THE MUSEUM

OF

NATURAL HISTORY.

ZOOLOGY.

Class III.—REPTILES (Reptilia).

The term Reptile is derived from the latin word re*pto*, to creep or crawl, and, in a general sense, sufficiently well characterizes the class of animals to which it is applied. An uncouth, elongated body, supported by remarkably short legs, which scarcely elevate them above the soil they creep upon; little glancing, glittering eyes; and a capacious mouth, the jaws often furnished with most formidable teeth—render many of them hideous and repulsive to the sight: whilst the total absence of legs, their sinuous, tortuous body, gliding along the surface of the ground, and the presence of fangs endued with deadly poison, cause others to be viewed with fear and horror. "Of all the animals," says the Abbé Bonnaterre, "which Nature has scattered over the surface of the globe, and which she appears to have thrown across the great scene of her works, in order to animate the vacant space and produce motion in it, reptiles are those which have the fewest of her gifts. Their body presents only an ill-formed mass, heavy and inactive; their senses are obtuse; their instinct is reduced to sensations the most coarse; and their life is confined to seeking their food upon the limits of earth and water, in those vast marshes where everything conjures up the images of monstrous growths from the ancient slime. In fact, they have neither the grace nor the liveliness of other terrestrial animals; they do not know, like these latter, how to amuse themselves, to enjoy each other's company, nor to take their pleasant sports either upon the earth or in the air; but they glide on the ground, along the borders of lakes, in the hollows of rocks, or under sterile thickets. Some delight in the rays of the sun; others remain in gloomy, moist, retired places during the day, and only quit them at night so as to conceal their deformity, and to avoid producing in man the sentiment of fear, disgust, and horror, which their presence inspires him with." This apparently natural loathing and abhorrence seems even to prevent the generality of naturalists from making them their study, and deters scientific travellers from collecting them. Reptiles, however, notwithstanding this gloomy picture, are well worthy of attention. There is, perhaps, no other class of animals in which such a great diversity of form and external configuration is to be found. The little harmless lizard; the fierce, gigantic crocodile; the gliding, hissing serpent; and the unwieldy, slow tortoise—though differing so much in general appearance, all possess characters in common, sufficient to enable them to be united in the same class. Amongst them, too, are many which, for beauty, do not yield to any species belonging to any other class of the animal kingdom. For rich and varied hues, and for graceful and lively action, few exceed the green lizard of the south of Europe; and what can be more beautiful than some serpents, which are endowed with the brightest colours, and clothed in scales flashing in the light with a thousand varied metallic reflections—

> "Terribly beautiful.
> Wreath'd like a coronet of gold and jewels,
> Fit for a tyrant's brow?"

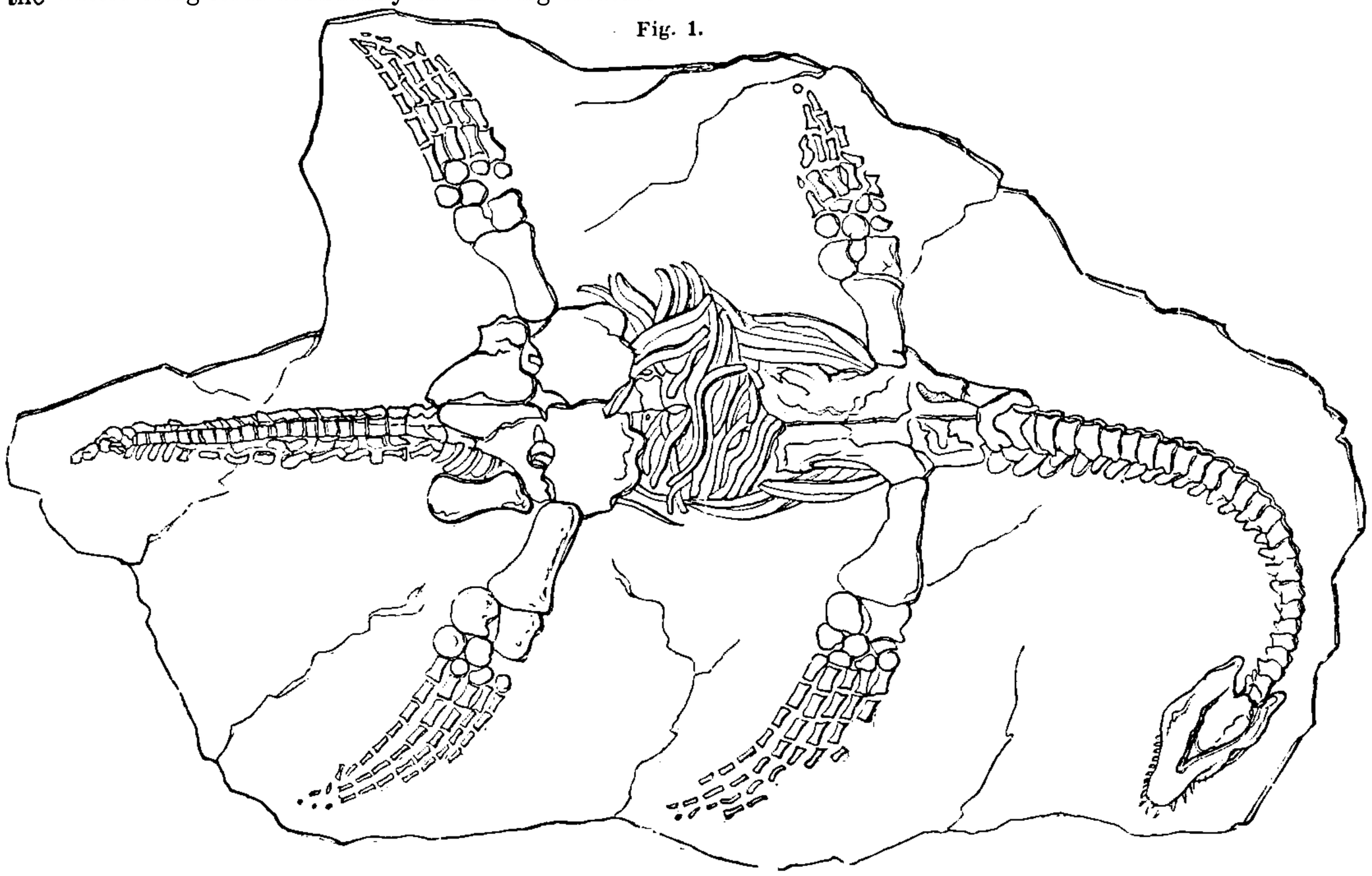
In an economical or utilitarian view, reptiles are not of much value to man. The flesh of many, as the guanas, is eaten by the inhabitants of the countries where they are found, and is said to be both delicate and well flavoured; while that of the turtle, in many instances, proves of great value to navigators in lengthened voyages, and its gastronomic repute, especially amongst English epicures, is too well known to require particular notice. The shell of these latter animals, known as "Tortoise-shell," is the most valuable product derived from the class of reptiles, being extensively used in the arts and manufactures.

From the earliest ages the forms and habits of reptiles have arrested the attention of mankind. Numerous passages in the Old Testament show, that many of them were well known at the time the Scriptures were written, whilst the ancient monuments of Egypt prove how much they had been noticed by that early race of people.

Though not the most ancient inhabitants of the globe (Crustacea, Polyps, Mollusca, and some fishes, having made their appearance before them), they yet precede Birds and Mammalia; and, to use the words of Boty St. Vincent, "were, perhaps, the attempt by which

nature passed from forms peculiar to creatures of the waters, to those which characterize the vertebrated animals of the land." In the account of the creation, in the first chapter of Genesis, we appear to have reptiles mentioned twice. At the commencement of the fifth day, or epoch, after the waters had been gathered together, and dry land had made its appearance, lighted up and warmed by the rays of the sun, "God said, Let the waters bring forth abundantly the moving creature that hath life." While the land was still in a soft, miry state, these huge aquatic reptiles of an amphibious nature, the remains of which are now found in the deposits of the fifth period, made their appearance, mixed with "great whales," and other moving animals "which the waters brought forth abundantly." Then were formed those immense creatures of most fantastic forms, the massiveness of whose bodies required deep ponds in which they could disport themselves, and in

Fig. 1.



Plesiosaurus Hawkinsii.—*Owen.*

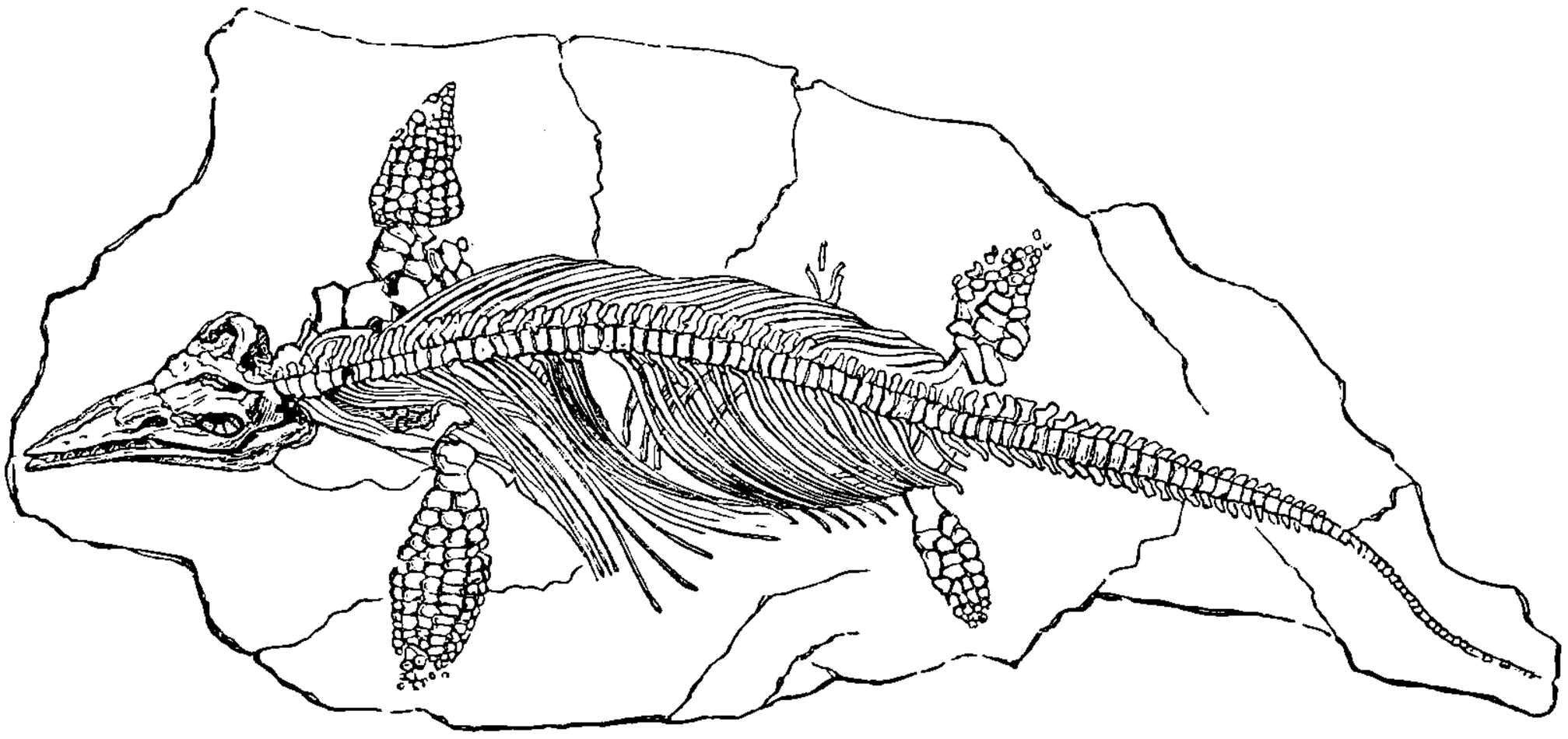
the thick mud at the bottom of which their impress has remained. They perished, no doubt, in proportion as moisture failed them on a soil in process of evaporation; and by the time the crust of the earth had become firm and hard, the immense Ichthyosauri and Plesiosauri, animals with the body of *lizards*, the fins or paddles of the *turtle*, and the neck of the *serpent*, had disappeared as living beings. At this period it was, or on the sixth day, that terrestrial reptiles were formed, when "God said, Let the earth bring forth the living creature after his kind, cattle and creeping thing." By the time the *chef-d'œuvre* of creation, Man, made his appearance, many species of reptiles had not only lived upon the globe, but had disappeared from its surface. Mixed up with the traditions of almost all nations, and veiled in the haze and obscurity of antiquity, there have been handed down also to us accounts of curious monsters, dragons, &c., which have been generally looked upon as fabulous and treated with derision. Along with the Ichthyosauri and Plesiosauri mentioned above, which lived exclusively during the fifth period of creation, in the muddy waters on the surface of the earth, there existed extraordinary creatures, which were provided with wings after the manner of the bats of the present day, by means of which they were able to raise themselves in the air. These animals are known by the name of Pterodactyles, and their form and proportions are such as might realize those of these mythological dragons mentioned above. Bory St. Vincent does not hesitate, alluding to this subject, to say, "that it would not be rash to conjecture, that in the sixth age (anterior to that which sanctifies the repose of the sabbath) some of those monstrous reptiles which might have joined to the characters of Plesiosauri the wings of Pterodactyles, infested the flat shores where the people that lived upon fish had begun to establish themselves." "We do not find their skeletons," he adds, "any more than we do those of man; but the remembrance of their existence is preserved by tradition, in the dragons of China, of Japan, Siam, and Greece, as well as in the Hydra and Lerna" of the latter country. Be this as it may, the belief in the existence of wonderful and monstrous forms of reptiles has not yet disappeared, as even in the nineteenth century, the semi-fabulous monster, the *Sea Serpent*, "though repudiated by all sufficiently learned to be sceptical," still forms part of the creed of honest Jack-tars and other dwellers on the mighty deep, and which is reported still to pay an annual visit to the Scandinavian fishermen on the shores of Norway!

In Great Britain, the number of species of existing reptiles is very limited, and the numerical proportion of individuals likewise is very small compared with hot

climates. One general inherent condition for the multiplication of reptiles is the reunion of equatorial heat with moisture. It is in the immense and submerged savannahs or in the depths of virgin forests, in tropical countries, that these creatures most abound. Hence we find them in such vast abundance under the ardent sky of the Moluccas, in the isles of Sunda and of New Guinea, where they are the terror of the human race. Guiana too, and the intertropical parts of Africa and America, demonstrate to us the fact, that it is in the countries near the equator that reptiles are most numerous and most largely developed in size.

The class REPTILES (*Reptilia*), according to Cuvier and many other naturalists, contains the Batrachians, that is, frogs, toads, newts, salamanders, &c., as well as lizards, serpents, crocodiles, and tortoises. The most recent systematic zoologists, however, are now agreed to constitute the Batrachians into a distinct

Fig. 2.



Ichthyosaurus intermedius.—*Conybeare.*

class, under the name of *Amphibia** or *Batrachia*;† and in the following pages we shall adopt this arrangement:—

The class REPTILES, then, thus limited, may be defined—cold and red-blooded vertebrated animals, with a heart trilocular, that is, formed of three cavities, which consist of two auricles and one ventricle; possessing true lungs, the respiration being exclusively pulmonary throughout life; having a hard and dry integument, which is generally covered with broad plates or imbricated scales; oviparous, the young, that is to say, being produced from eggs, which are deposited by the mother in such situations as to be hatched by the rays of the sun.

When we say that Reptiles have *cold* blood, we mean that their natural temperature is not much, if at all, above that of the atmosphere or water in which they live; that their power of producing animal heat is so limited as scarcely to be appreciable, and therefore not sufficient to prevent the system being immediately affected by the lowering of the temperature of the medium by which they are surrounded. In consequence of this, we find that in our climate, and in countries where the temperature is low, they undergo a state of torpidity in some sheltered retreat, to which as a refuge instinct directs them, and where they remain during the continuance of winter. The mode in which the blood is circulated is one of the principal characteristics of reptiles. The heart—which consists of three cavities, viz., of two distinct auricles opening into one common ventricle—transmits at each contraction only a portion of the blood through the lungs, the rest being sent directly to the other parts of the body, without being specially subjected to the influence of the respiratory organs; thus differing from the higher classes of animals, Mammalia and Birds, in which the whole of the blood must pass through the lungs before it is sent back to the more distant parts of the circulating system. The routine of the circulation is this: the right auricle receives the vitiated blood sent from the different parts of the body by the veins; the left auricle the arterialized blood returned from the lungs; and both auricles convey their contents into the cavity of the ventricle. These two kinds of blood are in this ventricle mixed together, and part of this mixed fluid is sent through the aorta, or great arterial trunk, to supply the system, and part through the pulmonary arteries, to undergo a further degree of oxygenation in the lungs. "It is clear then," says Mr. Bell, "that the blood is by this mechanism but partially changed by the action of oxygen; in other words, that the quantity of respiration, speaking with reference to the physiological meaning of the term, is comparatively small. Hence arises the circumstance that these animals have what is called cold blood; for, as it is from respiration that the blood derives its heat, and the temperature of the body is thereby sustained in animals which have more perfect respiration, it follows that where this function is but imperfectly performed,

* *Amphibios* (αμφιβιος), having a double life.
† *Batrachos* (βατραχος), a frog.

the animal heat, muscular force, and all the other functions dependent upon respiration, will be diminished." Hence it follows that reptiles possess but little power of sustaining muscular action, for though several species are capable of moving rapidly for a short time, it is only when they are supplied with that degree of temperature externally which is denied them from an internal source, that they are capable of exerting any energy at all. When deprived to a certain extent of external heat, they then, as has been mentioned above, pass into a state of torpidity or hibernation. In temperate and cool climates, the lizards and serpents retire during winter to holes in trees, under stones, beneath dead leaves, or in such like places, where many species, especially serpents, congregate in large numbers, and are found closely entwined together. The land tortoises take refuge from the cold in excavations, which they often dig for themselves, and the fresh-water tortoises in holes in the muddy banks, or in the mud at the bottom of their native lakes or rivers. "Here they pass the winter in a state of almost lifeless repose, the functions of life so nearly suspended, that none of the external signs of its existence are visible. The circulation is extremely slow, the respiration apparently altogether stopped, digestion absolutely suspended. The return of the genial warmth of spring calls them again into action. The circulation is restored, the blood is again fitted for its various offices by the return of regular respiration, the functions of the digestive organs are again performed, and the animal resumes its former habits, without having undergone any material change."* A similar state of torpidity takes place in many reptiles within the tropics. This summer torpidity, or, as it may be called, *estivation*, is governed by the times of drought. Crocodiles or alligators, and large boas, are frequently found in a lethargic state in the dry mud, and Humboldt's anecdote has been frequently quoted, of an Indian in South America having built a hut over the spot where a crocodile lay buried in the hardened clay, and was only made aware of his mistake by the rains moistening the ground, and bringing the huge creature into animation again.

