Scotland, have long been famous for the production of pearls. These concretions are found between the membranes of the cloak of the animal, as in the Avicula, or adhering to the inside of the shell, as in the Unio. In the former case, they seem to be a morbid secretion of testaceous matter; in the latter, the matter seems to be accumulated against the internal opening of some hole with which the shell has been pierced by some of its foes. Linnæus, from the consideration of this circumstance, endeavoured, by piercing the shell, to excite the animal to secrete pearl; but his attempts, though they procured him a place among the Swedish nobility and a pecuniary reward, were finally abandoned; the process being found too tedious and uncertain to be of any public utility. The largest pearl of which we have any notice, is one which came from Panama, and was presented to Philip II. king of Spain, in 1579. It was of the size of a pigeon's egg. Sir Robert Sibbald mentions his having seen pearls from the rivers of Scotland as large as a bean.

Besides yielding us a variety of wholesome food, and valuable ornaments, testaceous animals supply us with a beautiful *dye*. The *Purpura* of the ancients, according to the opinion of Rondeletius, confirmed by the observations of Cuvier, was chiefly extracted from the shell termed *Murex brandaris*. Since the introduction of the cochineal insect, the use of this dye has been superseded, so that we are now in a great measure ignorant of the process which the ancients employed to extract it. In Britain there are several kinds of shell-fish, which furnish a dye of this sort, but these are seldom sought after. Cole, in 1685, published a method of obtaining it from the *Purpura lapillus*, to which Montagu, in the supplement to *Testacea Brittanica*, has added several important directions. When the shell is broken in a vice, there is seen on the back of the animal, under the skin, a slender longitudinal whitish vein, containing a yellowish liquor. When this juice is applied to linen, by means of a small brush, and exposed to the sun, it becomes green, blue, and purple, and at last settles in a fine unchangeable crimson. Neither acids nor alkalis affect its colour, and it may be conveniently employed in marking linen, where an indelible ink is desirable. The *Scalaria clathrus (Turbo clathrus* of Linnæus) also furnishes a purple liquor of considerable beauty, but it is destructible by acids, and gradually vanishes by the action of light. The *Planorbis corneus* likewise yields a scarlet dye, but of still less permanency than the scalaria, as all attempts to fix it have hitherto proved ineffectual.

We cannot conclude this chapter without remarking, that the study of molluscous animals rises in importance as we perceive its utility. When we are told, that searching for shell-fish, and conveying them to the market, give employment to a British population of upwards of 10,000; that these animals furnish nourishing food to innumerable families, and in years of scarcity prevent the horrors of famine; we will be disposed to regard with a favourable eye the labours of that naturalist who examines the structure and economy of those animals, that, from a knowledge of their nature, he may render them still more subservient to our purposes.

Even when considered as objects of amusement, molluscous animals are not devoid of interest. In the preceding division of our subject, we have considered them as applicable to various useful purposes, and expressed our regret, at the same time, that no one qualified for the task had ever bestowed on economical conchology an attentive examination. We cannot therefore consider the present condition of the science as the result of the labours of its practical admirers. The lovers of this study, as an agreeable amusement, have at all times been numerous, from the days of

Lælius and Scipio to the present time; and it is to their exertions as collectors, that the science is principally indebted for its present state of improvement. The colours of shells are often so intensely vivid, so finely disposed, and so fancifully variegated, that, as objects of beauty they rival many of the esteemed productions of the vegetable kingdom. In their forms they likewise exhibit an infinite variety. While some consist merely of a hollow cup or a simple tube, others exhibit the most graceful convolutions, and appear in the form of cones, and spires, and turbans; and in another division, shaped like a box, all the varieties of hinge are exhibited, from that of simple connexion by a ligament to the most complicated articulation. The forms of shells are indeed so various, and many of them so elegant, that a celebrated French conchologist warmly recommends them to the attentive study of the architect. "Or," says Lamark, "comme l'extrème diversité des parties protubérantes de la surface de ces coquilles, ainsi que la régularité et l'élégance de leur distribution, ne laisse presque aucune forme possible dont la nature n'offre ici des exemples; on peut dire que l'architecture trouvéroit dans les espèces de ce genre *(Cèrithium)* de même que dans celles des pleurotomes et des fuseaux, un choix de modèles pour l'ornement des colonnes, et que ces modèles seroient très dignes d'être employés." *(Annales du Mus.* vol. iii. p. 269.) In this country, however, no such recommendation is necessary, as many of our beautiful ornaments of stucco, particularly for chimney-pieces, are copied from the univalve testacea, and are greatly admired. Shells are used for Gro

But shells, even with all their beauty and elegance, would never have acquired so much importance in the eyes of amateurs, had their forms been as difficult to preserve as the external coverings of the higher classes of animals. It is both a tedious and a difficult operation to preserve a quadruped, a bird, or a fish, as a specimen for the cabinet, and even when the task is completed, it is but of temporary duration. A slow but certain process of dissolution is going on, which, though invisible for a time to the owner, gradually destroys the finest collection of these objects. The very changes of the atmosphere, combined with the attacks of insects, accelerate the destructive process. But with shells the case is very different. Composed of particles already in natural combination, they do not contain within themselves the seeds of dissolution, so that for ages they remain the same. Besides, all that is in general necessary to prepare a shell for the cabinet, is merely to remove the animal. When the shell is covered with foreign matter, we must wash it away with a brush in soap and water; and it is frequently necessary to steep the shell for some time in fresh water, to extract all the salt water which may adhere to it. After being properly dried it is fit for the shelf of the cabinet, and stands in no need of anxious superintendence.

Amateurs are seldom contented with the simplicity of nature. Vitiated in their taste by a fashion which abides by no rules, they attempt to improve even her most elegant productions, and delight to exhibit in their cabinets some of the efforts of their art. As such are in search of innocent amusement, we mean not to dispute about the propriety of their conduct, but rather shortly to mention, for their edification, the method generally in use to improve the beauty of testaceous objects. Many shells, it is true, naturally possess so fine a polish, that no preparation is considered as necessary before placing them in the cabinet. Such are the *Cypreæ*, *Olivæ*, and the greater number of what is termed *porcellaneous shells.* In general, however, it happens that, when shells become dry, they lose much of their natural lustre. This may be very easily restored, by washing them with a little water, in which a small portion of gum arabic has been dissolved, or with the white of an egg. This is the simplest of those processes which are employed, and is used not only by the mere collector, but by the scientific conchologist. There are many shells of a very plain appearance on the outside, by reason of a dull epidermis or skin with which they are covered. This is removed by soaking the shell in warm water, and then rubbing it off with a brush. When the epidermis is thick, it is necessary to mix with the water a small portion of nitric acid, which, by dissolving a part of the shell, destroys the cohesion of the epidermis. This last agent must be employed with great caution, as it removes the lustre from all the parts exposed to its influence. The new surface must be polished with leather, assisted by tripoli. But, in many cases, even these methods are ineffectual, and the file and the pumice-stone must be resorted to, in order to rub off the coarse external layers, that the concealed beauties may be disclosed. Much address and experience are necessary in the successful employment of this last process. But it must be confessed that the reward is often great. When thus prepared, even the common mussel is most beautiful.

The arrangement of shells in a cabinet must depend, in a great degree, on the taste and fortune of the collector. If ornament is the object in view, it will be indispensably necessary to have the shells placed in glass cases, where they may be distinctly seen. But where a collection of shells is formed for amusement, they may be kept in drawers, each species placed in a paper case, or in a cup of wood, glass, or porcelain, with a label attached, intimating its name, and the place from whence it was obtained. In this manner, both univalves and bivalves may be conveniently disposed. But as many of the former are very small in size, it is often necessary to fix them on pieces of card, that they may be preserved, and rendered easier of inspection. When neighbouring species are thus brought together, they can be easily examined with a lens.

About the end of the sixteenth century, many individuals began to form collections of testaceous bodies. The first museum of this kind, of any consequence, was begun by Benedict Ceruto, and afterwards augmented by Calceolari. An account of the specimens contained in it was published by Olivi, in 1585, and, in 1622, Chiocco published plates of the shells. After this period, in proportion as collections of testaceous bodies became numerous, various works on shells made their appearance. These were not published for any scientific object, but merely to teach collectors the names of the different specimens in their museums. As works of this sort, we may mention the *Historia Naturalis* of Johnston; the *Gazophylacium Naturæ* of Petiver; the *Amboinshe Rariteitkamer* of Rumphius; and the *Wondertoonel der Nature* of Vincent. To this list we might add many modern works, which are termed Systems of Conchology.

From the labours of this class of conchologists the science has derived many important advantages. A taste for the study has been widely extended; the shells of distant countries and shores have been brought together; and numerous engravings of these bodies have been published. In this manner the labours of the man of science have been greatly facilitated, and our knowledge of nature enlarged.

The formation of a collection of shells is absolutely necessary to the successful prosecution of the science of conchology. To accomplish this, much care and attention are requisite. Shells must be sought for in their natural situations, and obtained, if possible, with the animal alive. After the animal has remained dead in the shell for any length of time, it loses its lustre and transparency, and becomes less valuable, either as an object of beauty or curiosity. Hence the collector must explore the sea-coast, the land, and the fresh water, in search of the testaceous animals which they support, for the purpose of obtaining in a perfect state their calcareous coverings.

The sea contains more species of shells than either the land or the fresh waters, and presents to the conchologist an extensive field for observation. Many species of marine shells frequent the sea-shore, adhere to rocks, stones, or sea weed, or lodge in the clay or sand. These are termed *Littoral* shells, and are seldom found in deep water. The littoral shells are easily collected at ebb tide. Those which burrow in the mud or sand may be detected by a small depression which they leave on the surface as they retire below it. Other shells live in deeper water. To collect these the dredge must be employed; and if the shells be put into sea water after they are brought up, the animals may afterwards be examined with ease. Such collectors as have not the advantage of a dredge, should examine the refuse of fishing boats, and traverse the sea shore, and search the rejectamenta, especially after a storm of wind. The roots of the larger *Fuci*, especially *F. digitatus*, which grows sometimes in four or five fathoms water, frequently contain a treasure of the rarer shells.

During the ebb of stream tides, the conchologist ought to be very diligent. The rocks are then uncovered, and under the projecting ledges of the strata he will find many species of shells in very perfect state.

In rocky shores it will prove a useful employment to turn over the stones which are scattered in the pools, near low water, and on the under side of these he will find a rich harvest of Chitons and Cingulæ.

In the tufts of *Corallina officinalis*, a number of the smaller shells are found concealed, likewise among the smaller Fuci and Confervæ. When these bodies are brought from the shore, and put into a glass of sea water, the smaller shells will soon be perceived by their motions.

When vessels which have been long at sea come into dock to be cleaned, their bottoms are often covered with shells, and with sea-weed, containing numerous rare vermes. To such situations the conchologist should resort; and in these he will often be successful in finding the objects of his pursuit. In illustration of this remark, we may mention the circumstance of the vessel employed at the Bell Rock as a floating light, having had her bottom covered with mussels three inches and a half in length, and upwards of one inch in breadth, although she had only been afloat three years and seven months. She was moored the 11th July 1807, and removed the 11th February 1811. Previous to being moored, she was completely caulked and pitched. The sand on the shore likewise yields many of the smaller species of shells, and should be carefully examined with the microscope.

When sea shells are obtained, they should be plunged into boiling water, to facilitate the extraction of the animal, and afterwards soaked in it for some time to remove the salt. They should then be cleaned with a brush, and all extraneous matter removed. When the shells are not soaked in fresh water, the salt remaining soon attracts moisture, which speedily destroys the ligaments and epidermis.

The land shells are more within the reach of the scientific collector. To obtain these, he has only to examine the crevices of rocks, the trunks of trees, decayed wood, moss, and brushwood. In summer, after a shower, the land shells are most easily procured. The animals come forth to feed on the moistened blade, and at that time, from their motion, may be very readily perceived.

The land shells are very easily preserved. Almost all that is required is the extraction of the animal.

The fresh water shells, though less difficult to procure than the sea shells, require more trouble than the land shells. A piece of gauze spread over a ring attached to the end of a staff, forms a very convenient net for fishing fresh water shells. By means of this net in the drought of summer, almost all the different species of fresh water shells may be obtained with ease.

The fresh water shells are frequently covered over with slime or mud, which must be removed by a brush; and the animal may be extracted after the shell has been plunged in boiling water.

Before closing our remarks on the important group of animals to which we have been directing the attention of the reader, we shall dedicate a few paragraphs to a brief notice respecting Fossil Shells.

Besides the shells which are found on the land and in our lakes, rivers and seas, and termed Recent Shells, there are relics of many species found in our marl pits and limestone rocks, always somewhat altered, and which are denominated Fossil Shells. While the shells of the former class have been eagerly sought after, few conchologists, previous to the beginning of the present century, directed their attention to the condition and distribution of the fossil species. Nearly six hundred species of recent shells have been described as natives of Britain, while the fossil species furnished by the strata of the different formations, and which have been accurately described, fall greatly short of that number. There is, however, reason to believe that the fossil species are even more numerous than the recent ones.

It would have been a pleasant task for us to have entered into the details of this most important subject, but our limits permit us only to trace its outlines. Our remarks, however, we trust, will prove useful to those who are entering this fruitful field of investigation, and will embrace some observations on the systematic characters, condition, situation, and distribution of these organic remains.

Systematical History of Fossil Shells.—The determination of the characters of fossil shells is attended with no inconsiderable amount of difficulty. The changes which they have undergone, and their union, in many cases, with the substance of the rock, having become incorporated with it, prevent us from ascertaining, with any degree of accuracy, the peculiar marks by which the species can be characterised. No trace of the animal remains to aid us in the investigation, so that all our distinctions must depend upon the characters furnished by the shell. This circumstance should prevent us from placing much confidence on the conclusions which have been drawn with respect to the resemblance between fossil species, and those which still exist in a living state.