All Reptiles possess true lungs, and their respiration is exclusively pulmonary throughout the whole of their existence. This forms one of the most important differences which have induced zoologists to separate the Frogs and Toads, &c., from true Reptiles; the respiration in these animals, and those arranged along with them, being carried on by means of *branchiæ* or gills during the earlier period of their life, changing—in some totally, and in others only partially—to the pulmonary character, in the adult condition. The lungs are two in number, right and left, nearly of equal size, except in the serpents, and cellular or spongy. Their structure differs somewhat in the different orders, but in all it is such as only to admit a portion of the venous blood from the heart, instead of the whole. In the Saurian Reptiles and Serpents, the act of respiration is carried on mechanically by the action of the ribs, which are more or less free and moveable, but in the tortoises and turtles the air is introduced into the lungs by a sort of act of deglutition or swallowing.

The integument or skin of reptiles is dry and hard, and is covered with either horny plates or with scales, which structure forms an excellent character for arranging them in two large groups, the *scaly* and *shielded coat of mail* reptiles. Their limbs are either four or two in number, or are wanting altogether, at least externally. When present, they are in almost all cases very short, and so formed as in most instances to prevent their possessors having a rapid motion. They possess the senses of sight, hearing, taste, smell, and touch. In general the eyes are small, and not so well developed as in the higher classes of animals. They are largest in the tortoises, crocodiles, and lizards, and smallest in the serpents. In these latter animals there are no apparent eyelids, and, in consequence, their eyes seem fixed and always wide open. In the lizards we find two lids; the tortoises and crocodiles have three, whilst the chameleons have only one, and that a very singular one. The sight itself in general is very acute, for on this sense depends their pursuit of food and their perception of the approach of enemies. The organ of hearing is, in general, not so highly developed in Reptiles as in Mammalia and Birds. They never possess any external ear; and the sense of hearing varies a good deal in the different orders. It is, perhaps, the most obtuse in the tortoise tribe, and the most acute in serpents. In these latter animals and in lizards we see that the sound of music imparts to them great delight, and this is well known to the serpent-charmers of the East. In most cases the internal organs of hearing are entirely covered by the scaly investment of the head; but in the crocodiles, "the external orifice, instead of being thus permanently closed, is provided with a firm, hard, moveable lid, or operculum, by means of which the aperture may be either stopped or kept open. Thus, while basking on the margin of the river, or lying there in ambush for prey, the crocodile has the power of raising the earlid, in order to listen attentively to every noise; but when he dives beneath the water, either for safety or to drown the victim he has seized, the entrance of water into the auditory cavities is prevented by the firm shutting of the lid, which accurately fits the orifice."* The sense of smell is comparatively feeble in reptiles. Indeed their manner of living would lead one to infer that they would have little use for acuteness in that organ. It is much the same with the sense of taste. In a large proportion of reptiles their food is swallowed whole and entire, and the structure of the tongue in some of those which tear their prey, as the crocodiles, is such as to show that that organ is not fitted to be of much use for the purpose of tasting. The sense of touch does exist in reptiles, but only in a low degree. The skin of their bodies and feet, covered with dry scales or horny plates, does not seem adapted for the possession of any acute degree of sensation; and even in those species, such as the Geckos especially, in which the toes are dilated, this structure is more for the purpose of enabling

* Bell—*British Reptiles*.

* Martin—*History of Reptiles*.

them to adhere firmly to the surface of the objects upon which they move, than to serve as organs of touch.

Reptiles eat and drink very little, and they are capable of undergoing long fasts. The greater number of them are carnivorous, very few subsisting entirely upon vegetable substances. Amongst the vegetable feeders are the land tortoises and some of the marine species. In the case of almost all the rest, it is living prey only that they eat, and the animals upon which they feed are generally swallowed entire. The structure, form, and position of the teeth in the carnivorous reptiles vary much, and form good characters for dividing them into generic groups. Besides the teeth which are planted in the jaws, there are others which are inserted upon the bones of the palate. In the herbivorous tortoises, and all the Chelonians, teeth, however, are entirely wanting. In these animals the jaws have a considerable resemblance to those of birds, being sharp-edged and horny. The lower jaw shuts within the upper, and the portions of food are cut or snapped off, as it were, on the principle of shears. Digestion is very slow, and indeed is carried on only in proportion to the degree of temperature of the surrounding atmosphere. "Many Serpents," says Mr. Bell, "are more than a fortnight after taking their food before the undigested remains are voided, during which period they usually fast. If the temperature in which they are placed be very low, it is greatly retarded, and during hibernation it ceases altogether; for I have known a tortoise, which had fed largely upon grass immediately before it became torpid, retain the grass unchanged in the stomach during the whole of the winter; so that, on opening the body after its death, which took place immediately on its awaking in the spring, and before it had any access to food, the stomach was found filled with a large quantity of grass wholly undigested."

Reptiles are for the most part oviparous, that is, they lay eggs which are hatched after expulsion. The mother buries them in the sand, or deposits them in some place of concealment, exposed to the rays of the sun; and in due time, without any further assistance from the parent, the young are hatched. In a few instances, however, the female retains the eggs within her body, till the young are ready to burst the shell, which are then excluded perfectly formed. Such is the case with the common lizard and viper of this country, and some other serpents, the blind-worm, &c.

The following is the arrangement adopted in the British Museum, where there is an extensive collection of reptiles. The method is that of Dr. Gray:—

CLASS.—REPTILES (*Reptilia*), from the Latin word *repto*, to creep, or crawl.

Animal furnished with a distinct bony skeleton. The skin clothed with horny imbedded plates or imbricated scales, which are covered with a thin, and often deciduous epidermis. They respire by cellular lungs. The heart is trilocular, that is, it has a single ventricle divided into two or more cells, giving origin to two arteries, and receiving the cold red blood by two veins, from two auricles. Oviparous, but the egg sometimes hatched in the body of the mother, often covered with a thick, more or less calcareous shell. The young like the parent, and not undergoing any transformation.

Reptiles are divided into two large sections, the *Scaly* and *Shielded*, according to the structure of the scales or plates with which the skin is covered, and the formation of the skull.

SECTION I.—SCALY REPTILES (*Squamata*), from the Latin word *squama*, a scale.

Body covered with overlapping scales. Skull formed of separate bones; the ear-bone external, and only articulated to the rest. Tongue free, elongate, nicked at the tip, often extensile.

This section is composed of two orders, containing all the species denominated *Saurians* or Lizards, and *Ophidians*, Serpents or Snakes.

Order 1.—LIZARDS (*Sauria*), from the Greek word *sauros* (σαυρος), a lizard.

Mouth not dilatable, jaws toothed, lower jaw-bones united by a bony suture in front; eyes generally with distinct eyelids; limbs four, distinct, rarely in such a rudimentary state as to be hidden under the skin; body elongate, rounded, covered with imbricated or granular scales; tail elongate, tapering, occasionally prehensile, generally covered with whirls of scales.

This order is divided into two sub-orders, from the structure and form of the tongue.

Sub order 1.—SLENDER-TONGUED LIZARDS (*Leptoglossæ*), from the two Greek words, *leptos* (λεπτος), smooth, and *glossa* (γλωσσα), a tongue.

Tongue flat, elongate, bifid. To this sub-order belong the *Monitors*, the *Teguexins*, the true *Lizards*, the *Scinks*, &c.

Sub-order 2.—THICK-TONGUED LIZARDS (*Pachyglossæ*), from the two Greek words, *pachus* (παχυς), thick, and *glossa* (γλωσσα), tongue.

Tongue thick, convex, attached to the gullet at the base. To this sub-order belong the *Geckos*, the *Iguanas*, the *Dragons*, the *Agamas*, and the *Chameleons*.

Order 2.—SERPENTS (*Ophidia*), from the two Greek words, *ophis* (οφις), a serpent, and *eidos* (ειδος), form or shape.

Mouth very dilatable; bones of the lower jaw separate from each other, only united by ligaments; facial bones moveable; limbs none, or only in the form of short spurs on the sides of the vent; tongue very long, retractile into a sheath at its base, apex forked, very long, slender, tapering; one lung very large, the other small or rudimentary.

This order is divided into two sub-orders, the Viperine Serpents (*Viperina*), and the Colubrine Serpents (*Colubrina*).

Sub-order 1.—VIPERINE SERPENTS (*Viperina*), from the Latin word *vipera*, a viper.

Jaws weak, upper jaw toothless, with large fangs in front, lower toothed. Head large behind, crown flat, generally covered with scales, rarely with shields. Hinder limbs not developed. Eyes lateral; nostrils lateral, apical, open. This sub-order contains the eminently poisonous serpents, such as the *Rattlesnakes* and the *Vipers*.

Sub-order 2.—COLUBRINE SERPENTS (*Colubrina*), from the Latin word *coluber*, a snake.

Jaws strong, both toothed, sometimes with some fangs in front, or grooved teeth behind. Head moderate, or indistinct; crown often covered with regular shields. This sub-order contains the *Water-snakes*, some of which are poisonous, the *Boas*, and numerous *harmless* serpents, such as the *True Serpents*, the *Wood Serpents*, the *Tree Serpents*, &c.; and the *Naja* group, which contains the *Cobra de Capello*, and other venomous species.

SECTION II.—SHIELDED REPTILES (*Cataphracta*), from the Greek word *kataphrasso* (καταφρασσω), to cover or protect.

Body covered with square imbedded plates, generally forming a dorsal and central shield; bones of the skull agglutinated together, hard, with the ear-bone sunk into its substance; jaws united into a solid mass; mouth not dilatable; tongue short, affixed to the mouth, scarcely exsertible; the egg covered with a hard shell.

This section consists of three orders, containing the Tortoises or *Chelonians*, the Crocodiles or *Emydosaurians*, and the Amphisbænians, *Amphisbænia*.

Order 1.—TORTOISES (*Chelonia*), from the Greek word *chelone* (χελωνη), a tortoise.

Body short, depressed; the bones of the thorax external, surrounding the muscles of the body like a case, out of which the head, limbs, and tail are protruded; jaws toothless, covered with a horny coat (like a bill); the upper bill covers the lower like a box.

This order contains the *Land Tortoises*, the *Terrapens* or *River Tortoises*, the *Soft Tortoises*, and the *Turtles*, &c.

Order 2.—CROCODILES and ALLIGATORS (*Emydosauri*), from the Greek words *emys*, *emydos* (εμυς, εμυδος), a lizard, and *sauros* (σαυρος), a lizard.

Body spindle-shaped, covered with square bony plates placed in longitudinal lines. Head large; jaws with teeth. Limbs four, free, short; tail compressed.

This order is composed of the *Crocodiles* and *Alligators*.

Order 3.—AMPHISBÆNIANS (*Amphisbænia*), from the Greek words *amphis* (αμφις), both ways; and *baino* (βαινω), to walk.

Body elongate, cylindrical, covered with square imbedded plates placed in cross rows. Tail short, continuous, blunt. Limbs none, or very short, and placed anteriorly, weak; jaws with teeth.

This order contains the *Amphisbænas* or Double-walkers, the *Trigonophes*, the *Chirotes*, or Two-handed worm, &c.

Such is a general sketch of the arrangement we propose to adopt of the Class REPTILES.

ORDER I.—LIZARDS (SAURIA).

THE first order, that of the Saurians or Lizards, is what inay be termed the typical order of the class. The species included in it, have more affinity with the Mammalia, both in the variety and rapidity of their movements, than any others; for we find amongst them, animals which creep, walk, run, climb, swim, dive, and even, to a certain extent, fly. Not but what the essential external characters of the class to which they belong are sufficiently apparent and well stamped. For though examples do occur in their ranks of creatures that are capable of executing a great variety of movements, yet the elongated and proportionately bulky body of the greater number, supported upon their short limbs with apparent difficulty, constrains them to walk slowly and with an air of embarrassment, very different from the light gait of the generality of mammiferous quadrupeds. Their arms and thighs are short, slender, but slightly muscular, and jointed so as to have a direction outwardly, while the elbows and knees are too angular, and the legs too far asunder from each other, to support with ease, when in a state of repose, the superincumbent weight of their body. They vary very much in habits and manner of living, and their organs of motion are always in harmony with these, and the particular situations for which they are designed. Some have slender and highly-developed toes, with a long, conical, and pointed tail, like the true Lizards. These are evidently fitted for an exclusively terrestrial mode of life, and a residence in sandy plains or stony deserts. Others have their toes expanded on their under surface, short thick feet and tail, and a broad flattened form of body, like the Geckos. These creatures are clearly thus constructed to enable them to adhere to smooth surfaces, to traverse walls or ceilings like a fly, and to remain fixed there for any length of time.

In a third set we see membranous expansions on each side of the body, supported by elongated ribs, and capable of being spread out like a fan, as in the Dragons. These are evidently formed for balancing themselves in the air, as if by means of a parachute, and darting, by long flying leaps, from one branch or tree to another.

In another group still we find animals endowed with, comparatively speaking, long and slender feet, the toes placed in opposite directions, like pincers, and a prehensile tail, as the Chameleons. These animals, it may at once be seen, are well adapted for climbing trees and perching upon the branches like birds.

Finally, several genera occur, the species of which have a serpent-like form, and are either almost deprived of feet or have them exceedingly short, as the Blind Worm, the Glass Snake, &c. These animals, we may therefore at once conclude, are destined to live in ground covered with herbage, and glide along like the snakes to which they bear such a striking general resemblance. The Saurian reptiles, in general, have the body of a lengthened form, in proportion to the size of the other parts of their frame. This arises from the great number of separate bones, or *vertebræ*, of which their spine is composed; these amounting sometimes, in species with long tails, as the Iguanas, &c., to the number of one hundred and forty separate pieces, and even in those with very short tails, to upwards of forty. With the exception of a few abnormal forms, they have four short legs, and their toes are armed with claws. Their skin is covered with scales of various sizes and figures, or with granulations. They shed their skin several times in the course of the year. This takes place especially in the spring, after which they appear in brighter colours—the male particularly so. The brain is only moderately developed in the Saurian reptiles, as is also the case with the various organs of sense, except that of sight. They are tenacious of life, and even when their head is cut off, they do not die immediately. If the tail or feet are amputated, they are not fatally injured in consequence, but on the contrary the lost parts are after a short time reproduced. As the skin and feet are covered with hard scales, it follows that the sense of touch must be very imperfect; and as they live exclusively upon living animals, which they seize the moment they see them, it may be easily conceived that the organ of smell is but slightly developed, that sense not being much required. The sense of taste is in like manner very slightly developed; for, as they do not masticate their food, and have very little saliva, a keen perception of the flavour of the articles of which their diet consists, is not required. They all, however, have a tongue, which is in general pretty

long, fleshy, and movable. They are not much better off with regard to the sense of hearing; but the organ of vision is much more highly developed, and their sense of sight is, in consequence, very active in most of the species. In this, however, there are exceptions; as, in the case of the Blind Worm, for instance, this sense is almost entirely wanting.

The animals belonging to this order live entirely upon living prey, their food consisting of small mammalia and birds, fishes, mollusca, and insects. They are remarkable for their voracity, devouring a great quantity of food at a time, though one meal suffices for several days. The jaws are furnished with teeth, which are small, simple, conical, unequal, isolated, and without true fangs. The mouth is destitute of lips, is generally large, so as to admit of their swallowing large pieces of flesh, and the hinder nostrils open into its back part. The tongue varies a good deal in the different families. In the Monitors and true Lizards it is protractile, is less so in the Geckos, but in the Chameleons is exceedingly long, cylindrical, and worm-like in appearance. The structure of the heart and lungs, and the circulation of the blood, are the same as has been already described in the preliminary remarks upon Reptiles. One of the most distinctive characters of the Saurian reptiles, is the existence of a breast-bone, or *sternum*, which is generally of large size, and of a cartilaginous structure. This *sternum*, along with the shoulder-bone, forms a protection for the heart and large vessels. The species of Reptiles belonging to the Lizard order grow very slowly, and the duration of their life is in general very lengthened. Many of them, in course of time, acquire large dimensions, as the Monitors and Iguanas. They are chiefly to be found in very warm and humid climates. Egypt, for example, the temperature of which is so burning hot, while the soil is periodically moistened by the overflowing of the Nile, possesses an immense number of Saurians, especially of the Lizard family, and they are remarkable there for there litheness, their agility, and the vigour of their movements. Bruce, speaking of them, says—"There is no genus of quadrupeds that I have known in the East so very numerous as that of the lizard, or of which there are so many varieties. The eastern or desert parts of Syria, bordering upon Arabia Deserta, which still have moisture sufficient, abound with them beyond a possibility of counting them. I am positive that I can say, without exaggeration, that the number I saw one day in the great court of the temple of the Sun at Baalbec amounted to many thousands; the ground, the walls, and stones of the ruined buildings, were covered with them, and the various colours of which they consisted made a very extraordinary appearance, glittering under the sun, in which they lay sleeping or basking." A very limited number of species, and these all of small size, inhabit our island, and the parallel and more northern countries of the adjacent continent. As we advance into cold climates they disappear altogether, but when we pass southwards, their number, specifically considered. increases; and among them some occur of unexpectedly large dimensions, as, for example, that beautiful species, the Eyed Lizard, measuring sixteen or seventeen inches in length, and which is a native of Spain, Italy, and the South of France.

The flesh of many Saurians is held in high repute in the countries in which they are found, as an article of food. Dampier, in his "Voyage," tells us that the island of Blanco (in the South Seas) was plentifully stored with "Guanos. Their flesh," he says, "is much esteemed by privateers, who commonly dress them for their sick men; for they make very good broth." In America the Iguanas are regarded by epicures as a great delicacy; and in Asia the Scinks are considered to have aphrodisiac powers. Medicinal properties have been attributed to many, especially by the Arabian physicians. But this belief was not confined to the East. "One species," says Mr. Martin, "the Adda of the Arabians (*Scincus officinalis*), formerly obtained a place in the British Materia Medica: its flesh was supposed to be a restorative, and of great avail in leprosy and other diseases. It was one of the ingredients in that compound known as *theriaca* or *confectio damocratis;* the 'wild exuberance,' as Dr. Lewis expresses it, 'of medical superstition in former ages.'"

None of the Lizard order are poisonous, though the ancients regarded many as poisonous in the extreme; and the vulgar, in our own times, frequently look upon them with great horror, and entertain a strong suspicion of their noxious qualities.

SUB-ORDER I.—SLENDER-TONGUED LIZARDS.

THE Slender-tongued Lizards are divided into two tribes, the Ring-scaled Lizards (*Cyclosaura*), and the Tile-like Scaled Lizards (*Geissosaura*), so named from the structure and arrangement of the scales with which their body is covered.

TRIBE I.—CYCLOSAURA.*

This tribe contains ten families, and is thus characterized. Scales of the belly square, in cross bands; those of the back and tail rhombic and imbricate, or circular and subgranular, placed in cross rings; of the sides, generally granular, rarely like the back. Tongue elongate, flattened, base sometimes sheathed, generally free, only attached to the gullet by a long bridle, and with two elongate, cylindrical, horny tips. Tail elongate, with whirls of scales, generally conical, tapering, sometimes compressed, with two elevated crests above. Eyes diurnal, with two valvular lids. Feet formed for walking. Toes unequal, compressed.

One hundred and fifty-four species of this tribe are enumerated. Our space, of course, will not allow us

* From the two Greek words, *kuklos* (κυκλος), a circle, and *saura* (σαυρα), a lizard.

to enter into minute details of these, nor would a dry definition of them, according to their zoological characters, be at all interesting to the general reader. "The truth is," says Mr. Griffiths, "that when we come to treat in detail concerning the reptile tribes, there is an abundant scantiness of that sort of information concerning them, which would prove interesting to the majority of readers. However useful and curious may be the investigation of their specific characters, it must be owned to the many it is dry and repulsive. It is *caviare* to the general." We will therefore only select a few of the more important or interesting.

THE MONITORS (*Monitoridæ*)—*Monitor*, one who gives warning or admonishment, from the Latin word *moneo*, to warn or admonish; these animals being believed to give warning of the crocodile's approach—form the first family we shall mention. The Monitors are the largest of all the lizard order of reptiles. Their body is very long, of a rounded form, and without any crest along the back. Their tail, in most of the species, is slightly flattened on the sides, and at least twice the length of the body. Their feet are strong; the toes are five in number, very long, but of unequal size, and terminate in strong hooked claws. The skin on the head, back, and flanks is furnished with small, round, tubercular, projecting scales, which are always arranged in circular bands or rings. It varies in colour from black to a more or less deep green, with spots scattered throughout, assuming the form of regular patterns, and presenting the appearance of beautifully arranged mosaic work. From the firm structure of this integument, and the hard symmetrical arrangement of the scales, it has been often used for covering little trinket cases and other small articles, as it is well adapted for resisting the effects of friction. They have a long, fleshy tongue, which, like that of the serpents, is deeply forked, and is capable of being withdrawn into a sheath placed at its base, and protruded again to a considerable extent. Their eyes are large and bright, and the openings of their ears are very apparent, and seated low down on the skull, near the angles of the mouth. The head is covered with small many-sided shields.

The Monitors are only found in the warmer parts of the Old World, none having ever been discovered in Europe. They live near the water's edge, and the greater number are aquatic in their habits. A few, however, are completely terrestrial, living in dry, sandy deserts. The structure of the tail indicates their special residence. In the aquatic species, this organ is compressed laterally, and is surmounted by a crest formed of two series of flattened scales. It thus becomes a powerful organ of progression, when the animals are in the water; with it they propel themselves along with considerable swiftness, moving it from side to side, with powerful and rapid action, and steering the body by means of it also, as by a rudder. In the terrestrial species, the tail is conical in shape, and of a rounded form, appearing as if its only use could be to act as a counterpoise to the weight of the rest of the body, or, as it rests upon the ground it may assist the animals in springing upon their prey. Their motion along the surface of the ground is rapid but sinuous, like the serpent; they run swiftly on the level plain, but are not capable of climbing rocks or trees. The Monitors are carnivorous animals; they live upon small quadrupeds, birds, and the larger kinds of insects. They often devour the eggs of crocodiles and aquatic birds; and even small fishes, lizards, and tortoises fall victims to their voracity. M. Dumeril informs us, on the authority of M. Leschenault de Latour, that some of the aquatic species unite on the borders of rivers and lakes, in order to attack quadrupeds coming there to quench their thirst; and that that traveller had seen them fasten upon a young deer which was trying to swim across a river, pull it under the water, and drown it. He had, moreover, found the thigh-bone of a sheep, in the stomach of an individual which he was dissecting.

THE NILOTIC MONITOR (*Monitor Niloticus*)—Plate 1, fig. 1. About twenty-three species of Monitors have been described. Of the aquatic species, which are by far the most numerous, the best known is the one just mentioned. The Nilotic Monitor is about five or six feet long, and of a greenish-grey colour, mottled with black. The nape of the neck presents four or five horse-shoe marks of a yellow hue; and along the back seven or eight rows of spots of a yellowish-green tint, extend from the shoulders to the root of the tail. The tail is compressed throughout nearly its whole length, and strongly crested or keeled on the upper edge. It is one half longer than the body, and is marked on the upper half with circular bands composed of spots like those on the back, and on the lower moiety with rings of greenish-yellow. The legs are strong, and the toes are long, and armed with compressed, very sharp, and hooked claws. The teeth are short, and consist of twenty-two in the lower, and thirty in the upper jaw. It is a native of Africa, inhabiting most of the rivers of that country. It is very common in the Nile; and is also found in the rivers of North Africa, Western Africa, and South Africa, as far as the Cape of Good Hope. This animal is held in great veneration by the natives of Egypt, who assert that by the hissing noise which it produces, it gives warning of the approach of the crocodile. Hasselquist informs us that the Egyptians have also an idea "that it is hatched from the eggs of the crocodile that have been laid in the sand, whilst the crocodile itself is the produce of those eggs which have been deposited in the water." He gravely adds—"I have no need to say that this is false!" Representations of the Nilotic Monitor occur on the ancient monuments of Egypt, and Cuvier has suggested that this may have arisen from the belief amongst that early people, that they devoured the eggs of the crocodile. Its food consists of small animals, insects, &c., which it always takes alive. M. Geoffroy St. Hilaire says that it is very voracious, and that even in captivity, it attacks all the little animals which it can reach, and throws itself with the utmost avidity upon the food presented to it. When irritated, it whistles violently, and tries to bite or strike with its tail. It would appear from Sparrmann's account of an individual caught by him at the Cape of Good Hope, that it is very tenacious of life. "One of this species," he says,

"of the middle size, which, together with its two young ones, I brought home with me from *Agter Bruntjes-hoogte*, was about two feet long in the body, and three in the tail. Having caught her by the neck, so that she could not bite me, and finding that it required some strength to hold her fast, I got a large worsted needle, and gave her several punctures with it, not only in the heart, but in every part of the cranium which was in contact with the brain. This, however, was so far from answering my purpose, which was to kill her in the most speedy and least painful manner, without mangling or mutilating her, that she seemed still to have life enough left to be able to run away. After this my host undertook to put an end to her; and after having given her several hard squeezes about the chest, and tied her feet together, he hung her up by the neck in a noose, which he drew as close as he possibly could. From this situation she was found in the space of forty-eight hours to have extricated herself, though she still remained near the farm, appearing at the same time to be almost entirely exhausted. Upon this, we tied her feet close behind her, so that with her long and sharp claws, of which she had five upon each foot, she could not damage the serpents and other animals which I kept in a cask of brandy, and among which I put her with my own hands, holding her a long time under the surface of the liquor; yet she was so far from being suffocated immediately by the strength of the liquor, that she flounced about a good deal in it; and even a quarter of an hour afterwards, convinced us by her motions that she had still some life remaining in her." "This species of lizard," he continues, "I found to be amphibious, living in water as well as on land, and likewise that it grew to a still greater size; consequently, it appears to be an extremely long-lived animal, and, as well on account of this property, as of that of not being killed without great difficulty, to have an important office assigned it in the general system of the economy of nature. It was supposed (and not without foundation) by the people among whom I resided, that this creature might easily be made tame, and that it was not in the least of a malignant or venomous nature." A large reptile, probably a nearly allied species of this genus, was found on the banks of the Tigris, by the gentlemen engaged with Colonel Sir Henry Rawlinson in excavating the ruined mounds of Babylon. The account given to the writer of this, of the extraordinary tenacity of life exhibited by the unfortunate animal, bordered on the marvellous. After being firmly secured, deep gashes were made right across the spinal column in several places, without destroying or apparently injuring its motive power. A large quantity of strong prussic acid was then poured down its throat, but without any result. It was then placed in a large tub of water with a weight attached, so as to keep it sunk to the bottom, and it was allowed to remain there for twenty-four hours. This seemingly having the effect desired, and life appearing at last to be extinct, it was taken out of its watery tomb and laid on the ground, preparatory to its skin being removed in order to make a stuffed specimen for the British Museum. No sooner, however, had the operator made his first cut with the scalpel through the skin, than, suddenly recovering its suspended animation, and shaking itself loose from his hands, it made with all haste to the river!

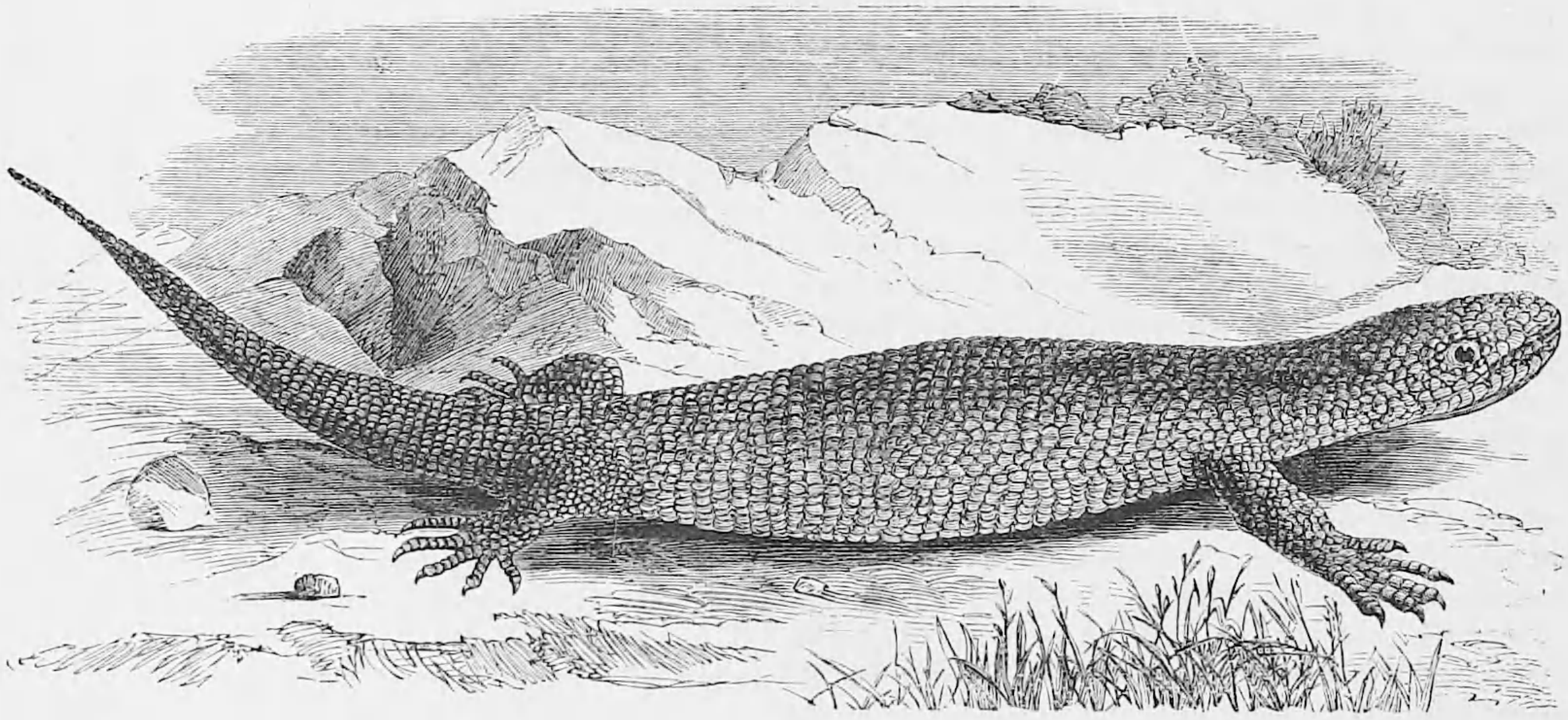
THE WHITE-THROATED MONITOR (*Regenia albogularis*) is another aquatic species of this family, which grows to the length of five feet, and is found in South Africa. It is an inhabitant of rocky places abounding in springs and streams, and feeds upon frogs, crabs, and small quadrupeds. It is regarded as sacred by the natives, who assert it cannot be injured without fear of producing a drought. Sir A. Smith met with this reptile in his South African expedition. "Though no specimens of this species," he says, "were obtained South of Lattakoo, yet there is reason to believe that it occurs occasionally within the limits of the Cape Colony. It is in all probability the animal called *Das Adder* by the natives, and which is much dreaded, under the idea of its being very venomous. It is usually discovered in rocky places, or on low, stony, hills; and when surprised seeks concealment in the chinks of the former, or in the irregular cavities of the latter. When any inequalities exist upon the surface of the rocks or stones, it clasps them so firmly with its toes that it becomes a task of no small difficulty to dislodge it. Under such circumstances, the strength of no one man is able to withdraw a full-grown individual; and I have seen two persons required to pull a specimen out of a position it attained, even by the assistance of a rope round one of its hinder legs. The moment it was dislodged it flew with fury at its enemies, who by flight only saved themselves from being bitten."—The terrestrial Monitors, or those which live exclusively in dry places, are few in number.

THE OUARAN, or LAND MONITOR OF EGYPT (*Psammosaurus Scincus*), is the best known. This species is about three feet long, and is distinguished by its tail being round, without any keel, and considerably more slender than that of the Nilotic species, the scales of the greater part of the body being round instead of oval, and the teeth being very small, very fine, and very sharp. Its general colour is of a clear brown, with square spots interspersed of a pale greenish-yellow. It is a native of the dry and arid deserts of Egypt, and is called by the Arabs, *Ouaran el-hard*, or Lizard of the Desert. Herodotus makes mention of it, and calls it the *Terrestrial Crocodile*. This species is less voracious than the Monitor of the Nile, and in captivity refuses food, and can only be made to take nourishment by forcing it to swallow what is put into its mouth. Travellers in Egypt, however, inform us that it is used by the jugglers of Cairo for performing their tricks, after having extracted its teeth.

THE GIGANTIC LACE LIZARD (*Hydrosaurus giganteus*). Two or three remarkable species of Monitors occur in Australia, known by the name of LACE LIZARDS (*Hydrosaurus*). They have the nostrils placed near the apex of the muzzle; their teeth are compressed, sharp-edged, and denticulated; and their tail has a double-edged keel on the upper part. They are very prettily variegated, and one species, the Gigantic Lace Lizard, is remarkably handsome. A specimen may be seen in the British Museum seventy-eight inches long.