The difficulty of determining the fossil species, and the reluctance to form new genera, rendered the descriptions of the older writers nearly unintelligible, although their figures are still useful to refer to. Lamark, aware of the imperfection of the characters of the genera of recent shells, as connected with this subject, and possessing a rich cabinet of the fossil species found in the neighbourhood of Paris, devoted much time to the illustration of this subject, and with great success, as his various papers published in the *Annales du Museum*, abundantly testify. In this country, Parkinson, in his work entitled *Organic Remains of a Former World*, has added some important illustrations of the genera of Lamark, and has given some good descriptions of the species found in our rocks. Mr. Sowerby, in his *Mineral Conchology*, (published in numbers), has given excellent figures of the British fossil shells; but we regret to add, that he has displayed too great anxiety to constitute species; and that the rocks in which they are found imbedded are but imperfectly characterised. But as the figures are well executed, they will prove highly useful to the British mineralogist, by enabling him to refer to them with confidence, and to give names to those species which he meets with in the course of his investigations.

Chemical History of Fossil Shells.—When we consider the elements of which shells are composed, and the nature of their combination, we might be ready to expect that fossil shells would differ but little in structure from recent species. But the case is widely different. In many instances the confused foliaceous structure which prevailed in the recent shell, has given place to a new arrangement of the particles, and the fossil shell exhibits a foliated crystalline structure. Here solution and precipitation have taken place in the same spot, or the results have been effected by the slow operation of the corpuscular forces. In some cases the calcareous matter of the shell has become impregnated with foreign ingredients, or has totally disappeared, leaving in its place ferruginous or siliceous depositions. But the most curious circumstance in the chemical history of these fossils, is the preservation of the animal matter of the shell in its original form and order of arrangement, even when the calcareous matter of the shell has been changed into compact or granular limestone. This very important fact we owe to the ingenuity of Mr. Parkinson, who, by treating the shell for a length of time with greatly diluted acid, abstracted the calcareous matter, and obtained a distinct view of the cartilaginous membranes of the shell. The student will in general observe, that the cavities of those shells, which present an external opening, are filled with the same sort of matter as the rock in which they are enclosed, while the cavities, of the multilocular testacea, for example, which have no external communication, are filled with matter invariably of a crystalline structure, even when not different from the substance of the rock.

Geognostic History of Fossil Shells.—It appears evident that the advancement of this branch of conchology must, in a great measure, depend on the accurate discrimination of the fossil species, and the relations of the rocks in which they are contained. It is only within the last twenty years, therefore, that our knowledge of this branch of the subject has been acquired. The members of the Wernerian and geological societies have contributed largely to our stock of knowledge: but much yet remains to be brought to light. The following notices may be regarded as embracing the principal facts which have been ascertained.

In those ancient strata upon which all the others are incumbent, and which are called *primitive*, no remains of shells, or other relics of organized bodies, have hitherto been detected. These rocks are therefore supposed to have received their arrangement previous to the creation of animals and vegetables, or to have been so much altered as to have all traces of organisms obliterated if such existed. In that group of rocks which rests upon the primitive strata, and to which mineralogists give the name of *transition*, fossil shells, as well as the remains of vegetables, have been observed. The shells exhibit such striking peculiarities of form, and bear so remote a resemblance to the recent kinds, that they are considered as the remains of species which do not now exist in a living state on the globe. They are much changed in their texture, and in general intimately united with the contents of the stratum. They are chiefly found in the beds of limestone, sometimes also in the greywacke and clay slate. In the numerous and ill-characterised series of strata which are incumbent on the transition class, and to which some mineralogists attach the term *floetz*, the remains of shells are much more numerous. In the older members of this class, such as the red sandstone and independent coal formations, the shells, though in a few instances different in form from those of the preceding class, appear to have belonged to one epoch. They are dissimilar to the recent species, and no longer exist in a living state. In the newer members of this class, such as the gypsum and chalk rocks, the species, in some examples, bear a much closer resemblance to the existing races, and several species cannot be distinguished, it is alleged, from them, by any satisfactory characters furnished by the shell. The fossil species found in the rocks of the older members of the class are greatly altered in their texture, and, in many cases, intimately united with the substance of the beds; the shells belonging to the newer members are much less altered in their form and texture, separate more readily from the surrounding rocks, and appear like recent shells somewhat weathered. The shells are found in nearly all the different kinds of rock, but are more numerous in the calcareous strata. In the *recent* or superficial strata, fossil shells are frequently to be met with. The species which here present themselves bear so close a resemblance to the existing kinds, that conchologists are disposed to consider them as the relics of animals which still exist. In many cases, the prototypes may be found on the neighbouring shore or lake, but in other instances they must be sought for at a greater distance. These shells are found in beds of gravel and sand, and likewise in great abundance in shell marl.

It appears, then, that the shells in the older strata differ specifically from those which the newer strata contain; and that they have belonged to molluscous animals, which no longer exist in a living state on this globe; that, in the newer strata, the fossil shells bear a closer resemblance to existing species; and that in the last formed strata, remains of species actually existing are to be met with.

In this geological distribution of the remains of testaceous animals we may likewise perceive that, in the older strata, the inequivalved shells are more numerous than the other kinds; and that the canaliculated univalves are seldom, if ever, to be met with in the transition or older members of the floetz series, but that they become more numerous in the newer members of the floetz rocks, and in the alluvial strata. Circumstances of this kind have induced geologists to conclude that different formations could be discriminated by the petrifactions which they contain. From the difficulty of distinguishing the fossil species, however, joined with our ignorance of their geographical distribution, some mineralogists have not permitted their conclusions to be much influenced by this rule.

It will likewise be observed, that the shells in the newer strata are but little changed, whilst those in the older rocks are greatly altered in their texture, and in part obliterated. The same power which rendered the rock compact or crystalline, has likewise exerted its influence on the imbedded remains. In the newest strata, this power has scarcely begun to operate; so that the imbedded shells still retain in perfection their original characters.

In examining a limestone quarry, for example, the student will perhaps be surprised to find petrifactions of shells in the bed of limestone, while, in the sandstone covering, he witnesses impressions of plants unaccompanied with shells. In order to gain more correct ideas on this subject, let him repair to a marl bog, and he will there find the bed of marl abounding in shells, while in the bed of sand below, on which it rests, or of peat moss, which covers it, he will find exclusively the remains of vegetables. Here let him study the subject, while the strata are yet recent, and while lapidification is only commencing. There is, however, this difference between the shells in the marl and those in the limestone, that individuals of the former species still exist, while no living examples of the latter are known.

Geographical History of Fossil Shells.—As the geographical distribution of recent shells is a branch of conchology to which few have devoted their attention, and about which very little is known, we can scarcely expect to find the geographical distribution of the fossil species more fully illustrated. We know, with regard to the recent shells, that some species which are found in the bays of Norway and Greenland occur also on the shores of the Mediterranean, and that the British Isles have several species in common with Africa and the West Indies. Still we know not, with any degree of accuracy, the geographical range of any one species. Geologists ought, therefore, to exercise a great degree of caution in drawing conclusions concerning the original situation of those shells which they find in a fossil state. When a fossil shell is discovered in the strata of this country, which bears a close resemblance to the recent shells of distant seas; many inquirers, without waiting until they have established the identity of the species, and without any precise information with regard to the geographical distribution of that species, conclude that this fossil shell must have been brought from these distant seas, and conveyed to its present situation by some mighty torrent. Instances of this mode of reasoning could easily be pointed out in the writings of British and Continental mineralogists.

In every country there are particular animals and vegetables, which indicate, by their mode of growth and rapid increase, a peculiar adaptation to the soil and climate of that district. Hence we find a remarkable difference in the animals and plants of different countries. Many shell-fish have indeed a very wide range of latitude, through which they may be observed; but we know, that the same molluscous animals which are natives of Britain, are not found, as a whole, as natives of Spain, while the molluscous animals of Africa differ from both. If the same arrangement of the molluscous animals always prevailed in the different stages of their existence, then we may expect to find the fossil shells of one country differing as much from those of another, as the recent kinds are known to do, so that every country will have its *fossil*, as well as its *recent* testacea. Few observations illustrative of this branch of the subject have hitherto been published.

It has often been remarked, that the fossil shells (and the relics of other animals and plants) found in the strata of this country, are very different in their appearance from those shells of the mollusca which at present exist in the country, but that they bear a close resemblance to the existing species of the equatorial regions. This very important observation has led some to conclude, that the mollusca which lived in this country at the period of the formation of the strata in which they are now enclosed, were influenced by different physical circumstances, from those by which the forms of the recent kinds are regulated; while others have imagined that those shells once lived in the equatorial regions, and that a mighty deluge transported them to their present situation. This last conclusion can never be admitted by those who have witnessed the perfect preservation of the different parts of fossil shells, their valves, spires, protuberances, and delicate spines, still unbroken. Though these species no longer exist in a living state in this country, nor on the globe, we must admit the conclusion of Werner, with regard to fossil plants, that they lived and died in the country where their relics are now found.

It would form a very curious subject of inquiry to ascertain the character of those fossil shells which are found in the strata near the equator. If they likewise differ from the recent species of those seas, and if, in appearance, they resemble or differ from the productions of arctic regions, we might then speculate, with more success, upon those mighty revolutions which have taken place on the earth's surface, and trace in the mineral kingdom the proofs of those changes which animals and vegetables have experienced. In the meantime, we would recommend the examination of the laws which regulate the physical and geographical distribution of recent shells and molluscous animals, as the most suitable preparation for investigating the condition of those extinct races, the memorials of which are preserved in strata, differing from one another in structure, in position, and in composition.

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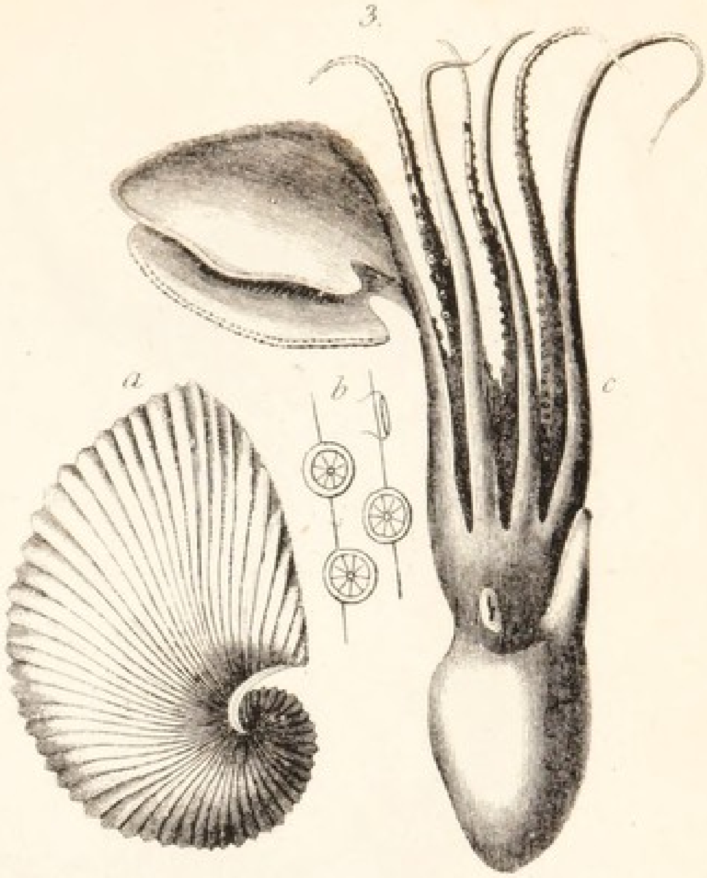
Spirula australis.



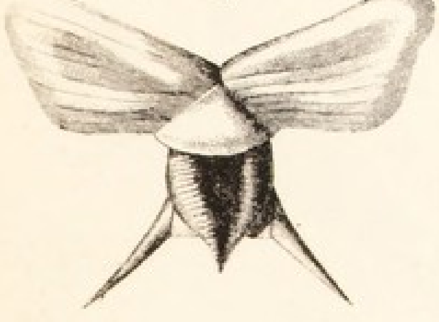
Argonauta Argo.

Octopus cirrhosus.

4.

Nautilus umbilicatus.

5.

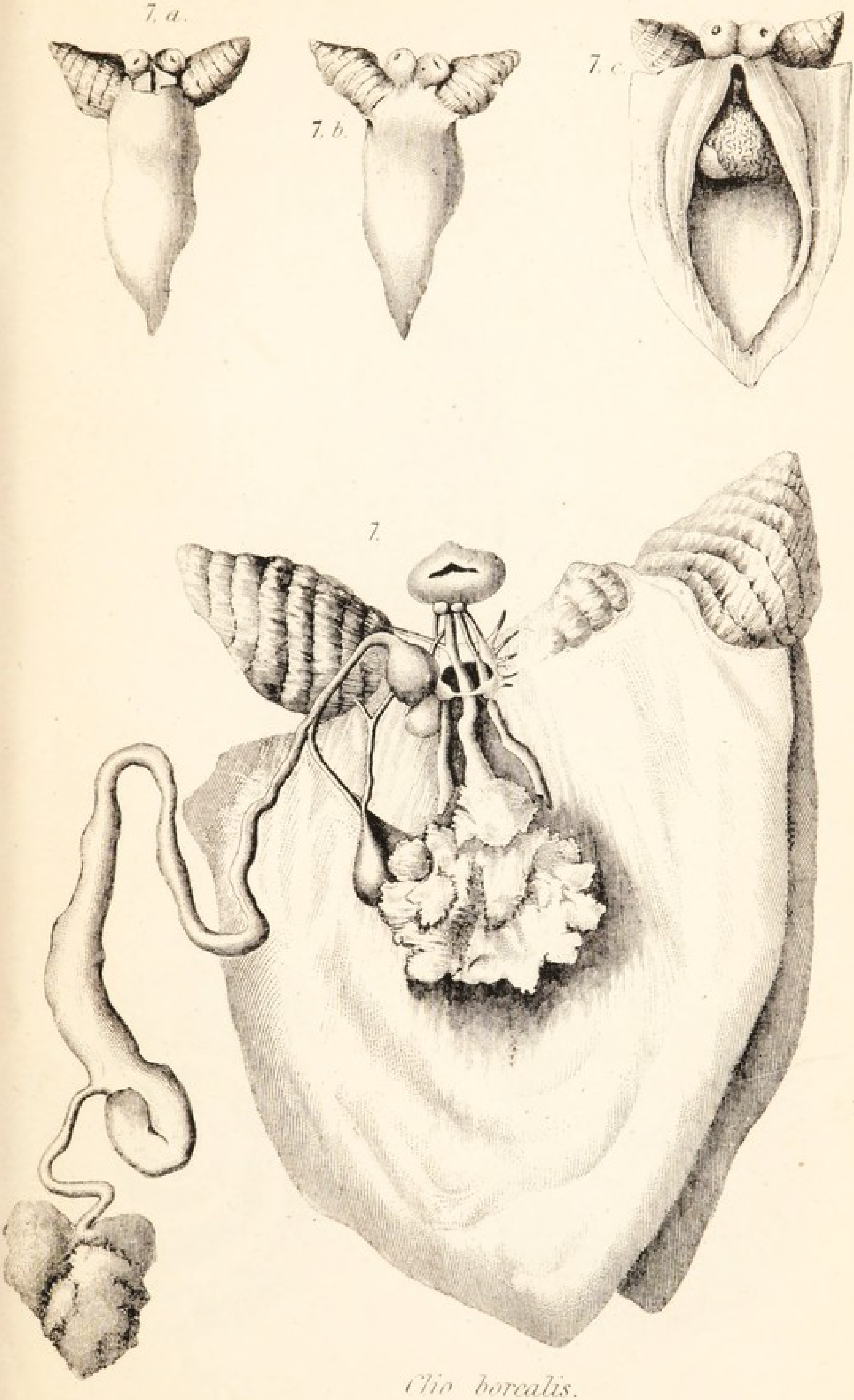


Hyalea globosa.

6.

Pneumodermon diaphanum

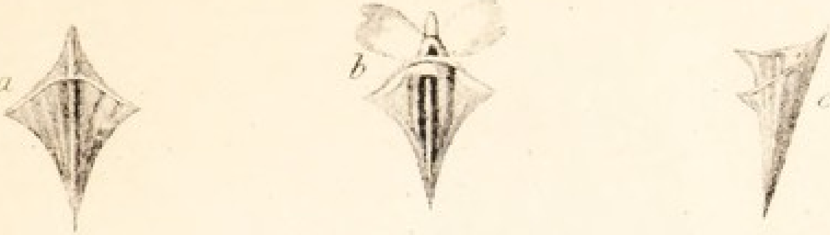
PLATE III.



Clio borealis.

PLATE IV.

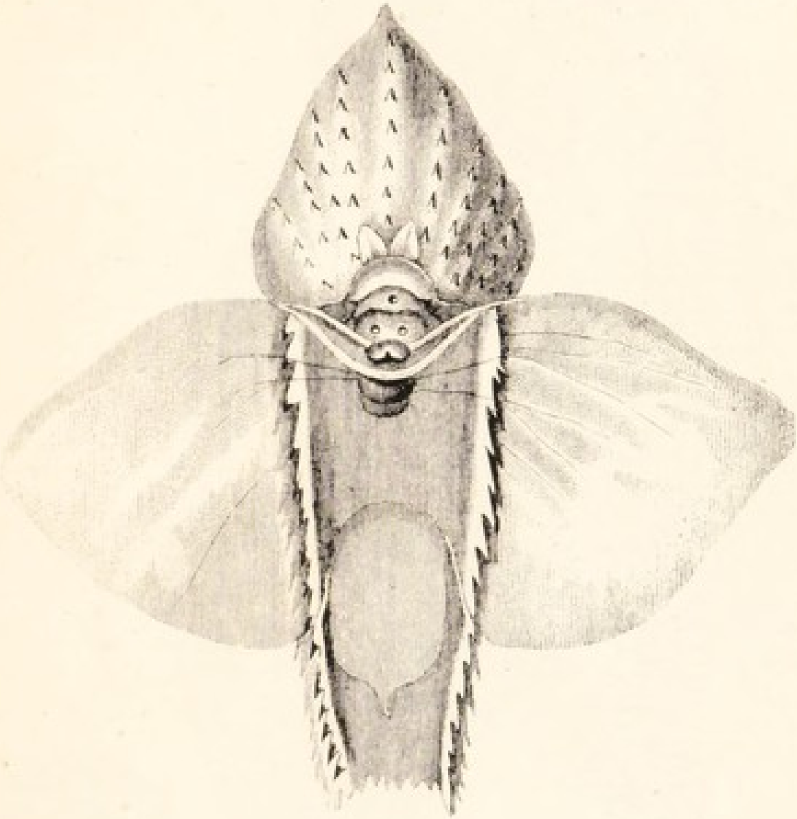
8.



a b c

Cleodora lanceolata.

9.

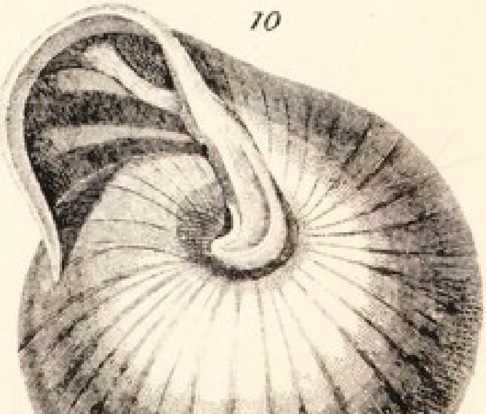


Cymbulia Peronii.

10

Helix cepa.

10



Helix cepa.

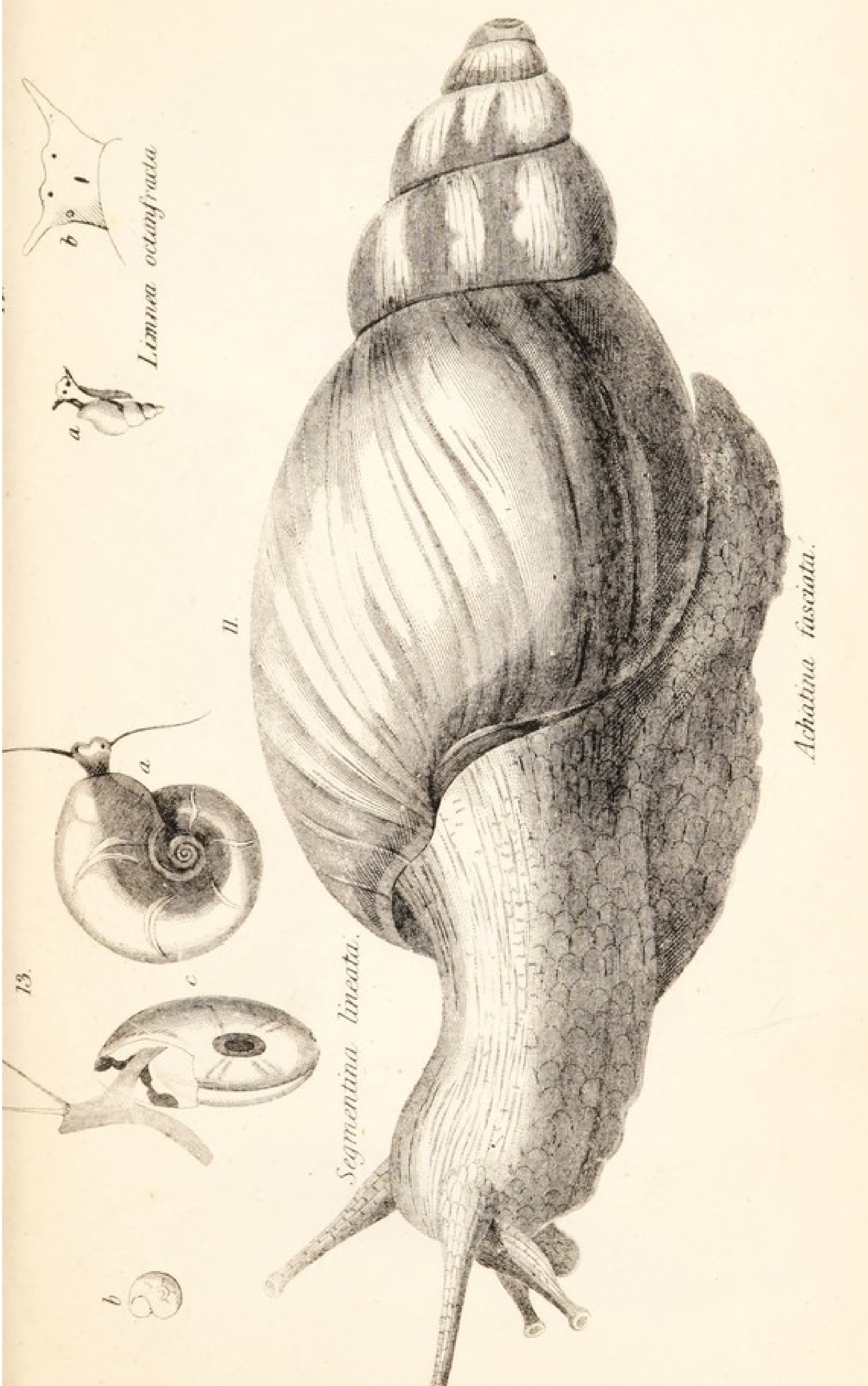

Limnea octanfracta
a
b
11.
Achatina fasciata.
13.
a
c
b
Segmentina lineata.

PLATE VI.

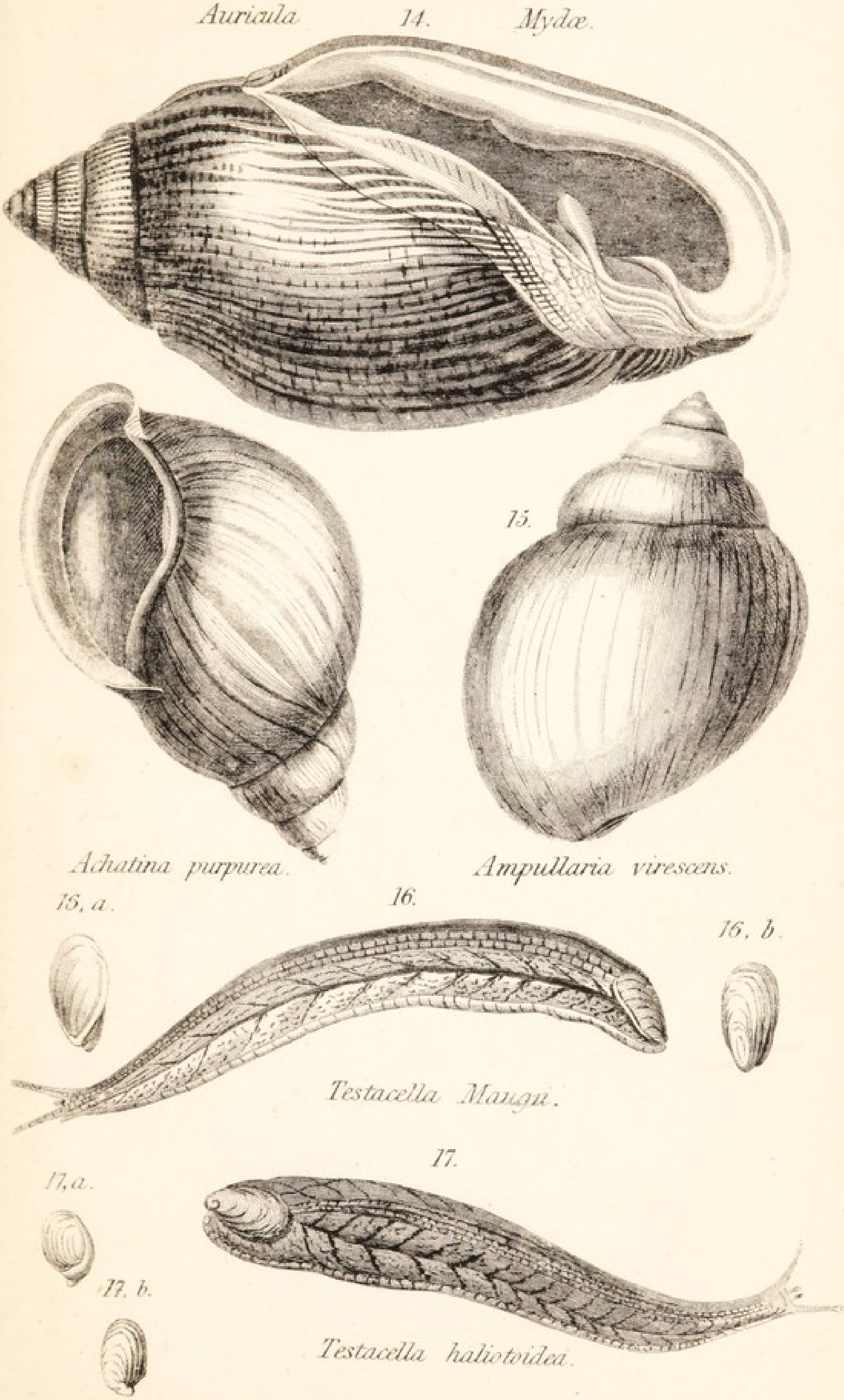

Auricula 14. Mydæ.
15.
Achatina purpurea.
Ampullaria virescens.
15, a.
16.
16, b.
Testacella Maugii.
17.
17, a.
17. b.
Testacella haliotoidea.

PLATE VII.

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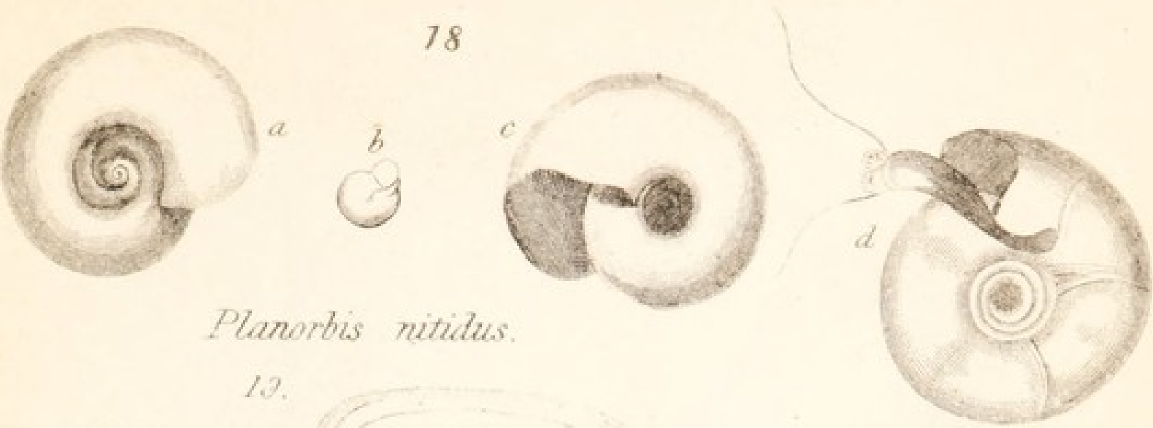
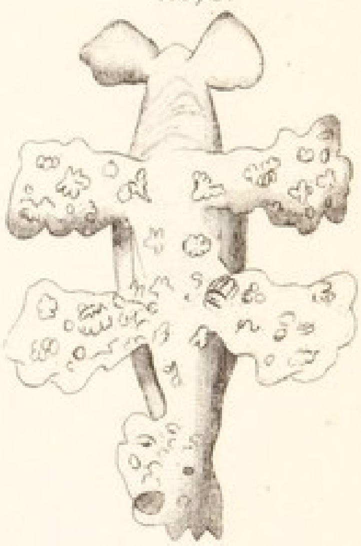


Planorbis nitidus.