THE CALTETEPONS, or HELODERMS (*Helodermidæ*), have been separated from the Monitors, and form a family by themselves; though as yet only one species —the ROUGH CALTETEPON (*Heloderma horridum*), fig. 3—has been discovered belonging to it; it is rare in collections, and is a native of Mexico. The body and head are covered with large convex scales, and the teeth, unlike those of other Saurians, have a groove behind, like the fangs of serpents. Hernandez, in his "History of the Plants and Animals of New Spain," was the first to make us acquainted with this curious animal. He describes it as "a terrific kind of lizard,

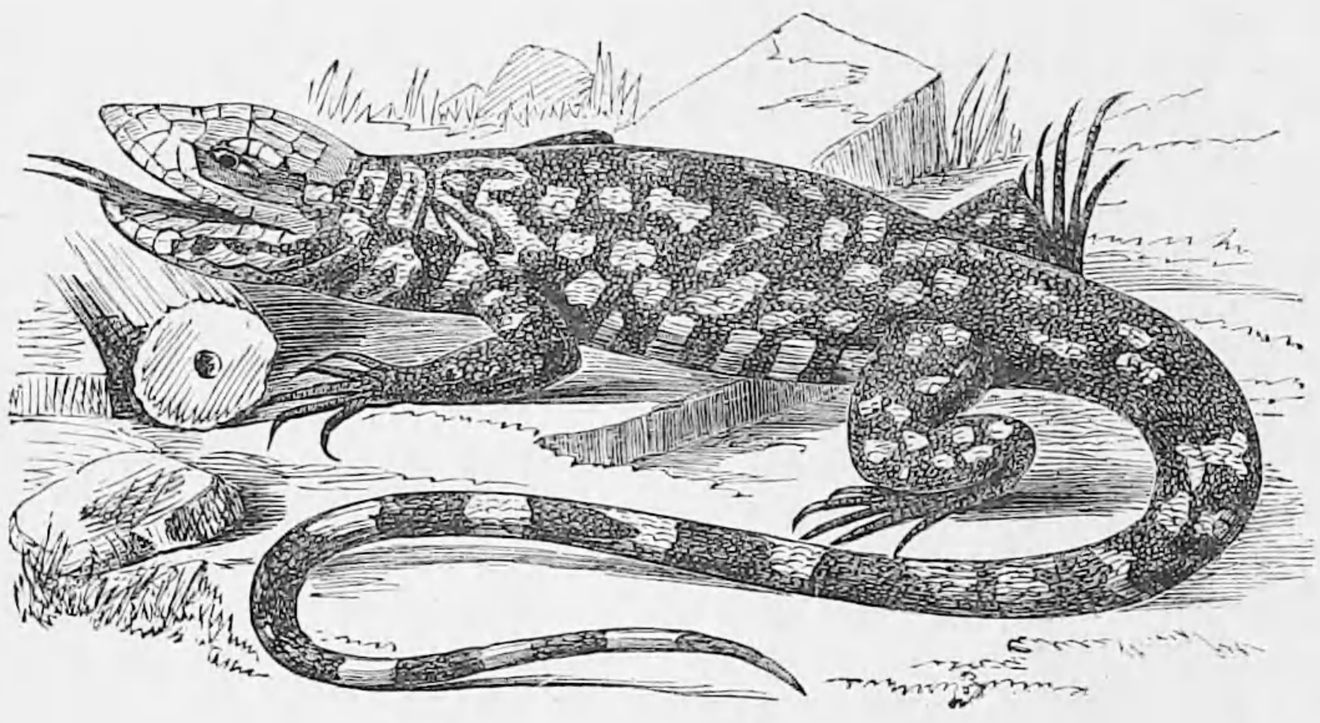
Fig. 3.



The Rough Caltetepon (Heloderma horridum).

called *Scorpius* by the natives, two ells in length, with a long tail, short legs, a broad, red, and bifid tongue, which it sometimes rolls about, and a twisted head; heavy and slow of motion, and covered with a hard skin variegated with brown and white spots, like small pearls or the seeds of the *Lithospermum*, which, from the hinder legs to the extremity of the head, are disposed in various forms, but on the tail form rings, chiefly of a brownish colour, which also surround the body transversely at intervals." "The bite of this animal," he adds, "is hurtful, but by no means deadly, so that it is more horrid to the sight than in reality, and attacks nobody unless injured or irritated." The flesh of this animal, he further informs us, was considered by the natives of New Spain as an aphrodisiac, and prized as much as that of the scink was in the East.

Fig. 4



The Common Teguexin (Teius Teguexin).

THE SAFEGUARDS (*Sauve-gardes* of the French authors), or TEGUEXINS (*Teidæ*), have also been described by many authors under the name of Monitors, and no little confusion has in consequence been created. The name, no doubt, has originated in the same belief that these animals were useful to man, in giving warning of the approach of the crocodile or alligator. By retaining the name of Monitors for the first group, the confusion will be removed by assigning to the latter the name of Teguexins, a name given to one of the species by the Indians of South America. In this family the head is covered with large regular shields, whilst the integuments of the back and limbs have only small scales, which are not disposed in tile fashion, but in transverse bands. The skin of the throat generally forms two or three simple transverse folds. The tongue is long, flat, extensile, and only occasionally sheathed at the base. The legs are pretty strong, and the tail is usually rounded. The species belonging to this family are all natives of the warm parts of the New World, and some of them grow to a considerable size, reaching the length of four or five feet.

THE COMMON TEGUEXIN (*Teius Teguexin*)—fig. 4 —is the best known. It is a native of the greater por-

tion of South America and the West Indian Islands. Madame Merian found it in Surinam, and describes it as growing with time nearly as large as the alligator. It never attacks human beings, she says, but lives upon insects, the eggs of birds, &c., and wages war occasionally upon small fishes. "When it wishes to lay its eggs, nature teaches the female to make hollows in the sand, on the bank of some river, and leave to the sun the care of hatching them." These eggs are as large, she says, as that of a small fowl, and are much relished by the Indians. Azara, an acute observer, in his description of the animals of Paraguay, informs us that these lizards are called by the natives of that country the *Teyú-güazú*,* and that they are generally found on the edges of woods, and in dry plains, in which latter places they form burrows, into which they retreat during the winter. Their motion is very swift, and being rather timid animals, they plunge into the water when pursued or alarmed, and remain there till the danger is over. He confirms Madame Merian's statement that they live upon insects, and further says, they eat frogs, serpents, young birds, and eggs. Dumeril and Bibron have always found the remains of insects in the stomachs of those they have opened, and, on one occasion, mixed up with the remains of some beetles, portions of the skin and bones of a lizard. The natives of Paraguay informed Azara that the Teguexin is very fond of honey, and that to obtain it the reptile approaches close to the hive, and strikes it a pretty smart rap with its tail; it then runs off, but shortly returns, and with repeated attacks of this kind succeeds in frightening away the bees, and finally regales itself upon the dainty meal thus cleverly obtained. Its flesh is esteemed as good eating. The colour of this species is highly beautiful, consisting of an elegant variegation of brown, blackish, and purple spots, on a pale bluish-white, and, in some parts, yellowish ground. In length it is in general about thirty-eight inches; the tail is round for the first half, but the latter portion is somewhat compressed. When it walks the belly and tail trail upon the ground, while the head is kept erect. The flattened structure of the tail shows its fitness for occasionally inhabiting the water, while its strong claws prove its adaptation for digging in the sand.

THE AMEIVAS (*Ameivina*) resemble the Teguexins in general form, but the head is more slender and compressed; the extremity of the muzzle is pointed, and there is no division in size between the neck and the body. The tail is more than two-thirds of the length of the whole body, and is of a rounded tetragonal form. They do not like them, however, frequent the neighbourhood of water; they only inhabit arid places. They live on worms, insects, snails, and herbs.

THE COMMON AMEIVA (*Ameiva Surinamensis*) is a native of Guiana and Brazil, being spread all over the latter country. It is about a foot, or a little more, in length, and has the back more or less picked out and spotted with black, and vertical rows of white ocelli bordered with black on the flanks.

* *Teyú* is the general name for lizards, *güazú* alludes to its size; this species being larger than any other lizard of Paraguay.

THE TEYU-HOBY, or GREEN LIZARD OF PARAGUAY (*Acrantus teyou*), differs from all the other species belonging to this family, in having only four toes on the hinder feet, like the Crocodiles. The head is short compared with the Ameivas, and the tail is thick at the root, and terminates in a very sharp point. It is nine inches long, tail included, and its colouration is very beautiful. The head is of an enamelled green, this colour being prolonged in a line along the back, and the body is marked with six yellow rays, three on each side; each of the intervals between the rays being filled up with a series of tolerably large black spots. This green lizard is very common in Paraguay, in the thickets, living there till the end of October, and at the approach of winter retiring into holes. It runs very quickly.

THE CROCODILE-TAILS (*Crocodilurina*),* in size and aquatic habits, and in the form of the tail, approach the Crocodiles. They frequent the large rivers, lakes, or wide morasses of South America, and pass a great portion of their life in the water.

THE ADA, or GREAT DRAGON (*Ada Guianensis*), is an example. It attains the length of from four to six feet, and is a native of Guiana. Its flesh is accounted excellent by the natives, who compare it to that of a fowl. Its eggs are also in request.

THE TRUE LIZARDS (*Lacertidæ*) comprise amongst them some of the smallest and prettiest species belonging to the Saurian order of Reptiles. They are rather numerous, upwards of fifty distinct species being enumerated by Dr. Gray in his British Museum Catalogue of Lizards. They are distinguished by having a pyramidal head, covered with regular many-sided shields; a scaly throat, often with a cross fold in front, and a collar of larger scales behind; a lengthened, flat tongue, not sheathed, but free at the base, divided at the tip into two long forks, and capable of being projected to a considerable length. Their teeth are hollow at the roots internally. They are all natives of the Old World and Australasia, and are all terrestrial. We do not know a single species which is really aquatic. Their tail, instead of being compressed and capable of acting as an oar, as in some of the preceding groups, is perfectly round, and in general very long. But though they are all terrestrial, they do not all inhabit the same kind of places, nor do they possess the same habits and manner of living. For instance, many of them cannot exist except in such situations as abound more or less in vegetation and herbage, whilst others are only found in desert and arid places. The first set are those which are found climbing habitually upon shrubs in thickets, or upon walls or hedges and palings which serve as inclosures of our habitations. In these the toes are always simple, compressed, and quite smooth. The second set never rise from the sandy soil, upon the surface of which they run with great rapidity; for, however unfavourable at first sight such a surface might appear for walking upon, the structure of their feet enables them to traverse it with the greatest ease. The toes in these are exceedingly flattened, keeled beneath, and dentated, or fringed on

* From the two Greek words, *crocodilus* (κροκόδιλος), a crocodile, and *oura* (οὐρα], a tail.

the sides, and this structure prevents them from sinking into the sand. This adaptation of structure to their particular habits of life, forms a good character for dividing this family into two groups, the *smooth-toed lizards*, and the *rough-toed lizards*.

Lizards are remarkable amongst Reptiles, for the agility of their movements. Any one who has noticed these animals, must have observed with what rapidity they dart from one point to another, and how they can cling to walls and rocks by means of their long and crooked claws. In intertropical countries, however, they are much more nimble and more active in their habits than in our temperate climes; for here, as soon as the cold weather commences, their motions become slower and slower, and they finish in winter by falling into a complete state of lethargy. Lizards in general are very gentle, timid creatures. Children in Europe make playthings of them, and the ancients used to call the lizard "the friend of man." They have, however, a considerable degree of courage, and notwithstanding the gentleness of their natural manners, they will bite pretty severely when laid hold of. Some species, as the "eyed lizard," have even been known to show tight to dogs and serpents, and though not often conquerors in such combats, to have inflicted severe wounds upon their enemies. Their bite is not poisonous, as was for a length of time believed; but still, from their teeth being placed in a series of rows, and thus acting as a sort of saw, it is often very sharp and severe. Their strength and courage depend much upon the temperature. Under the tropics they are hold, some rather dangerous, and of considerable size. In more northern countries they are timid, because they are weak and of small size. But they are not stupidly timid, as those who have watched them in their native haunts have explained to us. Should a slight noise strike upon its ear, or an unaccustomed object suddenly come in view, the little lizard previously, perhaps, lying basking in the rays of the sun, may be seen to raise itself immediately upon its feet, to draw back its head, and in that attitude carefully watch everything around it. A leaf may have suddenly fallen to the ground, it starts, watches the object for a time to see whether it will move again, then carefully advancing nearer and nearer, examines it well, and satisfying itself of its nature, returns to its position and lays itself down again to enjoy the warmth it loves so much. Should the danger be real, however, it flies like lightning. Lizards generally live in burrows or holes which they dig in the ground or sand, often a foot or more in depth, or in the bollows of rocks, or in crevices of old walls, choosing always such situations as are exposed to the sun. They are not sociable animals, and never appear to unite together in numbers, for the purposes of attack or defence. The instinct of procuring food or of increasing their species, alone appear to bring them together for even a very short time. They feed exclusively upon living prey; insects of various kinds, worms, snails, and any small animals they meet with. In securing their prey they are very cautious. When a lizard wishes to catch an insect, for instance, it does not throw itself inconsiderately upon it, but it follows attentively all its movements; remaining motionless itself with outstretched neck, it waits the favourable moment for action; several times it advances and withdraws its head as if to make sure of its aim, and then all due precautions taken, it darts forward the head, at the same time opening wide its mouth, in which the poor insect is immediately engulfed and held fast by the numerous small teeth with which the palate is furnished. Lizards are also accused of eating birds' eggs, and it is even asserted that they will eat their own eggs when pressed much by hunger. They eat seldom, however, and digest slowly. Losing little by transpiration, they can endure long fasts. It was formerly thought that these animals did not drink at all, but that is now ascertained to be incorrect, as they lap water in the same way as a dog does, with their tongue. Though not sociable animals, lizards live in pairs; the male and female, it is said—more especially of the "grey lizard of the walls"—remaining in a happy state of union during many years, sharing the arrangement of the household, the care of excluding the young from their numerous eggs, of carrying them into the sun, and in placing them in shelter from cold and humidity. With one exception (*Zootoca vivipara*) they lay eggs, from seven to fourteen in number, depositing them in small holes, which the female abandons immediately after they are laid, leaving them to be hatched by the warmth of the sun. They are said to be long lived, and the Abbé Bonnaterre relates that he had watched for twenty years the same lizard daily leave its burrow to come and bask in the sun. The tail differs in the two sexes, and this forms a characteristic mark; in the male it being flat, broad, and furrowed longitudinally; and in the female being round and narrow. This organ is remarkably brittle, and frequently snaps asunder by the mere exertion of the animal attempting to escape from danger. They possess the faculty of forming a new one, which, however, has only a central cartilage in the place of bones, and is often covered with scales different from those of the rest of the tail. "The least touch," says Mrs. Lee, "makes them fall off, and as long as tails are necessary, it is happy for them that Nature has given them the power of reproducing their lost member. A superabundance of this power, however, has occasionally some awkward results, for if the accident merely crack the tail on one side, a new tail will sometimes spring from the crack, and thus give them two at a time. On a certain road in Madeira, it was observed that all the lizards were without tails, and the circumstance was accounted for by its being the favourite resort of the midshipmen, who landed for a day's pleasure from the different ships of war which touched at the island, and a part of that pleasure consisted in knocking off the lizards' tails."

SMOOTH-TOED LIZARDS.*

THE GREAT GREEN or **EYED LIZARD** (*Lacerta ocellata*), represented in Plate 1, fig. 2, and Plate 8, fig. 11, is the largest of the family; a native of the south of France, Italy, and other southern countries of Europe; also met with in Northern Africa, on the shores

* The *Leiodactyles* of Dumeril and Biloron, from the two Greek words *leios* (λειος), smooth, and *daktulos* (δακτυλος), a toe.

of the Mediterranean. It frequents dry, arid places, among rocks, &c., exposed to the influence of the sun, and may be frequently seen in the neighbourhood of Montpellier, climbing along the bushes and hedges, or over large stones in search of insects. It is usually about sixteen inches in length, though sometimes it reaches that of two feet and upwards, and is of a bright, glossy, green colour on the upper parts of the body, ornamented with round spots of gold and blue, and with rings and irregular markings of black; the under-part is white, with a fine *glacé* of green. Its food consists of insects, especially beetles and grasshoppers, worms, frogs, mice, shrews, and other small vertebrated animals. It is a bold creature, and will bite severely. If attacked by a dog it will defend itself, and fastening on his muzzle, will allow itself to be killed rather than let go its hold. There is nothing poisonous, however, in its bite, as was at one time erroneously believed. Laurenti, an Italian naturalist, made a number of experiments upon this subject, which were perfectly conclusive of this fact. The Eyed Lizard runs with great swiftness, and is said to be able to leap remarkably high. Dante, in his Inferno, canto 25, alludes to the fondness for heat, and the quick motion of this lizard, which is known in Italy by the name of *Ramarro*. He says—

> "As underneath the dog-star's scorching ray,
> The *ramarro*, darting swift from hedge to hedge,
> Appears like lightning if he cross the way."

When young, it digs for itself a burrow in form of a trench, in the furrows of fields, especially where the soil is sand; and when adult, it excavates its retreats in a hard sand, often between two layers of a calcareous rock, having an abrupt slope, and exposed more or less directly to the south or south-east. It cannot bear the effects of cold; and thus the assertion of some naturalists that this lizard is found in northern climates is doubtful. On the authority of Ray and Linnæus, however, it is said to inhabit Sweden, and also Kamtschatka. In this latter country, we are informed that the natives regard it with terror, and consider it as an envoy of the infernal powers!