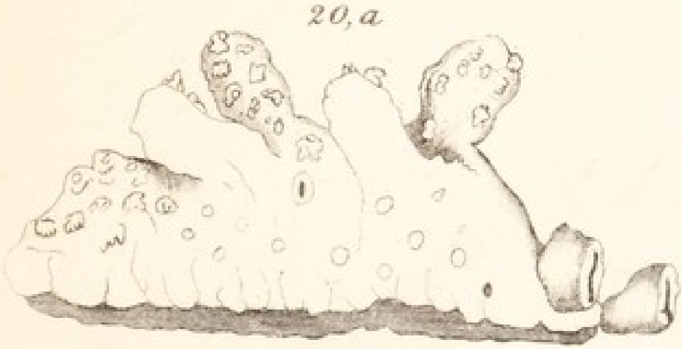
19.

Ancylus lacustris.

20, c.



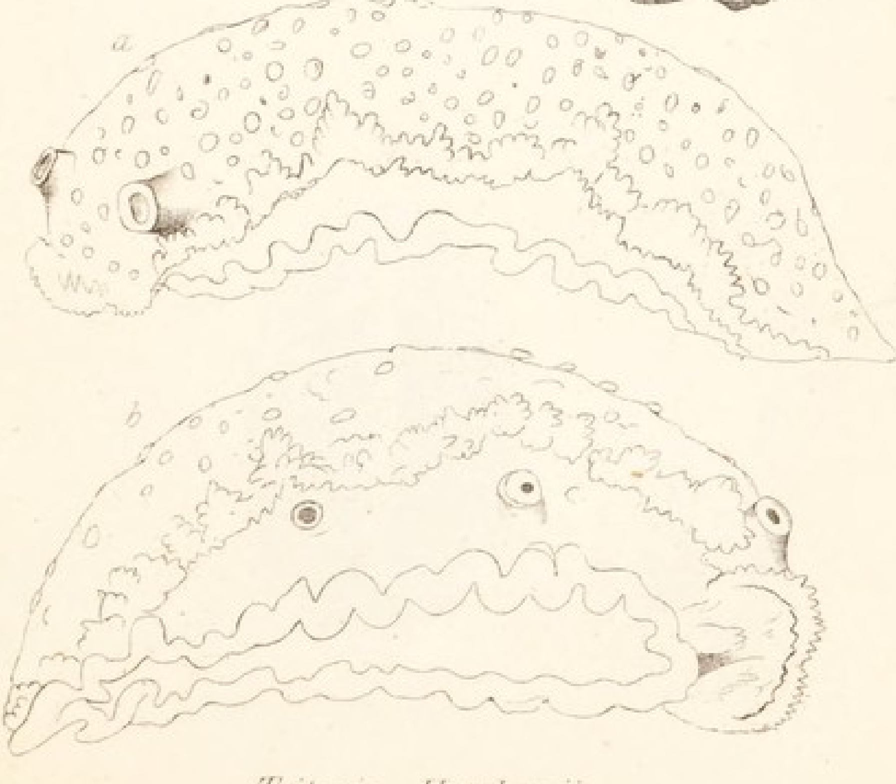
20, a



Scyllea pelagica.

20 b

21



Tritonia Hombergii.

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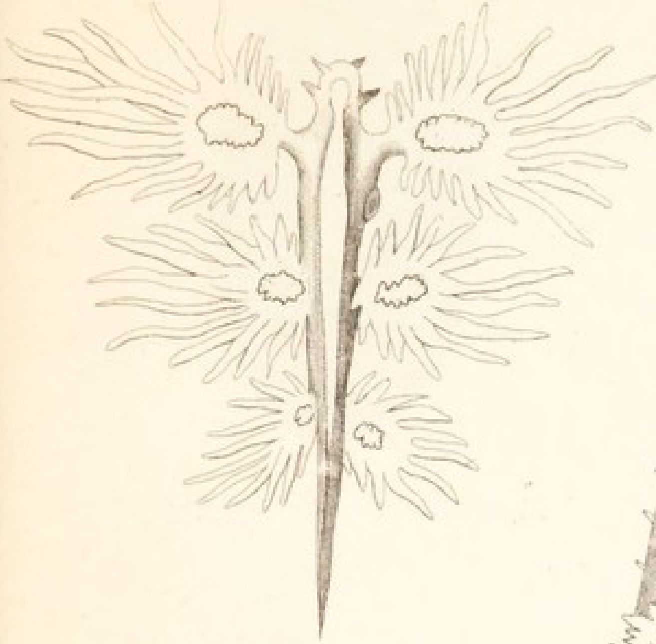
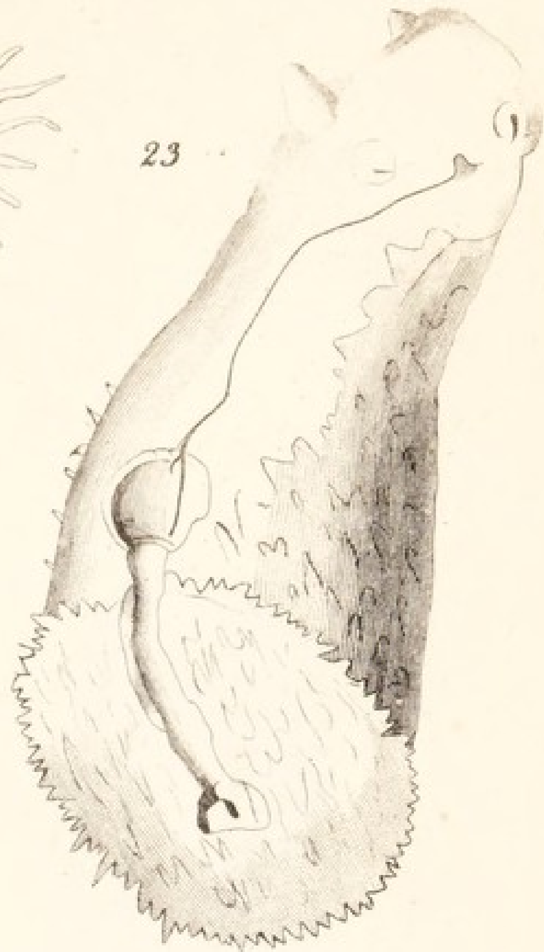


Glaucus radiatus.

23

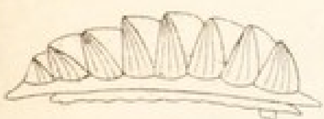


23 a.

23, b.

Dollabella Rhumphii.

24 a.



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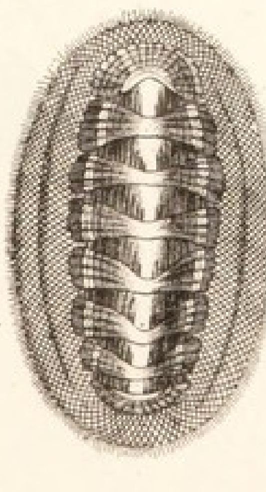
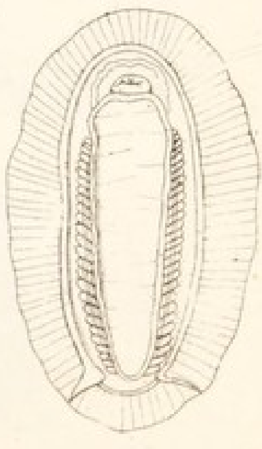
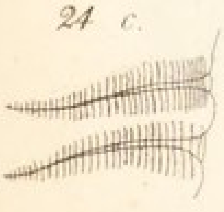


24, b.



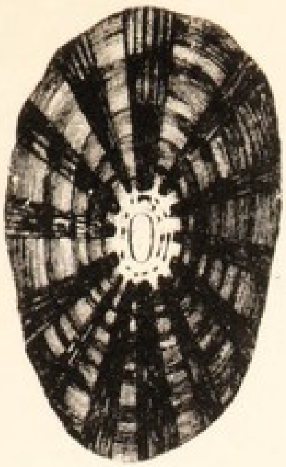
24 c.



Chiton squamosus.

PLATE IX.

25.



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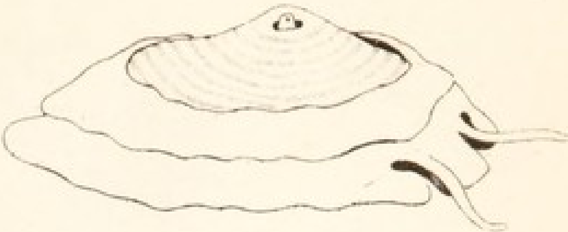
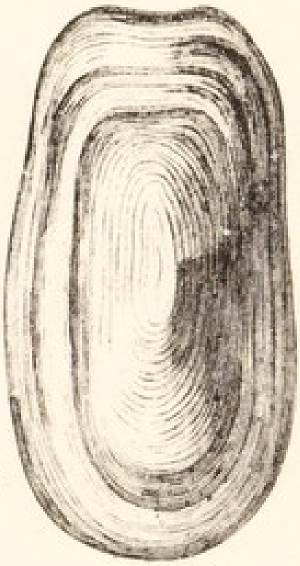


Fissurella annulata.

26.



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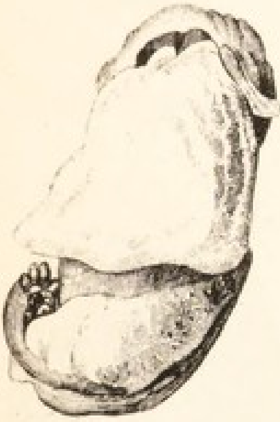
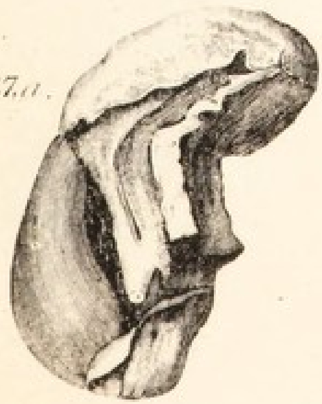


Parmophorus australis.

Bulla aperta.

27, b.

27, a.



27 c.

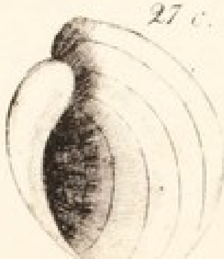
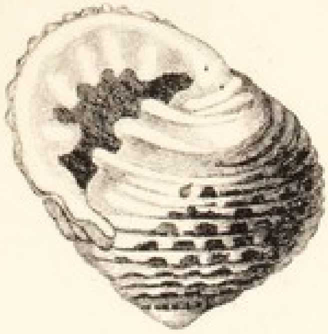


PLATE X.

28.

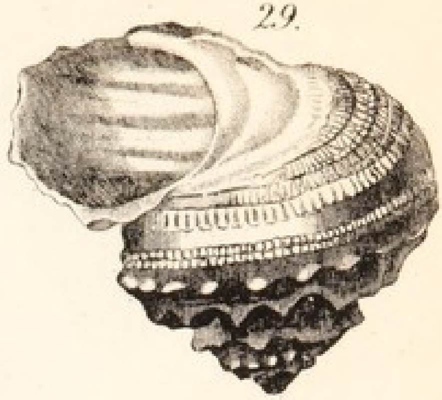
Trochus pagodus.

30.



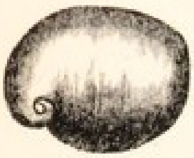
Natica plicata.

29.



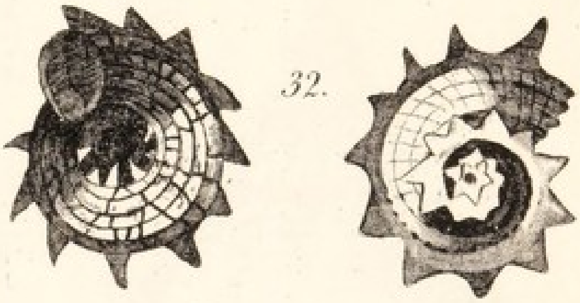
Turbo rugosus.

31.



Velutina lævigata.

32.

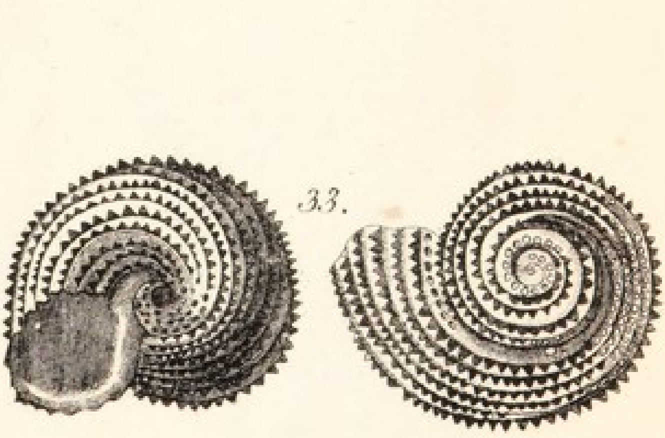


Delphinula calcar.

34.

Scalaria pretiosa.

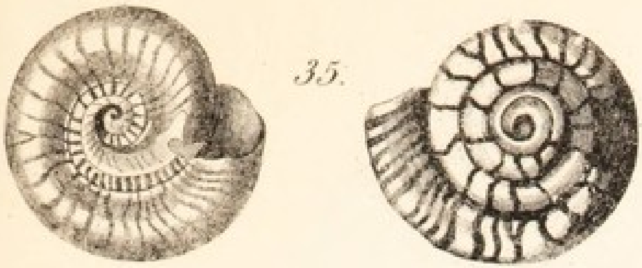
33.



Delphinula lima.

PLATE XI.

35.

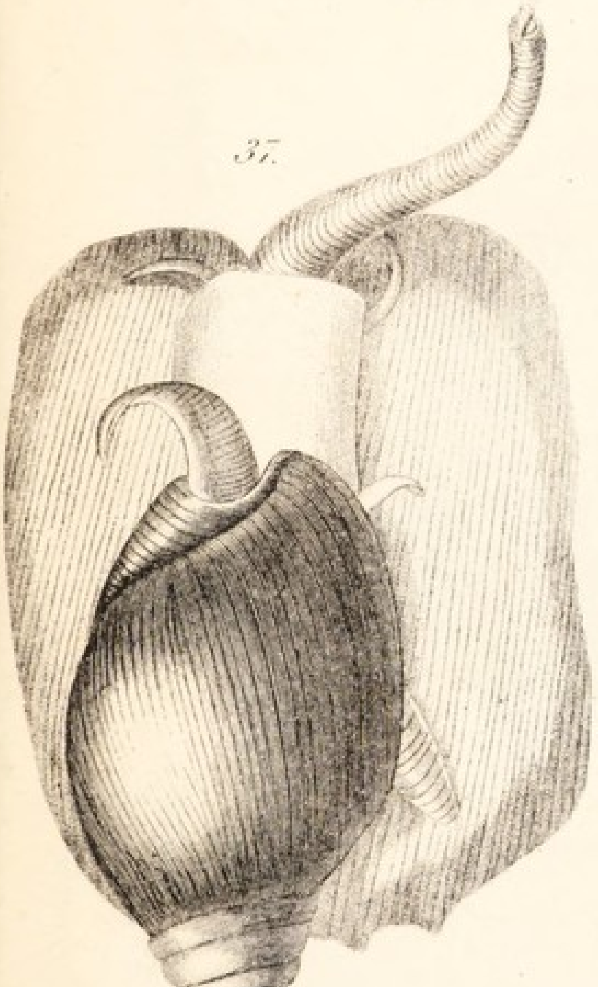


36.

Solarium hybridum.

Paludina vivipara.

37.



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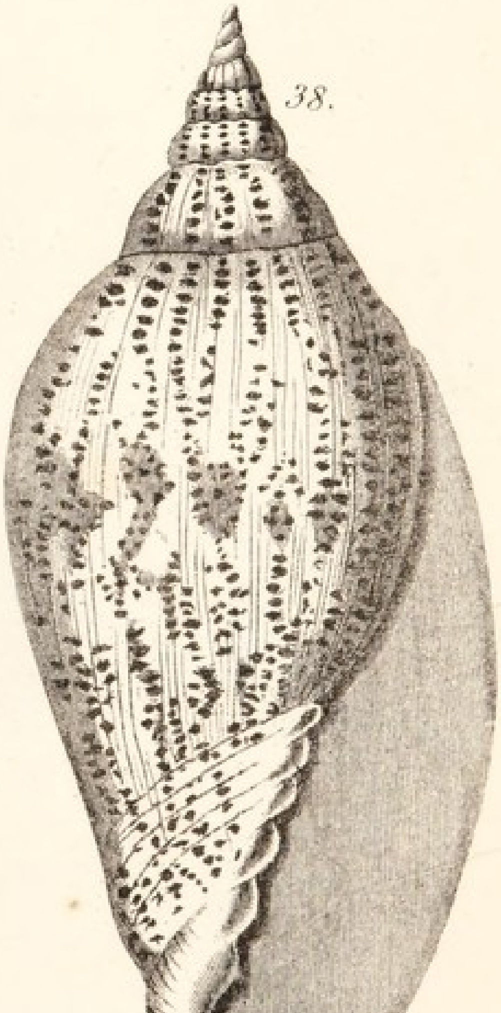
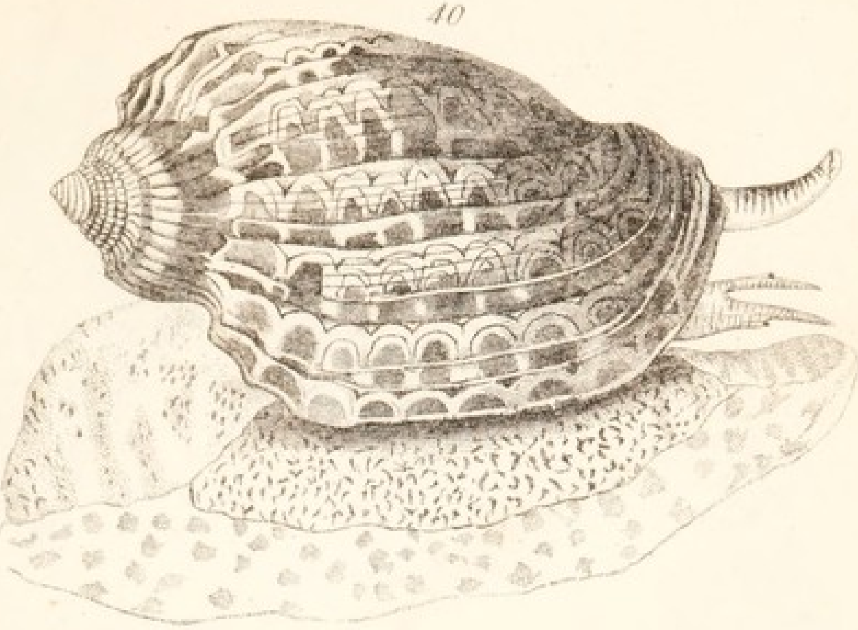


Buccinum lævissimum.

Voluta Japonica.

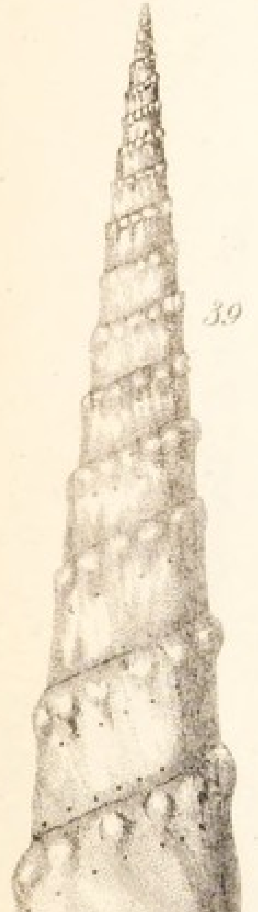
PLATE XII.

40



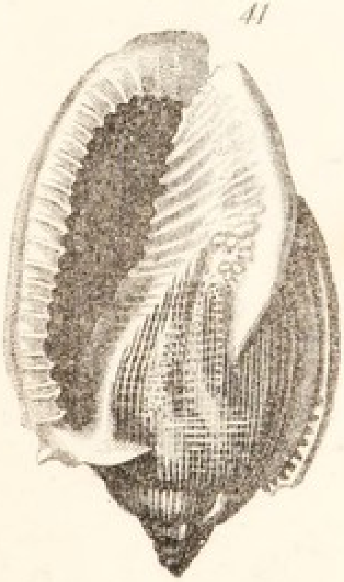
Harpa ventricosa.

39



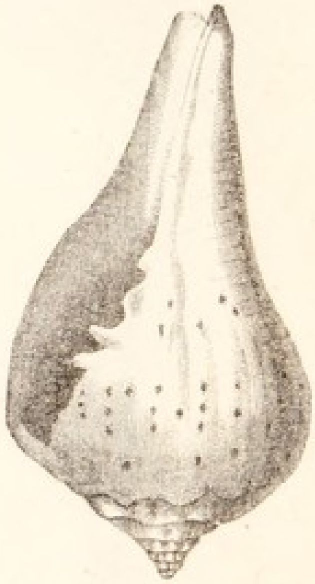
Terebra crenulata.

41



Cassis decussata.

42



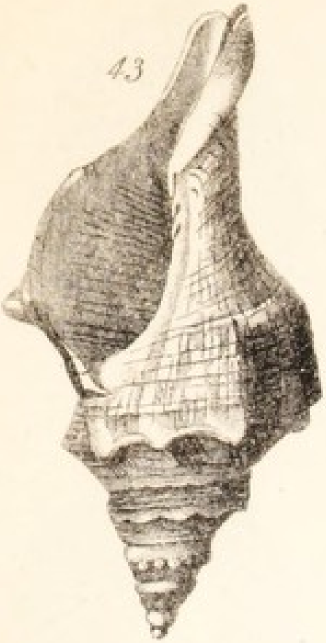
Turbinella pyrum.

45

Fusus retroversus.

PLATE XIII.

43



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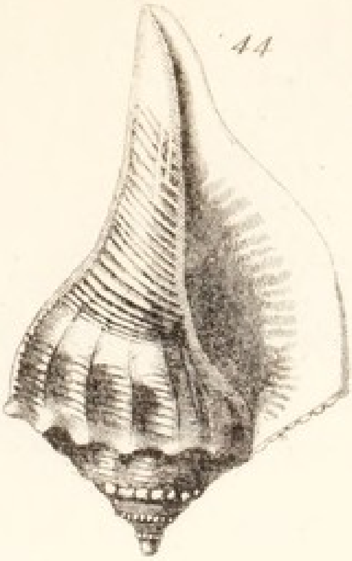
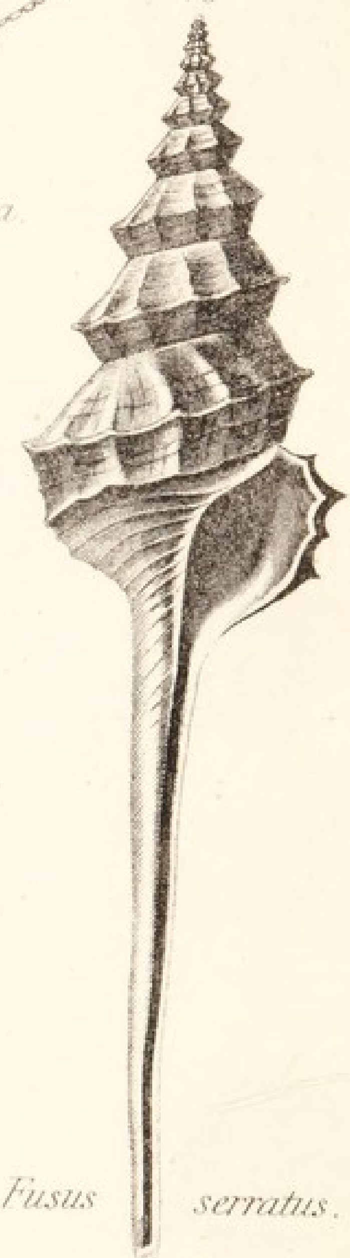


Pyrula perversa.

Fasciolaria trapezium.

46



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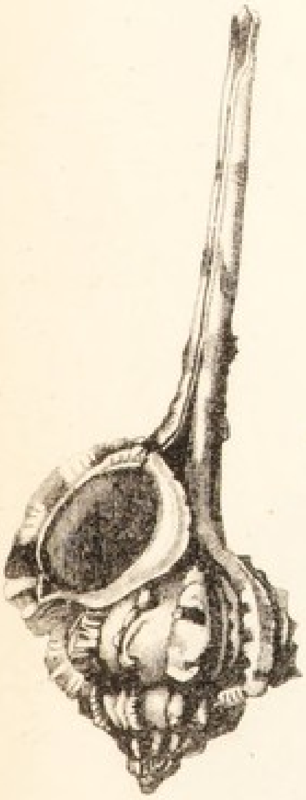
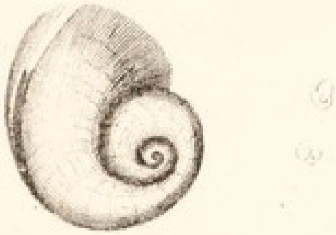


48

48



48

Fusus serratus.

Murex haustellum.

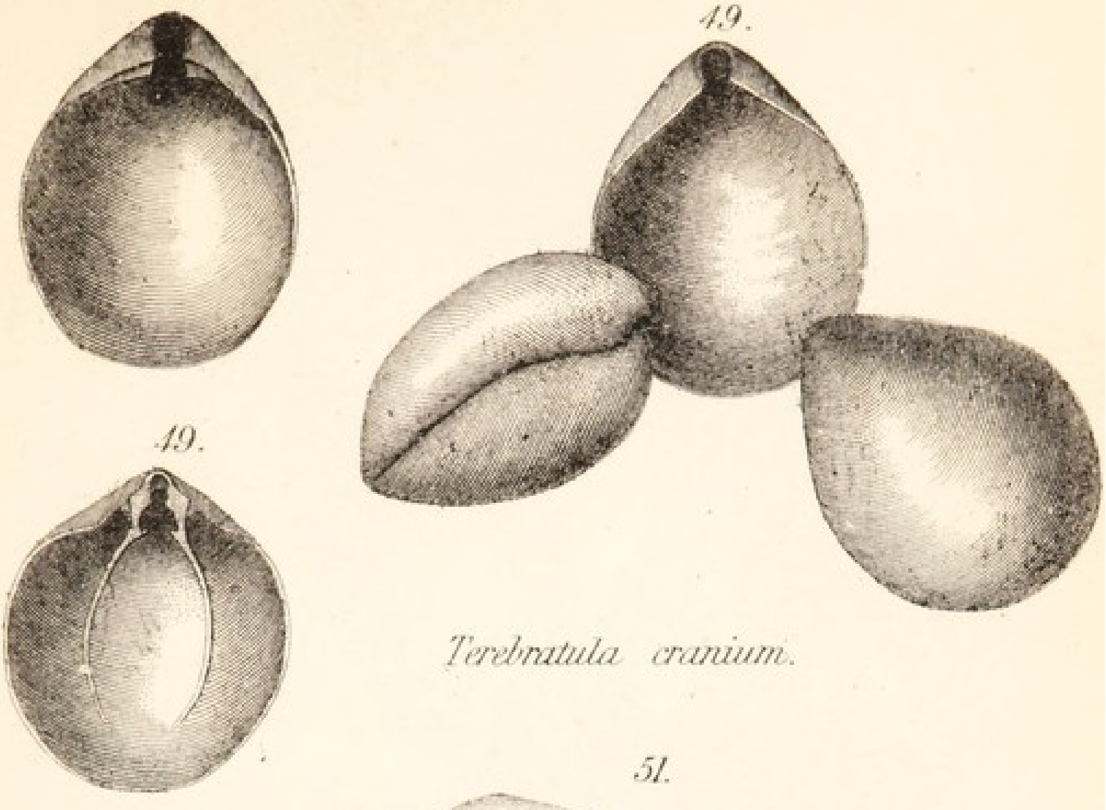
Scissurella crispata.