THE COMMON GREEN LIZARD (*Lacerta viridis*) is much smaller than the preceding, and is a native of the same countries, extending, however, as far as the island of Guernsey, one of the Channel Islands. In general, it is of a beautiful metallic green colour, becoming paler on the under surface of the body, and fading into a yellow tint. The back is often freckled with black, and sometimes the head is blue. Its favourite places of resort are tangled brushwood, brakes, and thickets, where it may be seen climbing the stems of the bushes with great facility, and feeding upon insects. It is a confident little creature, may be readily tamed, and taught to come to the hand for its food, and to drink from the hollow of the palm of any one to whom it is accustomed. It will lie coiled up between the two hands, enjoying the warmth, and not offering to escape. This little Green Lizard is often brought in cages to this country by Italians for show or sale. Its movements are very quick and graceful. Indeed, as Mr. Martin remarks, "its beauty and gracefulness are such recommendations that it is often kept in cages, which should have an inner compartment, filled with dried moss or bran, amidst which it buries itself in order to pass the winter." "It seldom," he adds, "attempts to bite; and, indeed, as we have experienced, its bite is a pinch scarcely to be felt." It is very impatient of cold, and its chief delight is to lie and bask in the rays of the sun, in which it glitters with metallic effulgence. Its ordinary size is about fifteen inches, though individuals are occasionally met with one and a half feet long, the tail being usually twice the length of the body.

There are two species of Lizards found in Great Britain—the Sand Lizard and the Viviparous or Scaly Lizard. The first of these—

THE SAND LIZARD (*Lacerta agilis*) is smaller than the green lizard, and is short in proportion to its thickness. The legs are short, and the tail, which is rather thick and swollen at its root, is usually about one-third longer than the body. The usual length of the Sand Lizard is about seven or eight inches; the body, including the head, measuring about three and a half, and the tail four and a half inches; but Mr. Bell has seen individuals in this country nearly a foot long. In colours, individuals vary very much; in general, however, the tint of the upper parts is sandy-brown, with obscure longitudinal marks of a darker brown, and a series of black rounded spots down the sides, each spot marked with a white or yellowish dot in the centre. The sides are often tinged with green. It is a northern species, rarely occurring so far south as Italy, but not uncommon in the northern parts of France, and the middle districts of the European Continent; it is not very frequent in this country, but extends as far north as Sweden and Denmark. Mr. Bell, in his excellent work on the "British Reptiles," informs us that the Sand Lizard is common in the neighbourhood of Poole in Dorsetshire, its general abode being on sandy heaths, "where it is generally seen crossing the small by-paths with considerable swiftness." It is also occasionally seen on the sunny sides of green banks, basking in the sun's rays, and retreating quickly on the approach of any intruder. Mr. Martin says he has often seen it in this country in sandy places covered with brushwood, and in warm copses. "It is quick and active, and its movements as it runs along are serpentine. When pursued, it makes for its burrow, or dives beneath the matted and thick herbage, escaping from sight with singular rapidity. If seized it will turn and bite, but its bite is very trifling. Unlike the green lizard, it is impatient of confinement, and soon pines to death, never becoming familiar." The female lays her eggs, to the number of twelve or fourteen, in hollows in the sand, which she excavates for the purpose, and having covered them carefully with sand, she leaves them to be hatched by the solar heat. The other British species—

THE VIVIPAROUS or SCALY LIZARD (*Zootoca vivipara*) is much smaller and more graceful in its movements than the sand lizard. The head is more depressed, the feet are more slender, and the body is more slim in general form. It is usually from five to six or six and a half inches long, and, though it varies much in markings, its ordinary colour is

greenish or olive-brown, with a dark brown line down the middle of the back, which is often somewhat interrupted. A broad band extends parallel with this on each side, and in the intervals between these are often one or more rows of black dots. In the male, the under part of the body and base of the tail are bright orange spotted with black; in the female, pale greyish-green without spots. It is a pretty, active, gentle little creature, and is chiefly found in dry, sunny banks, thickets, and copses. In England it is very common, much more so than the sand lizard, and is also met with in Ireland. On the Continent it is not so abundant, but it exists in France, Italy, Germany, and Switzerland. In this latter country, we are told by M. Tschudi, that it frequents in preference the forests of dry pines, making its runs under the fallen leaves. To these it retreats on the appearance of danger. Its motions are singularly rapid and sudden, and it darts on its insect prey with the velocity of an arrow. "Its sight," says Mr. Martin, "is very acute; the instant it perceives an enemy it takes refuge in its burrow. Its hearing appears also to be good. Some years since, while in a small wood in Lancashire, seated on a felled tree, we saw several of these animals sporting within a few yards of us, and chasing their prey. We could not but admire their light but graceful actions, and for a considerable time forbore to make either the slightest noise or movement; suddenly, however, we snapped a dried branch asunder, and in an instant they had all disappeared; in a short time, allured by the bright sunbeams, they emerged from their retreats, and on repeating the experiment, they again hastened to their burrows as before. The ground was covered with half-decayed leaves, and vegetables springing up through the moss, and it was in vain to endeavour to obtain one; we turned over heaps of leaves and grass, but they made their way more quickly than we could follow them. We thought at the time, and have often thought since, of the utility of these little creatures in gardens and greenhouses, insects and larvæ being their subsistence." Instead of depositing her eggs in the sand to be hatched by the warmth of the sun, as is the case with the other lizards we have mentioned, the female of the present species retains the eggs within her body until the young are ready to leave them, and thus they are produced alive. Hence the name given to it of *Viviparous Lizard*. These young, when brought forth are fully formed, and capable of running about, and very shortly afterwards of taking their own food. Their ordinary number is four or five. They are often seen in company with their mother, and are, probably, for some time under her immediate guidance, though it is scarcely probable that this continues for any considerable period.

THE TILIQUERTA, or GREY-WALL LIZARD (*Z. muralis*), is another species of the same genus *Zootoca*, and is the most common Saurian reptile in France, and in all the temperate parts of Europe. It is from five to six inches long, and inhabits sandy places, and frequents the walls of gardens, on which it climbs with a surprising degree of agility. It lives on flies, ants, and other insects. The vivacity of its motions, the grace of its rapid gait, its agreeable and slender form, cause it to be very generally remarked. M. Latreille has given such a graphic description of it that we will quote it at length. "Every one," he says, "knows this lizard; and there are few who have not, in childhood, made it an object of amusement: it is almost domestic; and its presence is the more desirable as it thins the hosts of annoying insects. The ancients called it the 'friend of man.' It is a harmless little creature, and lives in the chinks of walls and old buildings, where it deposits its eggs. When—on fine spring days—a bright sunlight illumines a sloping, verdant bank, or a wall which reflects the heat, this lizard may be seen stretching itself on the grass newly springing, or on the stones, as if in the enjoyment of pleasure; it revels in the grateful warmth, and testifies its satisfaction by gentle movements of its slender tail. It darts like an arrow upon its prey, or into some more commodious spot; but so far from flying on the approach of man, it appears to regard him with complacency. At the least noise, however, which alarms it, at the falling even of a leaf, it rolls itself up, tumbles down, and remains for a little time as if stunned; or, it darts off, is agitated, returns, again conceals itself, reappears, and in an instant describes a maze of tortuous circuits, which the eye can scarcely follow, folds itself up repeatedly, and at last retreats to some hiding-place, where it remains till its fear has subsided." It is so common in the environs of Vienna, that Laurenti declares that it might serve during the entire summer for the support of a great number of poor persons. Its flesh, wholesome, and productive of appetite, according to this observer, might be baked or fried, like that of small fishes. Formerly, the properties of this same flesh, were highly vaunted as a remedy against cutaneous and lymphatic complaints, &c., but its use is altogether abandoned at present for any medical purposes.

ROUGH-TOED LIZARDS.*

The particular arrangement and form of the scales of the head and belly, &c., of this group of lizards, give them, for the most part, a peculiar physiognomy, which enables the scientific observer to distinguish them very readily. Several species are described; little is known of their habits. The greater number are natives of South Africa, and we are indebted to Sir A. Smith for the chief part of what we do know.

THE CAPE SPINE-FOOT (*Acanthodactylus Capensis*) is a lizard about ten inches in length, the tail forming six of this. It is of a yellowish-brown colour above, the flanks being black-brown, and variegated with two series of spots, and two longitudinal lines of the same colour. The toes are long, slender, and each externally edged with a serrated fringe of slender, pointed scales. "This lizard is found in the sandy districts of Great Namaqua land, and where the surface of the country is irregular, it is generally met on the highest spots. Where small sand hills occur, it resorts to them in preference to the other localities, and, from the peculiar assistance it derives from the serrated fringe which edges its toes, it runs over the loose sand, on the

* The *Pristidactyles* of Dumeril and Bibron, from the two Greek words, *pristis* (πριστις), a saw, and *daktulos* (δακτυλος), a toe.

steep surfaces of these slopes, with great rapidity. It feeds upon small insects."

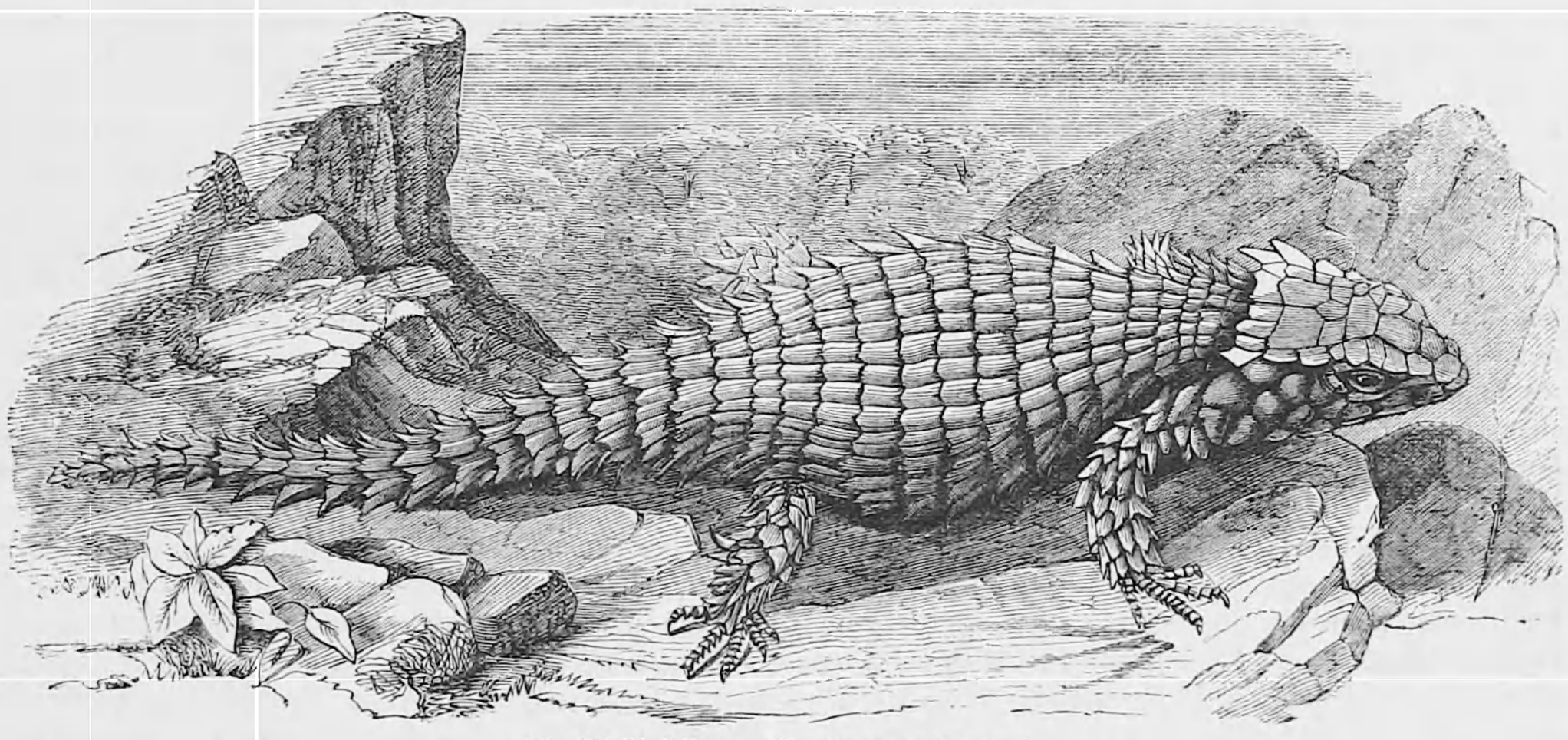
THE GARRIQUES (*Psammodromus Edwardsii*) is a species common in the south of France and Spain. Dugés, in mentioning the habits of this animal, says, that it is found in the environs of Montpellier, in the sterile, mountainous districts called by the inhabitants "garrigues," and that it is also very common in the flat sandy shores of the Mediterranean. There it hollows out, at the foot of a tuft of rushes, a shallow, cylindrical hole, towards which it darts with the rapidity of an arrow, at the approach of danger. The rapidity of its flight is so great, that it almost escapes the sight, and might cause it to be taken for some large insect flying close to the ground.

THE EREMIAS, or ARGUTAS (*Eremias*), are for the most part natives of South Africa. Sir Andrew Smith, in his "Illustrations of South African Zoology," has described eight or nine species found in the neighbourhood of the Cape of Good Hope and other parts of the colony. He tells us that they inhabit arid, sandy flats, and that they are wild, extremely watchful, and move from place to place with great rapidity. When frightened, they conceal themselves under loose stones, decayed wood. or any other material beneath which they can creep. They may be often seen during the day, enjoying the heat of the sun, and occasionally darting upon insects which form their food. They vary in size from about five inches to seven or eight; the tail generally measuring about twice the length of the body.

THE CORDYLES (*Zonuridæ*)* form a tolerably numerous family. They are very like the True Lizards just described, but the back and belly are covered with large, nearly square shields, and the sides, which are only dilated when the animal has eaten a full meal, are marked with a distinct longitudinal fold, and covered with small scales. The tongue is flat, and nicked at the tip. They have generally four pretty strong legs, but in some they are either rudimentary or entirely wanting. Eighteen distinct genera are enumerated by Dr. Gray in the British Museum Catalogue of Lizards, the chief characters being taken from the form and disposition of the scales of the head and body. Several species are natives of South Africa, and have been described at some length by Sir Andrew Smith.

THE SHIELDED ZONURE (*Zonurus cataphractus*) —fig. 5—and **THE FALSE CORDYLE** (*Pseudocordylus microlepidotus*) are found inhabiting rocky situations, and when they have a choice, they invariably prefer

Fig. 5.



The Shielded Zonure (Zonurus cataphractus).

precipices and the stony walls of difficultly accessible ravines. In these situations, they wander carelessly in search of food and warmth, unless alarmed by what they may regard as enemies. On being closely approached in their retreats, they seek concealment under rocks or in crevices; and when they get into such positions they are with difficulty captured, as by aid of the prominences on the hinder-edge of each temple, they hold on with a tenacity which is quite surprizing, and by them they occasionally offer such an effectual resistance to the force applied from behind, that the tail breaks off from the body before the reptile is secured. Indeed, to effect their capture, it is often necessary to displace the masses of stones between which the creatures may have insinuated themselves. Some of the species, as the Rough-scaled Cordyle (*Zonurus cordylus*), are very widely distributed over Southern Africa, and, as Sir A. Smith informs us, "there is scarcely a strong knoll, a precipice, or an exposed rock, which does not afford a habitat for one, two, or more individuals." They vary from six to eighteen inches in length, the tail being generally longer than the body, and spined.

THE SHIELD LIZARDS (*Gerrhosauri*)† are allied species, but the tail is smooth instead of being spiny. They are found in sandy arid districts in South Africa.

* From the two Greek words, *zona* (ζωνη), a band, and *oura* (ουρα), a tail.

† From the two Greek words, *gerron* (γερρον), a shield, and *sauros* (σαυρος), a lizard.

"They run with such extraordinary rapidity, that it is almost impossible for the eye to follow them in their flight. The instant they are discovered, they seek a place of concealment, and that they generally find in the loose sand which is commonly found accumulated under the shrubs with which the district is furnished. In this sand they burrow with amazing rapidity, and it requires an experienced eye to trace their course in it, though that is seldom far below the surface."—

Several other species are natives of South America. These are the BUCKLER-BACKS (*Gerrhonoti*).* They have the body of an elongate, spindle-shaped form, with very short legs, no true neck, and a long round tail, gradually becoming more slender as it approaches the extremity.

Of the habits of these animals little is known; but they lead on to another group of lizards, which are characterized by having still more elongate and slender bodies and tails, and either only two legs, which are quite rudimentary, or none at all. Their general appearance, in consequence, is that of a serpent, and indeed with that order they used formerly to be classed. These are the FALSE-FEET (*Pseudopus*) and the GLASS-SNAKE (*Ophisaurus*).