PLATE XIV.

49.

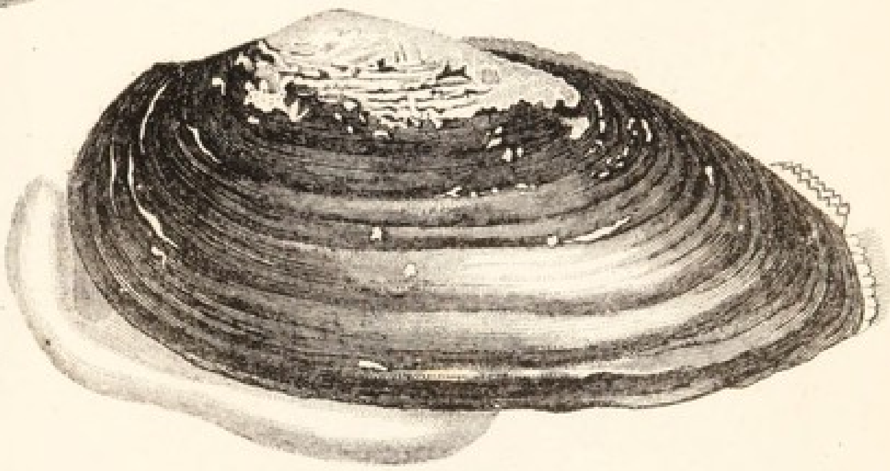
49.

49.



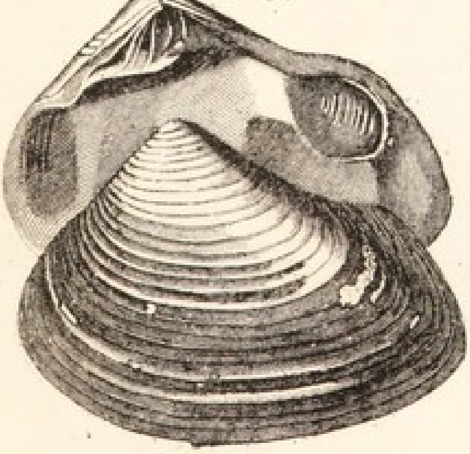
Terebratula cranium.

51.



Unio Pictorum.

52.



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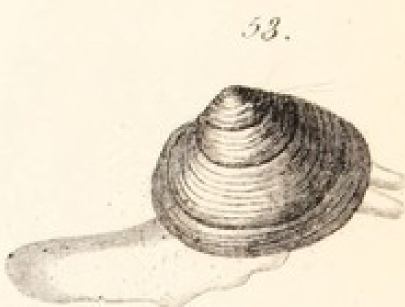
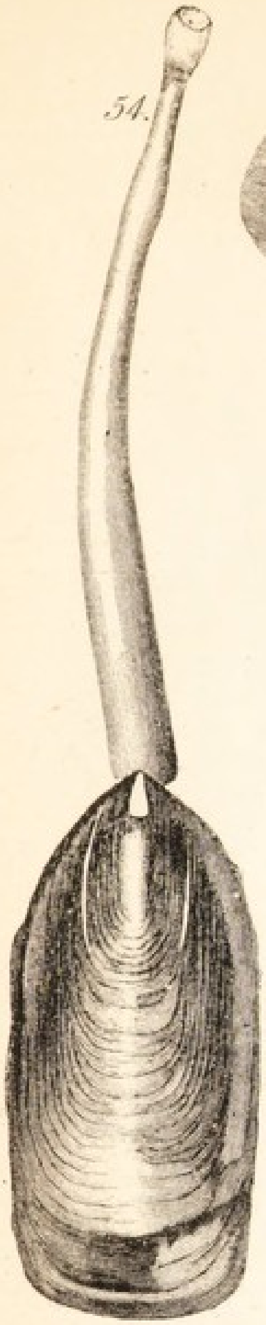


Cyclas cornea.

Crassatella sulcata.

54.



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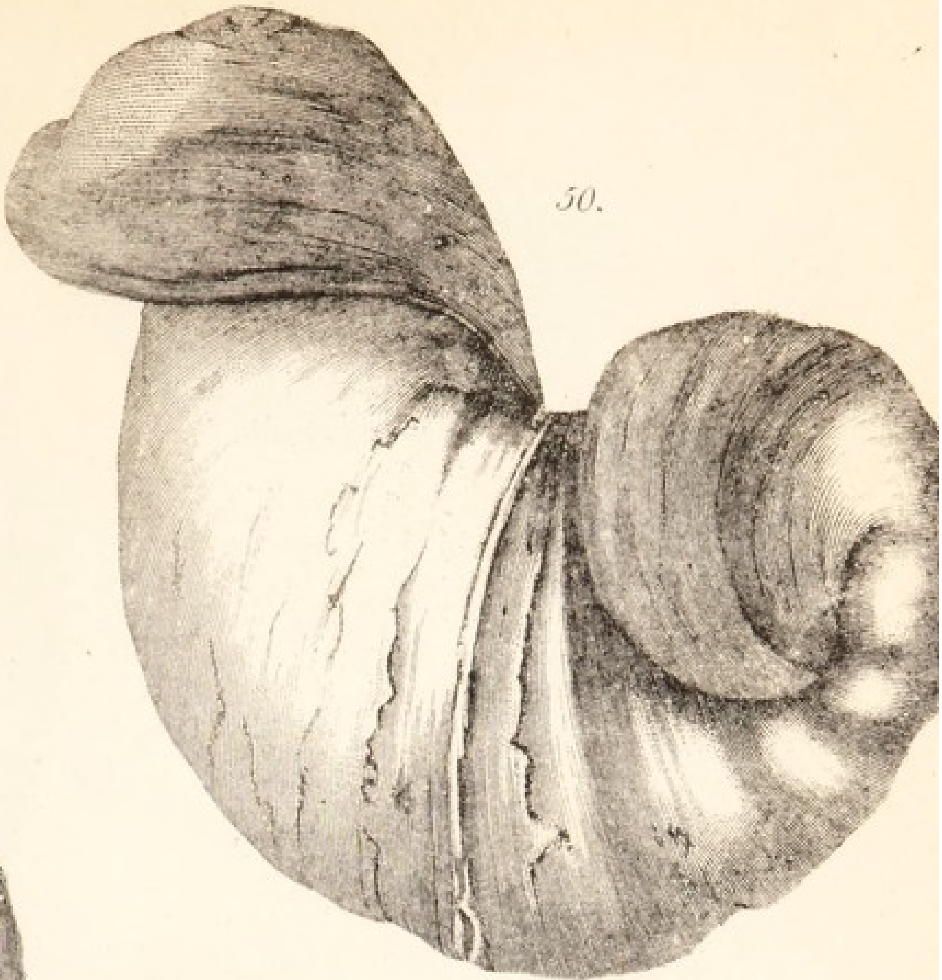
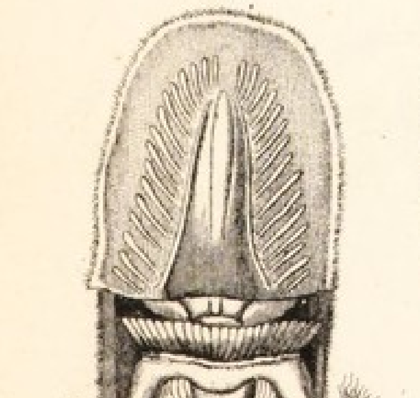


50.

54.

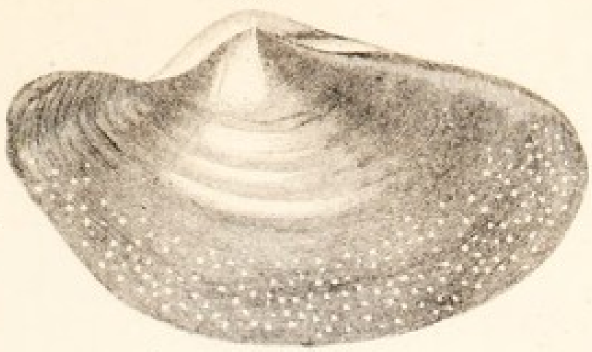


Lingula anatina.

Diceras arietina.

PLATE XVI.

55.



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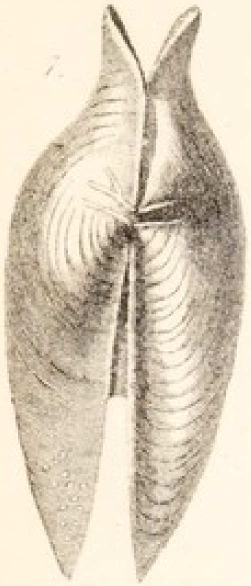


Anatina hispidula.

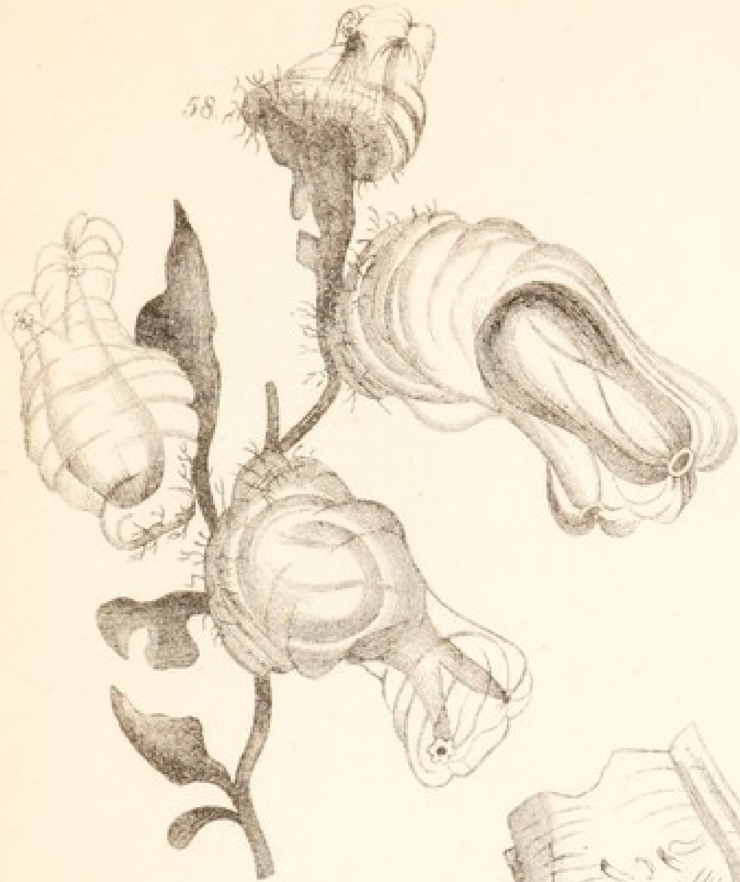
56.

Teredo navalis.

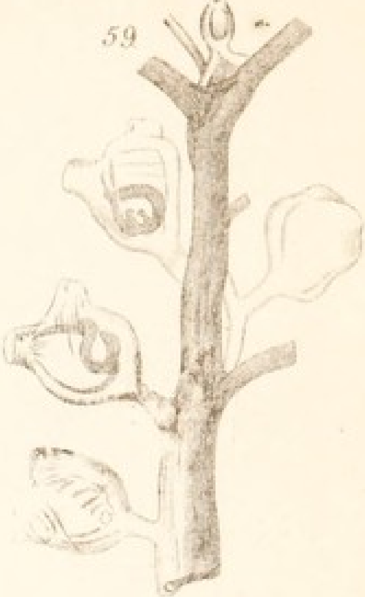
57

Clavellina lepadiformis

58.

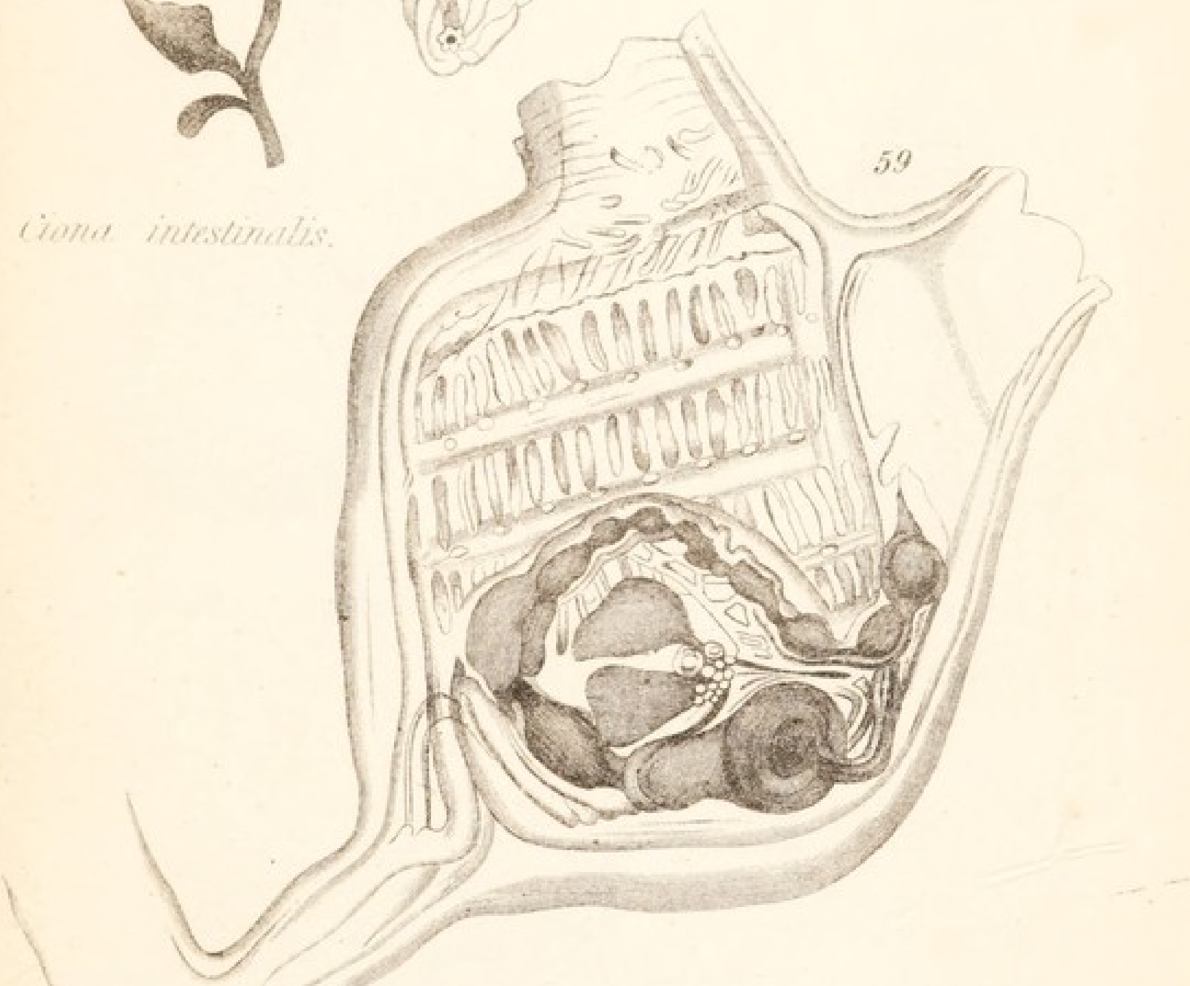


59



Ciona intestinalis.