THE FALSE-FOOT or SHELTOPUSIK (*Pseudopus Palassii*)—Plate 1, fig. 3—is a native of Europe, and is about three feet long. Cuvier placed it among the serpents; and as Dumeril and Bibron remark, if we consider only the form of the body, which is exceedingly long, and almost destitute of feet, this animal ought not to take its place amongst Saurian Reptiles. If we attentively observe the ensemble of its organization, however, both internally and externally, it may be said to be only a Buckler-back, or *Gerrhonote*, without feet. The tongue, teeth, nostrils, ears, and scales of the body, constitute it truly Saurian. Externally there is not the slightest appearance of fore-feet, but internally we find them represented by a bony tubercle on each side of the breast-bone. The hinder-feet are in the form of two very short appendages, mere vestiges of legs. It has no distinct neck, and the tail has the same form as the body, but is at least a third longer. In the adult, the upper parts of the body are of a chestnut colour, picked off with black; but in the young animal the neck and back are banded with cross bars of a brown colour on a grey ground. The False-foot is a native of the Crimea, Istria, the Morea, and the southern districts of Siberia. It was first described by the celebrated Pallas, who found it in the sandy desert of Naryn, near the river Volga. The natives of the districts where it abounds, give it the name of *Sheltopusik*. It dwells in preference in the shady valleys where grass grows abundantly, and where it can procure its favourite food, which consists of small lizards and insects. It is timid and harmless, conceals itself amongst the tangled brushwood, and flies when any one approaches it. By the French naturalists engaged in the "Scientific Expedition to the Morea," this reptile was found in the Peloponnesus. Being unknown to them at first, they supposed it to belong to the serpent order, and the first individual which was seen by them, while basking in the vernal sun, after emerging from its winter retreat, was instantly killed with the butt-end of their guns. They were surprised to find it destitute of fangs, and not poisonous. Many other specimens were taken after that, and kept alive in rooms, their quiet inoffensive disposition rendering them easily reconciled to such a degree of captivity. They were fed upon hard-boiled eggs, but, upon one occasion, one of the captives obtained access to a nest of young birds, which it soon swallowed up.

THE GLASS-SNAKE (*Ophisaurus ventralis*) is a native of North America, and is about eighteen inches long, the tail being about three times longer than its body. It is quite destitute of feet, for the body does not even offer the slightest vestiges of the hinder feet seen in the Sheltopusik. With the head of a lizard, it has a body exactly resembling that of a serpent; but still in its organization it is a true Saurian. The upper part is of a greenish-brown colour, regularly and elegantly marked with numerous spots and streaks of yellow. Catesby, in his "Natural History of Carelina," was the first who gave us any account of this singular reptile, and he considered it as a true serpent. "The skin," he says, "is very smooth and shining, and of a different structure from that of other serpents. A small blow with a stick will cause the body to separate, not only at the place struck, but at two or three other places; the muscles being articulated in a singular manner, quite through to the vertebræ. They are generally said to be harmless. They appear earlier in the spring than any other serpent, and are numerous in the sandy woods of Virginia and Carolina." It is a harmless and timid animal, and feeds upon insects, small reptiles, frogs, &c. The extreme brittleness of its tail has long been well known, and this, with its shining appearance, has procured for it its peculiar name. Bartram, in his "Travels in North America," has also described this reptile as he met with it in Carolina. "Stopping again at a natural shrubbery," he says, "on turning my eyes to some flowering shrubs, I observed near my feet the surprising Glass-snake (*Anguis fragilis*). It seems as innocent and harmless as a worm. It is, when full-grown, two and a half feet in length, and three-fourths of an inch in thickness; the abdomen or body part is remarkably short, and it seems to be all tail, which, though long, gradually attenuates to its extremity, yet not small and slender as in Switch-snakes. The colour and texture of the whole animal is exactly like bluish-green glass, which, together with its fragility, almost persuades a stranger that it is in reality that brittle substance; but it is only the tail part that breaks off, which it does like glass, by a very gentle stroke from a slender switch. Though it is quick and nimble in twisting about, yet it cannot run fast from one, but quickly secretes itself at the bottom of the grass, or under leaves. It is a vulgar fable," he adds, "that it is able to repair itself after being broken into several pieces; which pieces, common report says, by a power or faculty in the animal, voluntarily approach each other, join, and heal again."

Following the family of Cordyles (*Zonuridæ*), there succeeds, in the arrangement of Dr. Gray, a series of

* From the two Greek words, *gerron* (γερρον), a buckler, and *nwtos* (νωτος), the back.

or of a rounded form gradually attenuating to the tail, which is of a very elongate conical form, being, at the base, about the same size as the inferior portion of the body, and with difficulty distinguishable from it. · The scales with which the body and limbs are covered, are usually smooth and polished on the surface, so that most of these animals can glide along the ground, and are able easily to insinuate themselves into small holes. Their mode of progression is a creeping sort of motion, the body possessing a sinuous and undulating movement like that of serpents. The species are widely diffused. They occur not only in the most arid districts of temperate regions, and in climates the temperature of which is always high, but extend even to countries where the temperature would apparently not permit the existence of reptiles; the Blind worm (*Anguis fragilis*), for instance, being found as far north as Sweden. They are most abundant, however, in the islands of the Pacific, and in Australia. From the shortness of their jaws they cannot open their mouth wide, and, as their teeth are very slender, they seem able only to catch insects or very small animals.

The family of Scinks may be divided into two groups; first, those which have the scales of the body smooth, not striated nor keeled; and second, those in which the scales are thick, bony, rugose, striated, or one or more keeled.

The genus SCINCUS belongs to the first division—the smooth scales; and as now restricted, contains only one species—

THE OFFICINAL, or COMMON SCINK or the Scink of the shops (*Scincus officinalis*)—Plate 1, figs. 5, 6, and Plate 8, fig. 10—is a small lizard about six or eight inches in length, and is subject to considerable variation in its colouring. Its upper parts are usually yellow, or of a silvery gray, mingled with brown and black in transverse bands; the under parts are generally of a silvery white. It is a native of Syria, Egypt, Nubia, Abyssinia, and Arabia; and is also found in Senegal. It has been frequently mentioned by travellers, and its history is rather curious. Hasselquist in his journey to the Levant met with it. "This animal is found," he says, "in Arabia Petræa, near the Red Sea, and in Upper Egypt on the banks of the Nile. The people of the East employ it as an aphrodisiac; but the Europeans do not care to imitate them. Its flesh is given in the form of powder in some irritating vehicle, and the Arabians even make broth of its flesh." Bruce in his travels through Abyssinia, describes it at some length. "It is a native," he says, "of Atbara beyond the rains, in that situation where we have said the island and city of Meröe formerly were. This lizard is called El-adda. It burrows in the sand, and performs this operation so quickly, that it is out of sight in an instant, and appears rather to have found a hole than to have made one, yet it comes out often in the heat of the day, and basks itself in the sun; and if not very much frightened, will take refuge behind stones, or in the withered ragged roots of the absinthium, dried in the sun to nearly its own colour." "Almost the whole of this large tribe of lizards, is by the Arabians, described as poisonous. The El-adda is one of the few which the Arabs in all times have believed to be free of poisonous qualities, and yet to have all the medicinal virtues that they have so abundantly lavished upon the more noxious species. Though its legs are very long, it does not make use of them to stand upright, but creeps with its belly almost close to the ground. It runs, however, with very great velocity. Its tail is perfectly round, is exceedingly sharp-pointed, and very easily broke. Its jaws have a number of short, fine, but very feeble teeth, and when holding it in my hand, though it struggled violently to get loose, it never attempted to make use of its teeth; indeed, it seems to turn its neck with great difficulty." A later traveller confirms this account of Bruce in several of his minute details. M. A. Lefebure, we are told by Dumeril and Bibron, found the Scink in abundance in the oasis of Bahrieh, living on the little mounds of fine light sand which the south wind accumulates at the foot of the hedges which inclose the cultivated grounds, and around the roots of the tamarisk trees which grow on the confines of the desert. There he saw it quietly basking in the hottest rays of the sun, and occasionally giving chase to beetles and other insects which came near it. It runs with considerable swiftness, and when threatened or frightened it buries itself in the sand with singular rapidity, digging in a few instants a burrow several feet in depth. When caught it struggles to escape, but never attempts to bite or defend itself with its claws. It was for its great reputed medicinal virtues, however, that the Scink was formerly best known.

THE MABOUYAS (*Mabouia*) of the West Indies, are particularly mentioned by Sloane in his "History of Jamaica," as small animals, with a very dark appearance. Hence the name of Mabouya given to them by the natives of North America—that word meaning anything which inspires disgust or horror. They climb upon trees, and the roofs and rafters of the huts of the Indians and negroes. In general they live in the crevices and holes of rotten trees, but during the heat of the day they come out to bask in the rays of the sun. They seem very sensitive to wet, for at the approach of rain they make a great noise and leave their positions. The natives dread them as poisonous, but there is no proof of their being so.

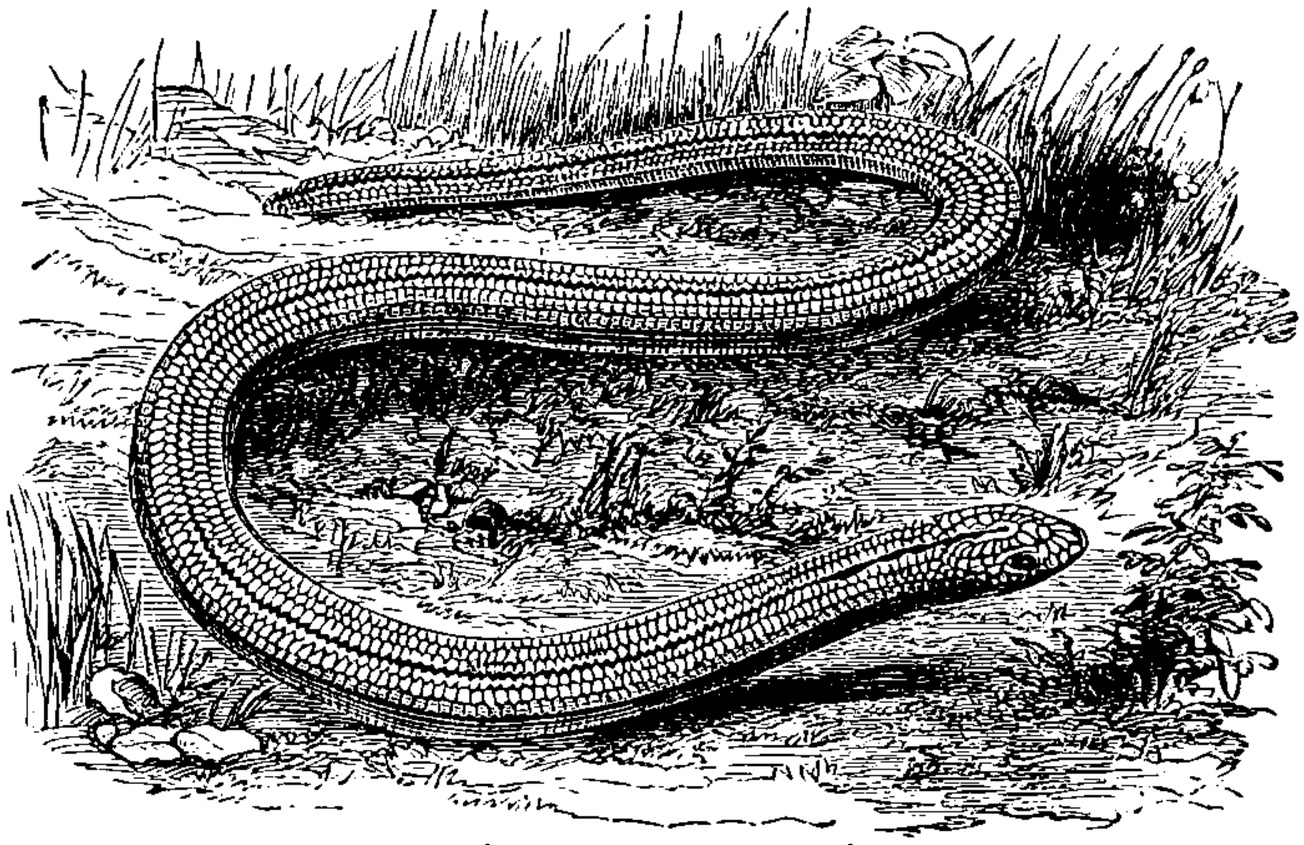
THE NIMBLE MABOUYA (*Mabouia agilis*), one of the species has been well described by Mr. Gosse. "In the parts of Jamaica with which I am familiar," he says, "this pretty, active little Scink is abundant. It is most numerous in the lowlands, and on the gentle sloping hills of moderate elevation that form the characteristic feature of the southern side of that beautiful island. The fences there are largely composed of 'dry wall,' built of rough, unhewn stones, without cement. On these walls the Mabouya may be seen crawling, and often lying quite still in the sunshine; when alarmed, it darts with lightning-like rapidity into one of the crevices which abound in all parts of such a structure. Indeed, it rarely ventures far from some refuge of this kind, and I presume that the facilities for instant retreat afforded by these pervious walls are the chief cause of its preference for them. It is scarcely ever seen on the ground, except when avoiding danger, nor on the trunk or branches of trees or shrubs; but

in the concavity of a pinguin leaf (*Bromelia pinguin*) it is occasionally observed to lie, basking in the sun. The rounded form of the head and body, devoid of projections; the close-lying and glossy scales; the shortness of the legs, bringing the belly flat upon the ground; and its constant habit of resting with the chin on the ground also—give to the Mabouya an aspect very much unlike that of our other common lizards, and cannot fail to remind even the least observant of its affinity with the serpent tribes. The negroes, in the recognition of this proximity doubtless, have bestowed upon it the appellation of 'snake's waiting-boy,' or, more briefly, 'snake's boy.' From the shortness of its legs results also another resemblance to a snake; for owing to the shortness of its steps, if made only with the legs, it throws the shoulder and hip forward at each step; and this throwing out of the sides at different parts alternately, produces a wriggling motion, somewhat serpentine in appearance. They are too wary and too swift to be caught by the hand. A smart tap with a switch, however, across the shoulders, disables them for a while; but if the blow descend on the tail, that organ instantly separates with the like brittleness as in other lizards. Cats not unfrequently catch them. The beautiful provision for protecting the eye, without impeding vision, shown by the lower (and larger) eyelids having a sort of window, a transparent, glassy, circular plate in the centre, immediately opposite the pupil when the eye is closed, is well worthy of admiration as an obvious example of creative wisdom and providential care. Habitually darting to and fro in the narrow crevices of walls and heaps of stones, the eyes of this Scink, if unprotected, might be continually liable to injurious contusions, while, as it feeds on the insects, at least in part, that resort to such situations, undimmed vision would be essential to it while permeating them." The Nimble Mabouya is found to be viviparous. Its total length is about nine inches.

We then come to a series of genera in which the limbs are weak, far apart from each other, and the body and tail much lengthened; the series terminating in the genus ANGUIS, where the limbs cease to be visible, the bones being rudimentary in structure and hidden under the skin.

THE BLIND-WORM, or well-known SLOW-WORM of English authors (*Anguis fragilis*)—fig. 7—is the only recognized species belonging to this genus. Professor Bell has given us a very good account of this little snake-like lizard, in his excellent work on British Reptiles. Its total length is about ten or twelve inches, sometimes even fourteen, the tail being nearly half the length of the body. The general colour is yellowish-brown or yellowish-grey, with a pearly lustre. A dark, or black line, runs down the middle of the back, and generally one or two parallel rows of small dark spots down each side. The under parts are of a bluish-black, with whitish reticulations. It is a native of Great Britain, and is found in almost every part of Europe, excepting the extreme north, and is capable of enduring a much colder climate than most other reptiles, even of our own country. It is plentiful in Russia, Siberia, Poland, Denmark, and Sweden, as well as the more temperate parts of Europe, as far south as Italy. The Slow-worm, in this country, makes its appearance at an earlier season than any other of our scaled reptiles. It frequents warm banks, where, like

Fig. 7.



The Blind-worm (Anguis fragilis).

almost all other Saurians, it delights to bask in the rays of the sun. In autumn, it retires under masses of decayed wood or leaves, or into soft dry soil covered with heath or brushwood. Its general habitation is in holes in the ground, which it bores for itself to a considerable depth, and from which it comes up for the purpose of breathing. The habits of the Slow-worm are exceedingly gentle and inoffensive. Even when handled roughly, it rarely attempts to bite, and when it is irritated so as to induce it to seize upon the finger, the teeth are so small as scarcely to make an impression. From its serpent-like form, it is not at all wonderful that it should obtain the unenviable reputation of being exceedingly venomous. Amongst the uninformed, accordingly, it really does possess this character. "Here," says Mr. Gosse, alluding to this belief amongst our peasantry, "here is Hodge the hedger; perhaps from his occupation he may have some acquaintance with the bit of dingy wire: what say you, Hodge? 'Tis a zneak, dang un!' and he makes a spiteful blow with his stick across the back of the poor animal, with the apologetic asseveration, 'Tis a deadly pizon varmin!' But see, the blow has effectually demolished it, and that in a strange manner; for, as if it had been made of glass, it has snapped across in four or five places; and we at once perceive the propriety of one of its Latin appellations, that of *fragilis*."* This fragile or brittle property, is so remarkable in this little creature, that on being laid hold of or alarmed, it contracts its body so forcibly as to become perfectly stiff, and then it will break in two with the slightest blow or attempt to bend it. The

* Excelsior, vol. vi.

food of the Slow-worm consists of insects, worms, and slugs, the latter of which seems its favourite article of diet. A Slow-worm kept in captivity for some time by Mr. Daniel, was observed to feed chiefly upon the little white slug, so common in fields and gardens. "It invariably took them in one position. Elevating its head slowly above its victim, it would suddenly seize the slug by the middle, in the same way that a ferret or dog will generally seize a rat by the loins. It would then hold it thus, sometimes for more than a minute, when it would pass its prey through its jaws, and swallow the slug head foremost." * This reptile is, like our common Nimble Lizard, ovoviviparous. The young are hatched before they come into the world, and the number produced at one birth varies from seven to twelve or thirteen. They become very active almost immediately after they are born, and soon learn to feed upon small soft insects, and probably small worms, snails, or slugs.

In the second group, or those species which have the scales thick, bony, rugose, and keeled or striated, the legs are generally strong, and the body fusiform. Amongst them are the curious-looking creatures called STUMP-TAILS (*Trachydosaurus*), natives of Australia. In them the body is thick, spindle-shaped, and the back rather flattened on each side. The scales are thick, convex, rugose, imbricate, and those of the under side crenulated round the hinder edge. The tail is short, convex, covered with large convex scales like the back, and rapidly tapering at the end.

THE ROUGH STUMP-TAIL (*T. rugosus*) is of considerable size, and is of a pale brown colour, with broad, rather irregular, yellow cross bands. It is the species here represented—fig. 8.

SNAKE-LIKE LIZARDS.

Immediately following the true Scinks, in Dr. Gray's arrangement, there succeed a series of families of snake-like Lizards, many of which have been, and by some authors are still, arranged amongst the serpents. The feet are often altogether wanting, and the body resembles that of a snake; but the structure of the scales of the head and muzzle, the firm manner in which the bones of the head are united, and the smallness of the mouth, which they cannot open wide like the true Serpents, distinguish them from these reptiles. They evidently, however, form a sort of connecting link between the Lizards and Snakes.

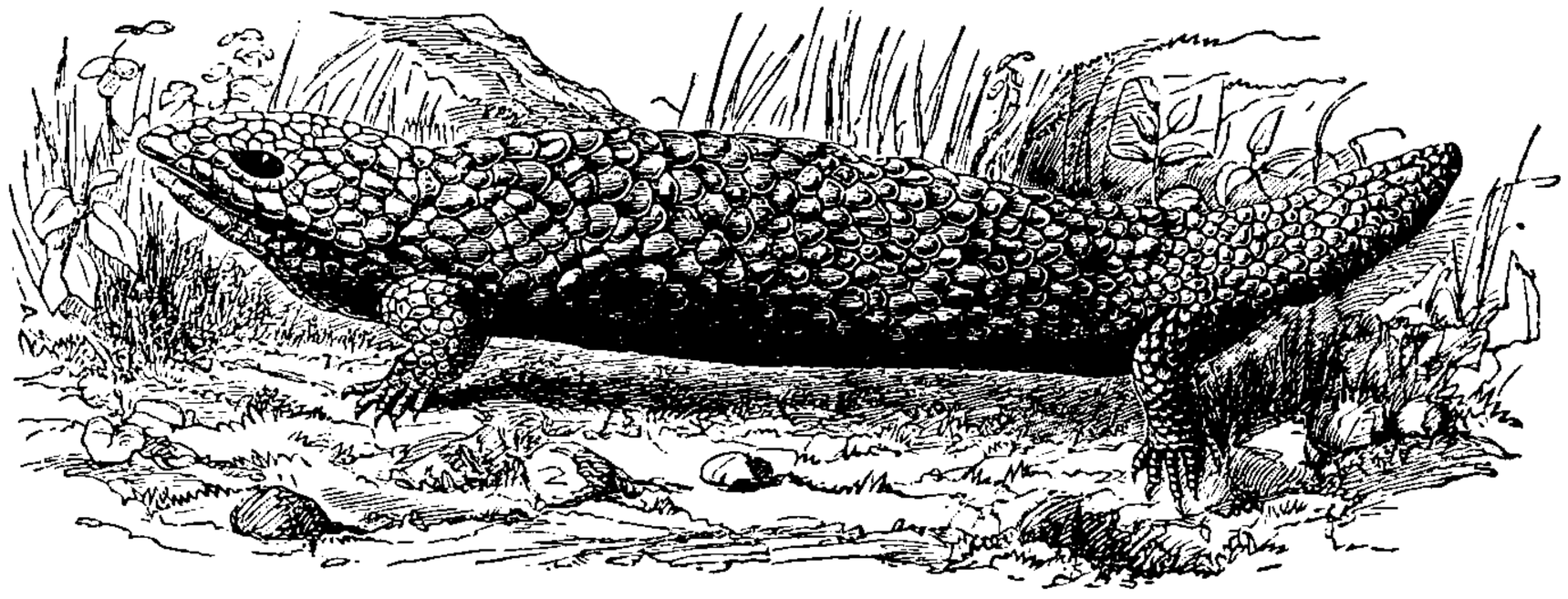
Such are the OPHIOMORES (*Ophiomoridæ*), and a family as yet represented by only one species—

The SEPS family (*Sepsidæ*) † which contains several species, resembling in general form the Slow-worm, except that they possess limbs, though weak, far apart, and more or less rudimentary in structure. The body is cyclindrical and elongate, and covered with round imbricated scales. The tongue is short, thick, and nicked at the tip, and the eyes are distinct, and provided with eyelids.

The genus SPHÆNOPS, belonging to this latter family, has a wedge-shaped head, and its elongate body is angular below.

THE BRIDLED SPHÆNOPS (*S. capistratus*), the only species known, is about the size of a small slow-worm, of a pale brown colour, with several series of black dots arranged longitudinally along the body, and a black streak on each side of the muzzle. It is a native of Egypt, over which it is widely dispersed. M. A. Lefebure found it very abundantly in the oasis of

Fig. 8.



Rough Stump-tail (Trachydosaurus rugosus).

Bahrieh, on the little ridges of the rice-fields, at the foot of the hedges which border the habitations, or on the edge of the wheel-ruts in the miry roads in the valleys. According to him it burrows, but very superficially, in the soil, the least sinking of it produced by the feet of the passer-by discovering its retreat. Its motions are very active, but it allows itself to be taken very easily, without its ever trying to defend itself. But one of the most curious parts of its history is, that it has been found, like the Crocodile, as a mummy in Egypt. M. Lefebure found it embalmed and placed in a small coffin of sycamore wood, ornamented with some degree of taste, in the neighbourhood of Thebes. It seemed to have been embalmed with considerable care, and it is the only reptile, with the exception of the Crocodile, that has been found as a mummy in Egypt.

The genus SEPS, which gives its name to the family, has a pyramidal-shaped head, and a conical simple muzzle. The body is cylindrical, elongate, and the

* Bennet's Edition of White's Selborne.

† Seps—a name anciently applied to one of the species by Ælian and Pliny—derived from the Greek word, *sepo* (σηπω), to putrefy.

sides rounded. The legs are weak and placed far apart, and the feet have three toes which are unequal, and furnished at their extremities with claws.

THE CICIGNA, or THREE-TOED SEPS (*Seps tridactylus*), represented in Plate 1, fig. 7, is a snake-like lizard, about a foot long, the tail being conical, pointed, and not quite so long as the body. It has weak small legs; they are four in number, two placed very near the head, and two far back near the commencement of the tail. They are about two lines long in individuals twelve inches in length. The animal appears scarcely to be able to touch the ground with them; and yet, notwithstanding their apparent inutility, it moves them with considerable quickness, and seems to derive much advantage from them when it walks. The general colour of the body is a steel-grey above, with four longitudinal brown rays, two on each side of the back, and whitish-grey beneath. It is a native of the south of France, Italy, Spain, all the islands of the Archipelago, and the shores of Africa bordering the Mediterranean. It lives in holes which it digs in the ground, concealing itself in them in winter, and coming forth in spring to take up its abode in grassy spots and near marshes. In such situations it spends the summer, feeding upon spiders, small snails, and insects. The ancients regarded this poor little reptile as highly venomous, but Sauvages has demonstrated the erroneous nature of this belief, and Cetti, in his "Natural History of Sardinia," says that throughout that country he had never heard of its bite being attended with any bad consequences, and that by the natives it is considered perfectly harmless. He asserts, however, that when cattle, and especially horses, have swallowed them in the grass they have been eating, their belly swells up, and they are in danger of dying, unless they have administered to them a draught composed of oil, vinegar, and sulphur. Like the slow-worm, the Cicigna appears to produce its young alive and fully formed.

The family of ACONTIAS (*Acontiidæ*)* contains only three species, which are either entirely destitute of limbs, or have them extremely rudimentary. They were formerly arranged amongst the true serpents, but Cuvier separated them from the Ophidians, and later Naturalists have shown their true position to be amongst the thick-tongued Saurians. Their body is cylindrical and elongate, like that of the Slow-worm, but the tail is short, being only about the fifth or sixth part the length of the body. They have a conical-shaped head, with the muzzle inclosed as it were in a cap-shaped shield. Their eyes are very small, and they have only one eyelid, the lower one. The ears are hidden under the skin, and the tongue is scaly and nicked at the end.

THE SPOTTED ACONTIAS (*Acontias meleagris*) is a native of South Africa, in the neighbourhood of the Cape of Good Hope, where it is very common. The body is of a brown colour, and the centre of each scale is marked with a chestnut spot. It has no visible external limbs, and the tail is cylindrical, short, and rounded at the end. The eyes are very small, and the only eyelid it has (the lower one) is short, scaly, and opaque.

The family of BLIND LIZARDS (*Typhlopsidæ*† is more frequently arranged amongst the serpents, but various characters have decided later naturalists to place the different species which compose it amongst the Saurian reptiles. The body is covered with small imbricated scales, like those of the Slow-worm, but the head is depressed, broad, rounded in front, with a large oblong, erect plate on the muzzle. The mouth is small, and they have teeth only in one jaw, sometimes the lower, at others the upper. The tongue is rather long, flat, and forked at the tip, and the eyes are either wanting or only visible through the scales which cover them. One lung is four times the size of the other. The body is slender, cylindrical, sometimes rather larger behind, and the tail is cylindrical, suddenly contracted, obliquely convex, and scaly at the extremity, and the tip is covered with a conical or spinose shield. As Cuvier—who places them amongst the Ophidia—observes, these animals are "little serpents which on, a careless glance, resemble earthworms." They live in moist places, or under stones, and like earth-worms burrow under the soil and form little subterranean galleries, sometimes three or four feet deep. They are natives of the warmer portions of the globe, move with considerable celerity, and are quite innocent, not appearing even inclined to bite. Dr. Gray observes, that the diameter of the body of these reptiles, after a certain age, appears to increase during growth much more rapidly than the length.

The CLAW-HEADED SNAKES (*Onychophis*)‡ are natives of Africa and India, and have short round tails. Two or three species are described by Sir Andrew Smith as natives of South Africa.

LALAND'S CLAW-HEADED SNAKE (*O. Delalandii*) is found at the Cape of Good Hope, and is pretty widely distributed over the southern parts of Africa. "It is generally found under large stones and trunks of decayed trees, or in soil broken up by the plough, or otherwise displaced by the spade or pick-axe, as often happens in digging up shrubs and dwarf trees for the purpose of clearing ground for cultivation. When it is exposed to view, it endeavours to conceal itself under whatever is nearest to it, and if unsuccessful, it rolls itself into a mass, and remains quiet unless seized, when it immediately endeavours to escape." Another species is found in Western Africa at Cape Coast. Mrs. Lee (formerly Mrs. Bowdich) relates an amusing anecdote of an individual of this species, at the capture of which she appears to have been present. "A report was spread," she says "that the large tank on which the inhabitants of the castle solely depended for the supply of water was infested by an enormous serpent; and not only was the idea of drinking the water repugnant, but many declared the water would be poisoned. The governor determined to have the tank examined, although he was told that the serpent was so fierce it would kill any one who would dare to approach it; that it was some great *fetish* (false god); and that no one

* From the Greek word *akontias* (ακοντιας), a javelin—the name given by the Greeks to a serpent.

† From the Greek word *typhlops* (τυφλωψ), blind.

‡ From the Greek words *onux* (ονυξ), a claw, and *ophis* (οφις), a snake.

would venture to approach the tank any more. It was impossible to convince those who believed this, by any reasonable means; so, sending for his head-cook named Yahndee, who was a celebrated snake-killer, the governor offered him a handsome reward if he would capture the animal. Yahndee shook his head, and muttered something about the fetish, upon which the governor offered him a present for the fetish. This altered the case; and the priests and their deity propitiated, Yahndee opened the tank, and the enormous serpent turned out to be about a foot and a half long, and he was going to seize it by the head, when he suddenly recoiled with horror, and declared he could not touch it. On being questioned, he said it had two heads, and thus was not only doubly poisonous, but if he seized it near one head the other would turn up and bite him. A glass of rum on the spot, and more promised when the feat was performed, reanimated Yahndee's courage; he wrapped a cloth round his naked arm, and brought the reputed monster out in triumph. A closer examination proved that, instead of two heads, there was, in common parlance, no head at all; both extremities being alike, with the exception of a small orifice, and a closing valve at one of the ends. It was never dissected, but was put into spirits, and was presented by Mr. Bowdich to the British Museum." This species is still in the collection, and has been described as Bowdich's claw-headed snake (*O. punctata*).

SUB-ORDER II.—THICK-TONGUED LIZARDS.

The Thick-tongued Lizards are divided into three tribes—the Nocturnal Lizards, (*Nyctisaura*); the Cone-tailed Lizards (*Strobilosaura*); and the Tree Lizards (*Dendrosaura*); so named from their habits in life, and the structure of the scales of the tail.

TRIBE I.—NYCTISAURA.*

In the first tribe, or Nocturnal Lizards, the eyes have circular eyelids, which cannot close and open; the pupil is narrow and vertical, and contracts in a strong light. The scales of the belly are small, of a rhombic form, and imbricated; the head is without plates, and naked, or covered merely with granules. The feet are formed for walking on the ground, or on flat substances.

FAMILY—GECKOTIDÆ.

There is only one family in this tribe, the GECKOS (*Geckotidæ*), the species of which are natives of both the Old and New Worlds. The Geckos never attain a large size. They have in general a large flat head, a narrow neck, and a depressed, squat body, which is sometimes fringed on the sides. Their legs are short, stout, wide apart, and the toes are all nearly of equal length. These are generally broad, flattened beneath, and furnished with scales or plates laid one over the other, like the tiles of a house. The skin is apparently naked on the upper parts of the body, being only roughened with granules, giving it a shagreened look. The tail is scarcely as long as the body, and is generally covered with small granular scales like those of the body. It is very brittle, is easily broken off, and when reproduced, has the scales small, square, uniform, and placed in a cross series, which give it a different appearance from the normal state, and must be taken into account in describing the species. The tongue is short, broad, fleshy, and not extensile, but is free at its extremity, which is rounded and slightly nicked. Their teeth are very small, close set one against the other, and form a row quite round the jaw. Their mouth is large; and as the under jaw is articulated behind the cranium like the crocodiles, it permits a wide separation of the jaws, which the animals have the power of keeping open for a length of time. In consequence of this structure, also, they possess the faculty of closing the entrance to the back part of the throat, by applying the base of the tongue to a hollow formed on the posterior part of the palate, while the jaws remain widely separate, and the mouth broadly gaping. The inside of their capacious gullet is strongly coloured; sometimes with bright orange or yellow, and at others with a rich black. Their eyes are large, and of a green colour; and the eyelids being very short and united into one, only leaving a broad opening through which we see moving a nictitating membrane, gives them a peculiar appearance. These peculiarities of structure are admirably adapted to their manners and habits of living. They are nocturnal animals, and thus their eyes are constructed so as to enable them to discern with facility objects in the obscurity of the night. The pupil enjoys a degree of mobility, similar to that possessed by nocturnal birds of prey, and other animals which seek their food at night. They can dilate it to a considerable extent when they require to collect the rays of light, and are able to contract it to the dimensions of only a narrow slit, when the eyes are likely to be injured by two bright a glare.

Their food consists of insects, caterpillars, &c., and these they procure by entrapping them, or pursuing them into obscure holes and cavities. The construction of their feet enables them to do this effectually. The imbricated plates with which they are furnished on the under surface, act like suckers, and enable these animals to adhere firmly to the surface of even the smoothest bodies, permitting them to run with the greatest celerity in all directions, to traverse ceilings, or suspend themselves on the under side of a leaf, while they watch the movements of their prey. Their toes, armed with hooked claws which are sharp and retractile like those of a cat, give them the power of climbing trees with perfect facility, of penetrating the cavities and clefts of rocks, and of ascending steep

* From the two Greek words, *nyx* (νυξ), night, and *saura* (σαυρα), a lizard.

walls for the purpose of finding chinks or hollows in which to conceal themselves during the day, and in which they will remain motionless for hours, affixed by their feet with the back downwards. Their flattened body, which is flexible in every direction, when insinuated into small crevices moulds itself as it were to them; and the variable colours of the skin enable them to harmonize with the dull tints of the objects with which the body is in contact. The usual colour of the skin of the Geckos is of a gray or dull yellowish hue. In a few species, however, bright patterns ornament some portions of the body, and according to some observers, the various tints of blue, red, and yellow which are shown, appear and disappear at the creature's will. Wagler states on the authority of some travellers, that certain species occur in India, which become luminous or phosphorescent in the dark. The varying colours of the skin thus enable them to conceal their presence from the animals which they prey upon, as well as from the little birds of prey and other enemies which seek to destroy them.

The Geckos, for the most part, are inhabitants of hot climates, and in almost all the countries where they live are objects of horror and repugnance. Nevertheless, they seem to have a preference for the dwellings of man, and love particularly to take up their abode in inhabited houses—probably from the fact that they are there enabled to find a greater number of insects which are themselves attracted by the substances used as food by the families living in them. Their repulsive appearance causes them often to fall victims to the fear they produce, for popular prejudices endow them with many hurtful properties.

The species of Geckos are numerous, upwards of ninety being described by Dr. Gray in his Catalogue. Some, as we have said above, are so far domestic as to live in houses; others are wilder, and live in sandy desert places; whilst a third set live in a great measure on trees, and chase their prey by springing from branch to branch. The name of Gecko is derived from the peculiar noise they make, which is like the sort of sound by which horses are urged to greater speed, and which the natives of different countries have tried to imitate or express by the names of *Gecko*, in Europe; *Tokaie*, in Siam; and *Geitze*, in South Africa.