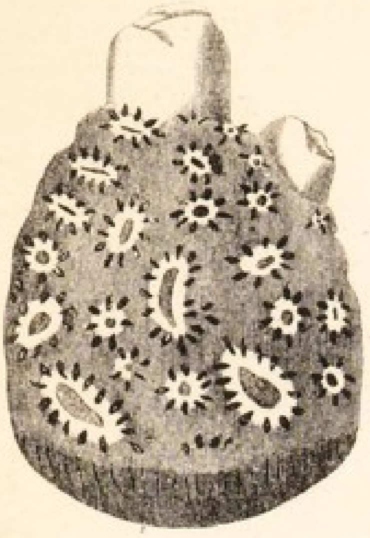
59



Ascidia N. S. Lister.

PLATE. XVIII.

60

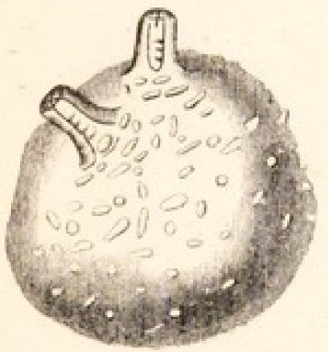


Botryllus polycyclus.

61

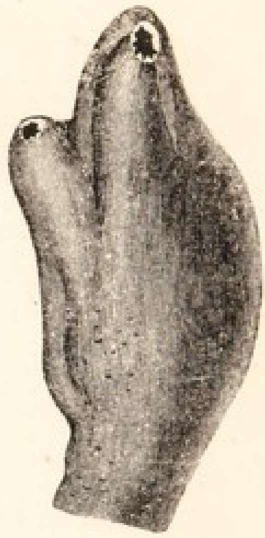
Boltenia ovifera.

62



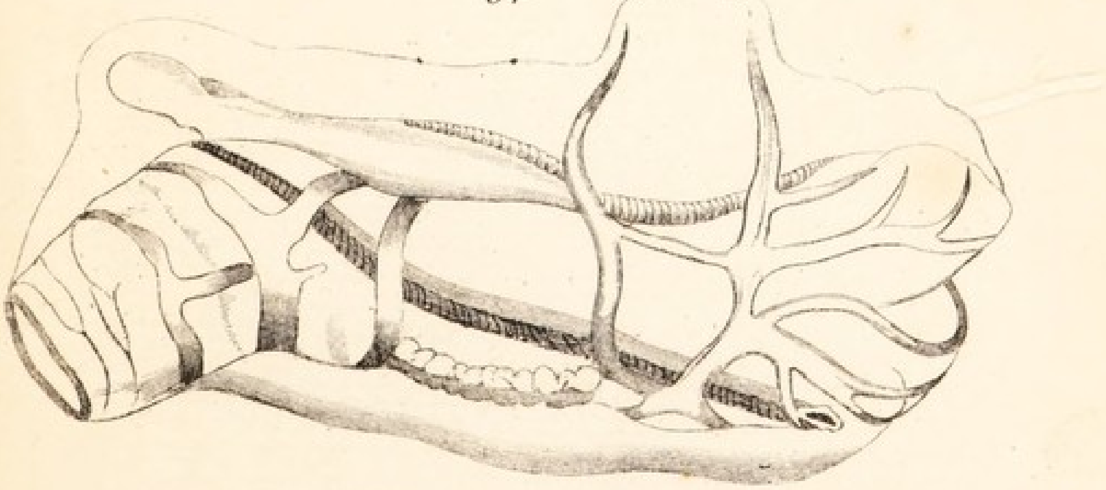
Cynthia momus.

63



Phallusia nigra.

64



Salpa cristata.

(From the MAGAZINE of NATURAL HISTORY, New Series,
1838, *p.* 412*).*

Remarks on Zoological Classification. By Sir EDWARD Ff. BROMHEAD, Bt., F.R.S. L. & E.

1. THE results obtained in an attempt to arrange the Botanical families in Alliances, and those alliances in natural sequence, without any preconceived views of dignity in structure, or any effort to crowd together families supposed by many to be related, have induced me to adopt the same principles in attempting to arrange the Zoological families.

2. It has not been presumed, that the most striking form would begin a series of structures; naturalists have usually opened with Man, the Lion, the Whale, the Eagle, the Crocodile, the Elephant, the Carnivorous *Coleoptera* or the Scorpion, though it is quite obvious that such marked forms must be gradually approached and receded from, if we expect the group to connect with any other series. Hence instead of a forced subordination of the contents of each group under its most striking and full developement, we should rather attempt to work from such a form as a centre, in opposite directions Mr. MacLeay has well laid down this law, and shown a tendency to re-entering or Circulating forms, and has placed the whole Animal Kingdom under five divisions:—

ACRITA,
MOLLUSCA,
VERTEBRATA,
ANNULOSA,
RADIATA.

The principle is undoubtedly sound, though his Quinary system may be pushed beyond its just limits, and the materials of the circle may not be quite correctly arranged.

3. It would appear moreover, that natural series do not merely tend to re-enter, but that the alliances at equal distances from two extremes, may be in some degree parallel or related to each other, as if the series rose to a certain point, and then descended at the same rate, through analogous structures.

4. In making this attempt, it was impossible to avoid reference to the shape of the developement of other organized bodies, as exhibited in the two parallel botanical races, but it was proper to renounce any expectation of finding the same number of alliances here, and also to leave it an open question, whether the zoological alliances formed one, two, three, or more independent Races. It now appears that these constitute a single re-entering race, of which the alliances at equal distances from the extreme points, offer analogies. I cannot therefore conceal from myself, that the two botanical

races may also constitute a single Race, connected by the Rhizanths and some of the Endogens at one extremity, or parting in opposite directions from Fungoid structures at the other.—Such suppositions will not in any way affect the existing arrangement.

5. It was necessary in this investigation to presume the possibility, that certain great divisions recognized in Zoology, might, as in Botany, form the parallel portions of two different series. It seems however that the *Mammalia*, *Aves*, and *Insecta*, are not so divided; and the impossibility of finding four distinct points in each, by which each might connect with some other assemblage, proved their unity. On the other hand it was not difficult to see that the *Amphibia* and *Pisces* are so divisible. The Acephalous *Conchifera* and the *Mollusca proper* have been lately united, but it would appear without sufficient reason. The separation of the *Entozoa* from the *Radiata*, and the Crustaceous families from the *Insecta* and their allies, will not appear harsh to any naturalist. The Crustaceans resume the station assigned by Aristotle.

6. It has also been necessary to keep out of sight any supposed gradation of dignity in structure; the very existence of any re-entering series forbids this, nor could our views on this point have any basis in practice beyond mere imagination.—Lamarck aims at a kind of intellectual scale, which ought to throw the dog, the elephant, and the ant into proximity, whereas intellect is a matter of very subordinate importance in mere *animal* nature. What makes such an attempt more unfortunate, is the result herein exhibited, that the zoological race not only consists of a single re-entering series, but that this series itself consists of three sub-races, each also forming a re-entering assemblage:—the *Infusoria* swell through the *Radiata* and *Conchifera* up to the *Crustacea*, and then descend through the true *Mollusca* down to the *Polypoid Molluscs;* the series then swells through certain *Pisces* and *Amphibia* up to the *Aves* and *Mammalia*, and descends through other *Amphibia* and *Pisces* down to the *Cartilaginous Fish;* the series then swells from the *Annelida* and *Myriopoda* up to the *Coleopterous Insects*, and then descends through the *Arachnida* to the *Epizoa* and *Entozoa*. For anything we know to the contrary, one structure may be equivalent to another, and a developement in one direction may compensate a non-developement in another; in Botany, a parasitic plant without leaves, may rank with others of apparent high developement. Possibly in zoological structure the whole series may be steadily rising towards an independent aeration, flight, or some other property equivalent to the apparent contraction.

7. Naturalists have been very jealous about the place of man in the system, and some have gloried in the impossibility of placing him any where. He seems to me to stand between *Pithecus* and *Troglodytes*, or between *Troglodytes* and one of the *Cebidæ*, yet to be discovered, and he seems to indicate an approach towards the plantigrade Lemurs. Let us not deceive ourselves; the importance of man does not lie in the formation of his animal structure; in this he is vastly inferior to many other animals; he is not free to use both land and water, nor has he wings, nor the relative strength of the *Termes*, nor the prodigious powers of insect leaping, nor senses as acute nor perhaps as various as many, nor the wonderful powers of manipulation in many, nor the speed of others, nor a shell or other covering for protection, nor independent powers of reproduction, nor independent existence immediately after birth, nor eyes multiplying many thousand-fold, nor independent means of aeration, nor powers of fasting, nor powers of reproducing limbs. An imaginative person would rather say, that animal nature having left him in many points weaker than others, has in pity given him Reason, to preserve his continuance in creation; imagination would also point to the more perfect insect forms higher in the scale of developement, and to their metamorphosis, as shadowing his condition. It must be admitted, that I expected to find Man in the middle of the animal series, and in the middle of his alliance; it appears however that his dignity is not animal but moral, an immortal Being waiting a change of body and form and powers.

8. I could have wished to avoid the question of a Quinary principle in nature; it is not sought after in the general series, and it is left for others to subdivide the three fundamental subraces, as they please, by breaking down the two extremities of the *Vertebrata* into two supplementary divisions, or otherwise working out their favorite principle. In the alliances a quinary plan is adopted for these reasons:—I found a tendency of this nature in the botanical alliances, and adopted it after a prejudice against it; I have found a similar tendency in Zoology, and have also found it convenient in practice; from natural causes, or from the industrious leaning of zealous disciples, quinary assemblages have very frequently offered themselves ready formed. Possibly nature may not have any defined law in the relative dignity of these subdivisions, nor any uniform scale of rank, and in such case the leaning to any uniform system, even artificial, may tend to prevent wide deviations and inequalities. The alliances were first assembled in groups according to recognized divisions, and have been gradually worked to the present quinary shape, as offering, on

the whole, least violence to nature, and as the most convenient artificial plan provisionally.

9. I cannot refer to Mr. Swainson's families of Birds so freely as I have done, without noticing the principle of Representative forms, which he most ingeniously attempts to trace through all zoological nature. If we are justified in conceiving an ideal fundamental form, out of which all animals may be supposed to be constructed by various degrees of developement in the different parts, it is also quite conceivable and not improbable, that five or any other definite number of primary divisions, may arise from the whole force of developement being thrown successively on such five or more fundamental divisions of the ideal elementary structure. It is also quite conceivable, that each of these primary divisions may contain subdivisions, distinguished from each other by a successive leaning towards developement in the direction of the same elementary structures, nor need there be any limit to the downward operation of such a principle. On the other hand, I do not see any reason whatsoever for expecting that in each sub-division, and in each department of such sub-division, the same *order* should be always followed, and that the force of developement should *always* fall in one unvarying succession upon each of the supposed elementary structures.

10. This research confirms many analogies suggested by ingenious writers, such as those between *Bivalves* and *Diptera*, and between *Arachnida* and certain *Radiata*. An established linear series checked by a parallel series would by gradual progress and comparison of structure, settle many such doubtful points of organization and function. The Table also confirms the suggestion of a late writer, as to the zoological series passing in opposite directions from the *Simiadæ*.

11. The botanical arrangement is exceedingly more difficult than the zoological. Though in Botany some kind of approach has been made towards definite limits of families, a work most imperfectly performed in Zoology ; yet on the other hand, in Botany no great recognized natural groups were to be found till very lately, beyond the Cryptogamous, Monopetalous, and Endogenous structures, so that families had to be separately weighed from every possible quarter. In Zoology, the leading structures are much more distinctly marked, except perhaps in the *Aves* and *Pisces*, and even these have, in some degree, passed satisfactorily through the hands of Swainson and Cuvier.

12. The limits of the alliances are not always very definite, and some of them may hereafter require consolidation or subdivision. I have endeavoured to use, as a sort of scale, some

obvious natural assemblages, apparently of this sort, such as the *Pachydermata*, *Ruminantia*, *Raptores*, *Natatores*, *Grallatores*, *Chondropterygii*, *Malacopterygii*, *Abdominales*, *Myriopoda*, *Orthoptera*, *Neuroptera*, *Lepidoptera*, and *Echinodermata*. I have also been aided by the presumed parallelism of the alliances at equal distances from the extremities of the series; without such reference to the Crustaceous alliances, it would scarcely have been possible to surmise the comparative rank of the groups in the *Insecta*, and the matter will after all require steady re-examination.

13. The want of some such work as Dr. Lindley's Natural System, puts me under a difficulty in indicating the limits of the families, of which some few only are my own. Since however each family is named from a genus, the reader will understand it as applying to the usual division containing it, limited by the families between which it stands, and without any reference to the dignity claimed for such divisions by naturalists. I shall hereafter refer to the principal authorities which I have followed. Recognized divisions above families are indicated by a semicolon.

14. I have followed botanists in introducing a uniform termination, for all the zoological families; there is a tendency to use the termination in *dæ*, and it is here made general.— Genera ending in *a* are formed in *adæ;* in most other cases they are formed in *idæ*, except to avoid a termination in *iidæ;* and finally the names are formed from the nominative, where an ambiguity might otherwise be thrown on the generic name. I have also, as in botany, adopted the termination in *ales* for the Alliances, throwing aside entirely all characteristic names. By this very necessary change the memory is unloaded from an incredible number of harsh compounds, perpetually changing, often inaccurate, and often hostile to natural distribution. The use of a generic name for families and alliances, is moreover a direct aid to the memory, and frequently, as has been justly observed, harmonizes with the limits and names of the ancient genera.

15. A table such as this proposed, cannot safely make any pretension to precision in the details, nor will its value at present consist in that. It must require for a long period, many corrections as to the limits of families, their place in the alliance, and the limits of the alliances themselves, and their immediate succession, before the full benefit can be derived from an improved nomenclature, a systematic grouping of families, and a uniform scheme of complete continuous developement through all animal organization.

a. Monadæ, cyclidiadæ, AMŒBADÆ; enchelydæ, tracheliadæ,
b. Kolpodadæ, vorticelladæ; FLUSTRADÆ, milleporadæ, alcyonelladæ;
c. Hydradæ, plumatelladæ, SERTULARIADÆ; gorgoniadæ, coralliadæ
d. Ammotheadæ, pennatuladæ MADREPORADÆ, zoanthidæ, actiniadæ;
e. Asteriadæ, encrinidæ, ECHINIDÆ, spantangidæ, holothuriadæ;

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f. Physaliadæ, physsophoradæ, MEDUSADÆ, diphyadæ, pelagiadæ;
g. Pyrosomadæ, botryllidæ, ASCIDIADÆ; salpadæ; linguladæ;
h. Pectenidæ, ostreadæ, AVICULADÆ, pinnadæ, arcadæ;
i. Mytilidæ, unionidæ; TRIDACNADÆ, cardiadæ, pholadæ;
j. Tubicinelladæ, balanidæ, PYRGOMADÆ; anatifadæ, cineradæ;

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k. Maiadæ, canceridæ, GECARCINIDÆ, calappadæ, corystadæ;
l. Dromiadæ, raninadæ, HIPPADÆ, paguridæ, porcellanadæ;
m. Scyllaridæ, astacidæ, PALÆMONIDÆ; mysidæ, squilladæ;
l. Caprelladæ, cyamidæ; HYPERIADÆ, gammaridæ, corophiadæ;
k. Byporidæ, cymothoadæ; SPHÆROMADÆ, idoteadæ, asellidæ;

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j. Onisciadæ; cyclopidæ, CYPRIDÆ; limnadiadæ, branchipodidæ;
i. Limulidæ; argulidæ, CALIGIDÆ, cecropidæ, dichelestiadæ;
h. Calymenidæ, asaphidæ, OGYGIADÆ, paradoxididæ, agnostidæ;
g. Patelladæ; phyllidiadæ; HALYOTIDÆ, fissurelladæ; calyptæadæ;
f. Conidæ, volutadæ; BUCCINIDÆ, muricidæ, strombidæ;

e. Trochidæ, turbinidæ, MELANIADÆ, janthinadæ, neritadæ;
d. Orthoceratidæ, lituoladæ, ORBICULINADÆ, m[illegible]adæ, rotaliadæ;
c. Bulladæ, aplysiadæ; LIMACIDÆ, helicidæ, planorbidæ;
b. Nautilidæ, ammonitidæ, ARGONAUTADÆ, octopodidæ, sepiadæ;
a. Tritoniadæ, glaucidæ; PNEUMODERMONIDÆ, hyalæadæ; pterotracheada

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aa. Trichiuridæ, xyphiadæ, SCOMBERIDÆ, chætodontidæ, smaridæ,
bb. Sparidæ, sciænadæ, SCORPÆNADÆ, mullidæ, percadæ;
cc. Tetraodontidæ, balistidæ, SYNGNATHIDÆ; fistulariadæ, labrid
dd. Acanthuridæ, anabantidæ, MUGILIDÆ, blenniadæ, lophiadæ;
ee. Sirenidæ, ranadæ; TRIONYCIDÆ, testudinidæ; ornithocephalidæ;

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ff. Alcadæ, colymbadæ, ANATIDÆ, pelecanidæ, laridæ;
gg. Rallidæ, tantalidæ, SCOLOPACIDÆ, charadriadæ, ardeadæ;
hh. Gypogeranidæ, vulturidæ, AQUILADÆ, buteonidæ, strigidæ;
ii. Caprimulgidæ, hirundinidæ, MEROPIDÆ; trochilidæ, meliphagadæ
jj. Sylviadæ, muscicapadæ, MERULADÆ; corvidæ, fringilladæ,

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kk. Musophagadæ, buceridæ; RHAMPHASTIDÆ, psittacidæ, cuculidæ;
ll. Columbadæ, phasianidæ, TETRAONIDÆ, otidæ; struthionidæ;

aaa. Cysticercidæ; tæniadæ, TETRARHYNCIDÆ; polystomadæ, fascioladæ;
bbb. Echinorhyncidæ; strongylidæ, LIORHYNCIDÆ, cucullanidæ, ascaridæ,
ccc. Ichthydiadæ, megalotrochadæ, FURCULARIADÆ, rotiferidæ, brachionidæ;
ddd. Planariadæ, lernæadæ, LERNEOPENNADÆ, lernentomadæ, lerneopodadæ;
eee. Oribatadæ, acaridæ, GAMASIDÆ, hydrachnadæ, trombidiadæ;

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fff. Salticidæ, araneadæ, MYGALIDÆ; scorpionidæ; pycnogonidæ;
ggg. Hippoboscadæ; muscadæ, ŒSTRIDÆ, conopsidæ, syrphidæ;
hhh. Empidæ, asilidæ, TABANIDÆ; tipuladæ, culicidæ;
iii. Pterophoridæ, papilionidæ, SPHINGIDÆ, bombycidæ, tineadæ;
jjj. Phryganeadæ; termitidæ, MYRMELEONIDÆ; ephemeradæ, libelluladæ;

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kkk. Acridiadæ, locustadæ, GRYLLIDÆ; phasmadæ, blattadæ;
lll. Forficuladæ; staphylinidæ, OXYTELLIDÆ, tachinidæ; pselaphidæ;
mmm. Mastigidæ, silphadæ, DERMESTIDÆ, byrrhidæ, histeridæ;
lll. Copridæ; trichiadæ, MELOLONTHADÆ, scarabæidæ; lucanidæ;
kkk. Cicindeladæ, brachinidæ, CARABIDÆ; dytiscidæ, gyrinidæ;

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jjj. Hydrophilidæ; elateridæ, BUPRESTIDÆ; cleridæ, lampyridæ;
iii. Cantharidæ; tenebrionidæ, DIAPERIDÆ, cisteladæ, œdemeradæ;
hhh. Curculionidæ, scolytidæ, CUCUJIDÆ, cerambycidæ, sagradæ;
ggg. Chrysomeladæ, erotylidæ; COCCINELLADÆ, lycoperdinadæ; stylopsidæ;
fff. Tenthredinidæ; ichneumonidæ, FORMICADÆ, vespadæ, cynipsidæ;

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eee. Aphidæ, coccidæ, CICADADÆ; notonectadæ, cimicidæ;
ddd. Pulicidæ; pediculidæ, RICINIDÆ; poduradæ, lepismadæ;
ccc. Iulidæ, polyxenidæ; SCUTIGERADÆ, scolopendradæ, cryptopidæ;
bbb. Peripatidæ; nereidæ, EUNICEADÆ, aphroditadæ; sipunculidæ;
aaa. Serpuladæ; arenicoladæ, LUMBRICIDÆ; hirudinidæ; gastrobranchidæ,

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aa. Petromyzidæ; squalidæ, RAIADÆ; chimæradæ, acipenseridæ;
bb. Siluridæ, salmonidæ, CLUPEADÆ, cyprinidæ, esocidæ;
cc. Morrhuadæ, soleadæ, CYCLOPTERIDÆ; murænadæ, gymnotidæ;
dd. Cæciliadæ, coluberidæ, ANGUINIDÆ; scincidæ, chamæleonidæ,
ee. Geckoidæ, iguanadæ, LACERTADÆ, crocodilidæ; ichthyosauridæ;

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ff. Delphinidæ, balænadæ, MANATIDÆ; phocadæ; lutradæ,
gg. Musteladæ, felidæ, CANIDÆ; melesidæ; soricidæ;
hh. Vespertilionidæ; simiadæ, HOMINIDÆ, cebidæ, lemuridæ;
ii. Didelphidæ; caviadæ; CASTORIDÆ, sciuridæ; kanguridæ;
jj. Moschidæ, cervidæ, CAMELIDÆ, bovidæ, antelopidæ;

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kk. Anoplotheriadæ, equidæ, ELEPHANTIDÆ, suidæ, hyracidæ;
ll. Bradypodidæ; dasypodidæ, MYRMECOPHAGADÆ; echidnadæ, ornithorhyncidæ;

In 1828 Mr. John Stark published his 'Elements of Natural History,' bringing the whole Zoological Series up to the highest level of Science at that time; but the subject has since so entirely changed, that a reference to his Work will not carry us very far. The Cuvierian Table to be found at the end of Griffith's Translation, takes us nearer to the present views of Classification, but the Scale of Genera is so extremely high and so inadequate to necessary subdivision, as to remind us of the wide Linnæan Genera. It will perhaps be better to enumerate the references of the leading Structures, where these Publications principally fail us:—

The Infusoria, Polypi, and other Elementary Structures are as yet in the same loose state, as the Fungi, Lichens, and Algæ of Botany; the place of many in the System is disputed, and the stations deviate widely; Ehrenberg, Blainville, Milne Edwards, and Farre may be consulted.

The Amœbales are the Gymnica, Epitricha, Pseudopodia; Enantiotreta, and Allotreta of Ehrenbergh.

The Flustrales may represent the Bryozoa of Ehrenbergh, and the Ciliobrachiata of Farre; they open with Ehrenbergh's Katotreta and Anopisthia.

Sertulariales may represent the Hydriform Polypes of Farre; Madreporales are nearly his Zoanthiform Polypes. In the Echinales I have taken the limits of Agassiz. I follow Agassiz in considering the Medusales as the true passage, connecting the *Echinales* with the Ascidiales. The Bryozoa are admitted to pass by Vorticella to the Infusoria, and are said on the other hand to pass into the Ascidiales; but in laying stress on the Vent, we must recollect, that the Vent may gradually approach the Mouth, until the two openings may coincide.

The Families of Aviculales and Tridacnales are limited from Dr. Flemming's Treatise on Mollusca.

The *Crustacea* are limited principally from Milne Edwards:—

Gecarcinales are Oxyrhinques, Cyclometopes, Catometopes, Leucosiens-calappiens, and Corystiens-dorypiens.

Hippales are Dromiens, Raniniens, Hippiens, Paguriens-homaliens-pactoliens, and Porcellaniens.

Palæmonales are Macroure cuirassées, Thalassiniens-astaciens, Salicoques; Caridioides-bicuirassées, and Unicuirassées. Bopyridæ-cymothoadæ are his Cymothoadiens; Sphæromadæ-idoteadæ-asellidæ are his Idotéidiens; Gammaridæ-corophiadæ are his Crevethiniens.

The Families of the Cephalose-Molluscs are easily distinguishable; their order of Succession and that of the Alliances are open to remark.

The PISCES are principally formed from the Groups of Cuvier.

In the AVES I have leaned to Swainson's Divisions, but his Families seem frequently too small, nor am I now satisfied, that I have sufficiently consolidated them:—

Meropidæ are (Trogonidæ)-Halcyonidæ-Meropidæ;
Trochilidæ are Trochilidæ-cinnyridæ-promeropidæ;
Meliphagadæ are (Paradiseadæ)-Meliphagadæ;
Muscicapadæ are Ampelidæ-Muscicapadæ-Laniadæ;
Corvidæ are Corvidæ-Sturnidæ;
Psittacidæ are Psittacidæ-Picidæ;
Cuculidæ are Certhiadæ-Cuculidæ.

I have not any satisfactory reference for the families of the Mammalia, which require new-casting, and which seem to have retrograded since the arrangements of Desmarest, in consequence of the Abuse of Characteristic Nomenclature.

Between Equidæ and Suidæ may lie Hippopotamus-mastodon-elephas-tapirus-palæotherium-rhinoceros.

Didelphidæ and Kanguridæ may be compound, and the parts lie in different Alliances.

From Felidæ to Melesidæ we may pass thus, Hyæna-canis-viverra-paradoxurus.

For LUMBRICALES, and EUNICEALES consult Milne Edwards; LUMBRICALES are:—

Cephalobranches; Arenicoliens, Terricoles; Suceurs; Gasterobranchidæ.

EUNICEALES are:—

Cepalées § A.; Nereidiens, Eunicieus, Amphynomiens-aphrodisiens; Sipunculi (Agassiz).

There will not be any difficulty in recognizing the Families intended among the Insecta; an attempt is made at a more natural distribution of the great Groups; Lamarck seems to have been underestimated here. Mr. James Wilson in his Treatise gives the Diptera from Meigen, who seems to have divided the families much too far and beyond Lamarck:—

Hippoboscadæ are Nycteribia-coriaceæ;
Muscadæ are Trineuræ-muscides;
Conopsidæ are Stomoxidæ-conopsariæ;
Others are still more broken down.

GAMASALES are from Dugés:—

Acaridæ are Bdelleæ-acareæ;
Gamasidæ are Ixodeæ-gamaseæ.

FURCULARIALES are from Ehrenberg:

Monotrocha, Schizotrocha, Polytrocha, Zygotrocha nuda, and Zygotrocha loricata.

Thurlby Hall, Lincoln,
June 13th, 1838.

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