The species may be divided into two large groups: first, those which have the toes dilated, and possess under the dilated part two rows of membranaceous plates; and second, those which have the toes more or less dilated, but which possess only a single series of transverse plates beneath.

Amongst the species of the first group, we may mention two or three which have the transverse scales under the toes divided by a longitudinal furrow, which is deep enough to permit the claws to be withdrawn as into a sheath, and which are called *Sheath-claws*, or Thecadactyles.

THE TURNIP-TAILED GECKO (*Thecadactylus rapicauda*), one of these, is remarkable for the shape of its tail. On being caught, in its exertions to escape it often parts with its tail, which is round and tapering, but which when reproduced assumes an almost globular shape. Even when thrown alive into spirits it does the same, and the tail then contracts and becomes rounded in form. As it is usually found in this state in collections, it has in consequence received its specific name of Turnip-tail.

THE HOUSE GECKO, or FAN FOOT (*Ptyodactylus Gecko*), another species, which abounds in Egypt. It is found also in Arabia, Syria, and Barbary, whence it has spread to the southern countries of Europe. It frequents the humid and gloomy parts of houses, and there may often be heard croaking somewhat like a frog. Hasselquist tells us that it is very common in Cairo, and asserts it to be poisonous. Its claws are very sharp, and he says "that he had occasion to convince himself of the acrimony of its venom, as it ran over the hand of a man who wished to catch it. His hand was instantly covered with red pustules, and became inflamed as if it were stung by a nettle. At Cairo it has received the name of *Abou-burs* (Father of leprosy), from the belief the natives have that its poison produces this disease. Cats, we are told, pursue the Gecko, and feed upon it; and the natives keep their kitchens free from its visits by keeping in them a large quantity of garlic. Its eggs are spherical, with a hard calcareous shell, and about the size of a small nut.

THE FAMOCANTRATA, or FRINGED GECKO (*Uroplates fimbriatus*), is a third species of the *Sheath-claws*, and few reptiles are more remarkable for singularity of form. It partakes somewhat of the appearance of the chameleon, the gecko, and the salamander. In its head and skin it resembles the former, and in its tail that of the latter. Its head is very flat, and of an elongate triangular shape; the eyes are extremely large and prominent, and its throat of immense extent. Its tail is broad and flat, like that of the beaver, and much shorter than the body. It is covered with a membrane which extends on each side, and gives it somewhat the form of the blade of an oar. The toes are united for half their extent by a broad membrane, which is covered underneath with small square scales or plates, and are only dilated at their tips. The body is flat and elongate, and is remarkable for having a prolongation of the skin, in form of a slashed membrane, extending like a frill along its sides the whole length from the muzzle to the tip of the tail, including the legs. In colour it varies like the chameleon, presenting successively the various shades of red, yellow, green, or blue. This curious animal is found in Madagascar, and is the lizard mentioned by Flacourt in his history of that island in 1658. This author informs us that the natives regard it with a kind of horror. As soon as they see it they turn away, cover their eyes, and even fly from it with great haste. He says, moreover, that it is a very dangerous animal; that it darts upon the negroes, and that it attaches itself so strongly to their chest, by means of its fringed membrane and sharp claws, that it can only be removed by the use of a razor! This statement, however, is contradicted by a later observer, M. Bruguiéres, who says they are perfectly harmless, that he has often taken them in his hand, and that he has allowed them to squeeze his fingers between their jaws

without any bad effects having followed. He believes that the fear with which they inspire the negroes, is caused by their not flying from them when encountered; but, on the contrary, boldly walking up to them with their mouth wide open, in spite of any attempt they make to frighten them away. The Famocantrata lives generally upon trees like the chameleon, retiring into holes during the day, and leaving them only at night. Upon the approach of rain it may be seen leaping from branch to branch with great agility. If it falls to the ground, however, it is unable to leap up again, but it crawls to the nearest tree, creeping up the smoothest bark, and then recommencing leaping from one branch to another. It walks with difficulty on the ground, like the chameleon, and what appears to add to its awkward gait is, that its fore-feet are much shorter than its hind ones, and its head forms, underneath, such an angle with the body, that at every step it takes it strikes its nose against the ground. Its food consists exclusively of insects, and it may generally be seen moving about with its throat wide open, ready to catch them.

In this first group we have also several genera, the species of which are distinguished by having their toes dilated only at their base, the two last joints being free, compressed, and clawed. These are the *Half-toes*, or Hemidactyles.

THE WARTY GECKO (*Hemidactylus verruculatus*), one of these, is one of the few Geckos found in Europe. It is a native of all the countries bordering upon the Mediterranean, and is found in Northern Africa, in the neighbourhood of Trebizond, in Greece, Sicily, Italy, Spain, and the south of France; and, according to M. Bibron, it would appear to be even found in Senegal and in Chili. It is of a grayish colour, marbled with brown.

THE MABOUYA OF THE WALLS (*Hemidactylus Mabouia*), another Hemidactyle, is extremely common in the West Indies and Brazil, living in houses, and where it receives this name, to distinguish it from the Turnip-tailed Gecko, which the negroes call the Mabouya of the Bananas. It is of a fawn colour on the body, with a number of five-sided brown spots across the back. Little is known of the particular habits of these two animals.

In the second group, those which have only a single series of transverse plates underneath the toes, we find a number of genera, the species of which have the toes dilated throughout their whole length, and the plates beneath the toes membranaceous and smooth. These are the *Flat-toes*, or Platydactyles.

THE TRUE GECKO (*Gecko verus*), one of these, is of a thicker and stouter form than most others of the family, having a large and somewhat triangular flattish head, a wide mouth, large eyes, and a broad flat tongue. The back is covered with numerous, distant, round warts, or tubercles, and is of a reddish-gray colour, spotted with white. It is a native of India, being found both on the continent and throughout the islands of the Indian archipelago.

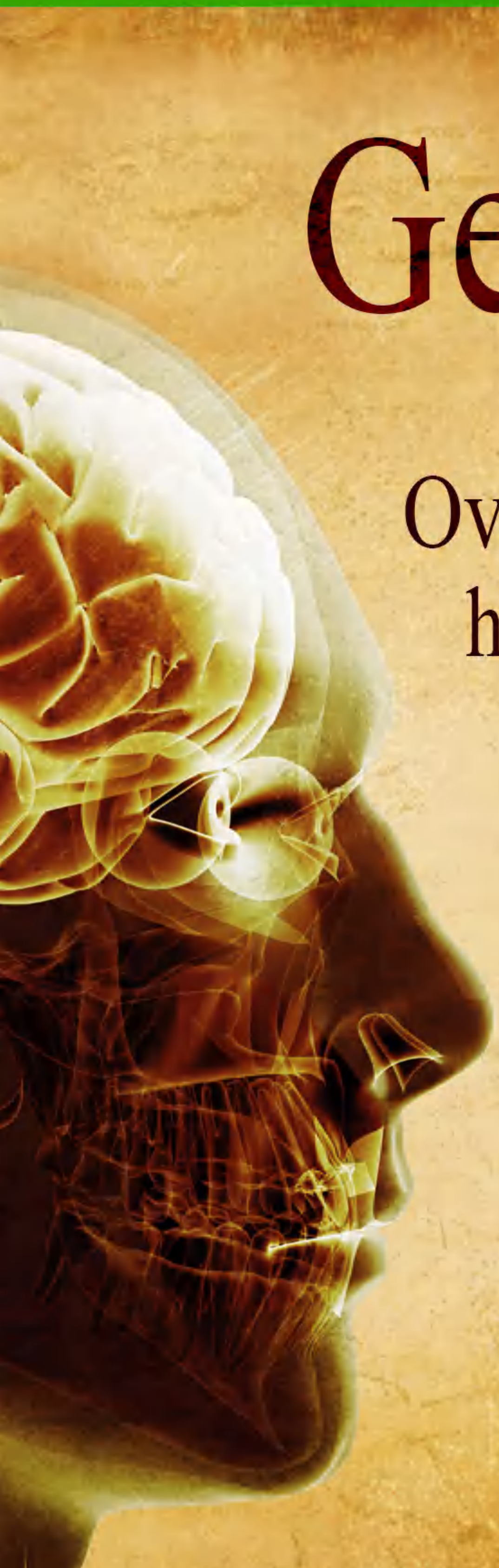
THE FRINGED TREE-GECKO (*Ptychozoon homalocephala*) is one of the most remarkable species of this group. The sides of the head, the lateral parts of its body, the front and back parts of its feet, and the sides of its tail, are fringed with membranes which are quite entire along the flanks, but scalloped along the edges of the tail. These membranes on the temples give the head the appearance of being more than a third larger than the skull. On their external margin they are very thin, but where they approach the body of the animal, they assume a greater thickness, owing to solid bundles of muscular fibres. The eyes are large, and the toes are united to each other throughout their whole length by a web or broad membrane. The body on the upper parts is of a brown colour, marked with several black lines *en chevron;* a dark-brown streak runs along the head from the back of the eye along the neck, terminating on the shoulder; and the membranes of the head and flanks are white. This curious Gecko is found in Java. It appears to live on trees, and makes use of the expanded membranes with which its body is furnished as parachutes, to assist its movements from one branch to another.

The genus TARENTOLA (*Platydactylus*) contains several well-known species.

THE WALL GECKO (*Tarentola Mauritanica*), is one of the most common. It is said to be a most hideous reptile, concealing itself in holes of walls and heaps of stones, and covering its body with dust and ordure. It is a native of temperate climates, being found all round the Mediterranean Sea, even as far as Provence and Languedoc, where it is very common, and is called there *Tarente*. The Wall Gecko likes warmth, and avoiding low and damp situations, takes up its abode under the roofs of ruined houses and old habitations of all kinds, in which kind of places it spends the winter, but without becoming perfectly torpid. At the first approach of spring, it leaves its hiding place, and betakes itself to some warm spot to bask in the rays of the sun; but it does not go far from its retreat, returning there upon the least noise, or on the approach of rain. Its food consists of insects chiefly, and to find these it can run quickly up walls or along the ceilings of rooms back downwards. Like most repulsive looking animals, the Wall Gecko has the credit with the vulgar of being venomous. This, however, is a mistaken notion, as they are perfectly harmless. Lacépède, on the authority of M. Olivier, says that this species, unlike the generality of the family, utters no cry; and that M. Olivier has frequently taken hold of them with a pair of pincers without being able to elicit from them any sound.

THE EGYPTIAN GECKO (*Tarentola Egyptiaca*), represented in Plate 2, fig. 1, very nearly resembles the Wall Gecko, differing only in a few particulars, and being a little larger. Geoffroy says that full-grown individuals measure five feet in length from the muzzle to the extremity of the tail. It seems peculiar to Egypt, and its habits are nearly the same as those of the last. Two or three species of this same genus are found in South Africa.

BIBRON'S TARENTOLE (*Tarentola Bibronii*), and the **CAPE TARENTOLE** (*T. Capensis*), are described by Sir A. Smith, as being found in the interior, though not very abundantly. They occur chiefly in rocky precipitous places, and in outhouses badly lighted.



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caught. As long as the whistling continued it was very quiet, but when the sound ceased it became very savage, and bit at everything within its reach; its green colour became blackish, and at last changed to a bluish-black, with darker bands upon the body, brownish-black upon the tail, and the only trace left of its original colour was about the eyes. It fiercely seized a piece of linen, and would not let it go for hours. When put into a cage it darted wildly about, and tried to bite everything it could lay hold of. At night it became green, and the changes were very rapid. After four weeks' confinement it changed its skin, and died in the operation. In former days, when those substances known under the name of Bezoars were famed for their wonderful virtues in curing diseases, that found in the stomach of the Iguana was highly prized in America. In the present day, these concretions are fallen into the most complete disrepute.

THE RHINOCEROS GUANA (*Iguana rhinolophus*) is distinguished from the preceding species by having on the muzzle two short horns, with five or six tubercular scales surrounding them, and being furnished with fewer scales forming the dorsal crest. This species is a native of the West Indies, and attains the length of five, and sometimes even of six feet, the tail being about one-half or three-quarters the length of the body. The general colour is a bright green in the young, and a dirty gray in the old individuals, with about six black streaks across the body, and fifteen across the tail.

The genus CYCLURA has been separated from *Iguana*, from its having no dewlap or true throat pouch, but only a lax fold of skin plaited across, and the tail being covered with scales forming rings, alternating with rings of spines. The habits of the Cyclures are very similar to those of the true Guanas.

THE CLOUDED CYCLURE, or GUANA OF CAROLINA (*Cyclura nubila*), has been described at some length by Catesby in his "Natural History of Carolina." "This kind of lizard," he says, "somewhat resembles the crocodile or alligator in shape, but has a shorter head, and a serrated crest on the ridge of the back, extending from behind its head to the middle of the tail. They are of various sizes, from two to five feet in length; their mouths are furnished with exceeding small teeth, but their jaws are armed with a bony beak, with which they bite with great strength. They inhabit warm countries only, and are rarely to be met with anywhere north or south of the *Tropics*. Many of the Bahama Islands abound with them; they nestle in hollow rocks and trees; their eggs have not a hard shell like the eggs of alligators, but a skin only, like those of turtle, and are esteemed good food; they lay a great number of them at a time in the earth, which are there hatched by the sun's heat. These *Guanas* are a great part of the subsistence of the inhabitants of the Bahama Islands, for which purpose they visit many of the remote *Kays* and islands in their sloops to catch them, which they do by dogs trained up for that purpose, which are so dexterous as not often to kill them, which, if they do, they serve only for present spending; if otherwise, they sew up their mouths to prevent their biting, and put them into the hold of their sloop till they have catched a sufficient number, which they either carry alive for sale to *Carolina*, or salt and barrel up for the use of their families at home. These *Guanas* feed wholly on vegetables and fruit, particularly on a kind of Fungus growing at the roots of trees, and of this and others of the Anona kind. Their flesh is easy of digestion, delicate, and well tasted; they are sometimes roasted, but the more common way is to boil them, taking out the leaves of fat, which they melt and clarify; this they put into a calabash or dish, into which they dip the flesh of the *Guana* as they eat it. It is remarkable that the fat which adheres to the inside of the *abdomen*, imbibes the colour of the fruit they eat last, which I have frequently seen tinged with pale red, yellow, and sometimes of a purple colour, which last was from eating the *Prunus maritima*, which fruit at the same time I took out of them. Though they are not amphibious, they are said to keep under water above an hour. When they swim, they use not their feet, but clap them close to their body, and guide themselves with their tails. They swallow all they eat whole. They cannot run fast; their holes being a greater security to them than their heels. They are so impatient of cold that they rarely appear out of their holes but when the sun shines."

THE SHOULDER-CRESTED CYCLURA (*Cyclura lophoma*), a species found in the island of Jamaica, has a very interesting account given of it by Mr. Gosse in the Proceedings of the Zoological Society for 1848. This animal is about three feet long, the tail alone measuring twenty-one inches. It is of a russet-green colour, with obscure, confluent, dark olive-brown spots, and its crest is high along the upper part of the back, and continued over the shoulders, but interrupted over the loins. The skin of the throat is loose and transversely wrinkled, is of considerable size, and can be distended by the animal at will. This Cyclure appears to be found only in particular parts of the island. Mr. Hill, in a communication addressed to Mr. Gosse, says that its ordinary haunt is a low limestone chain of hills along the shore from Kingston harbour and Goat Island, or to its continuation in Vere. Succulent herbs, growing in the forests of these hills, supply its food. These hills, however, he says, are so little suited for this sort of vegetation, that hardly anything more than aromatic and resinous trees and balsamic plants grow there. In the occasional hollows a little mould has been collected from decayed leaves, mingled with marl, extremely stony and sterile, and there a little more succulent herbage prevails. The rocks have numerous caverns; and the springs that break out at the foot of the cliffs are an impure brackish water, though extremely transparent. It is this district that is almost exclusively the haunt of this creature. When excited, it assumes a menacing attitude, and directs its eye to the object of attack with a peculiar sinister look. "At this time," says Mr. Hill, "it inflates its throat, erects the crest and dentelations on the back, and opens the mouth so as to show the line of its peculiarly-set white teeth, with serrated edges," so well adapted for cutting and cropping its vegetable food. "In defending itself from attack, the Cyclure converts its long flexible tail into

no unimportant weapon. The dentelated upper edge, drawn rapidly over the body and limbs of an enemy, cuts like a saw. The twisted attitude which it assumes when approached, is converted into a quick turn, in which movement the tail is nimbly struck by an overblow from one side to another, and then jerked round." The negroes informed Mr. Hill, that dogs in attacking these reptiles frequently received desperate punishment, from the gashes and lacerations that were made in the thick muscles of their legs by the rapid flinging round of the animal in defending itself. The sudden jerk with which it threw back its tail was said by them to be sufficient to rasp the very flesh off the bone.

The Galapagos Islands abound in two species of lizards of the Iguana family, which appear to be exclusively confined to that archipelago, and have been described at considerable length by Mr. Darwin in his "Journal of a Naturalist" during the voyage of the *Adventure* and *Beagle*. One is aquatic in its habits, the other terrestrial.

THE CRESTED AMBLYRHYNCHUS (*Amblyrhynchus* or *Oreocephalus cristatus*), the aquatic species, is extremely common on all the islands throughout the group, living exclusively on the rocky sea-beaches, and never being found ten yards in-shore. It is a hideous-looking creature, of a dirty black colour, stupid and sluggish in its movements, and growing to the length of three and even four feet. When in the water, to which it often takes, being sometimes seen several hundred yards from the shore, it swims with perfect ease and quickness by a serpentine movement of its body and flattened tail, the legs being motionless and closely collapsed on its sides. The creature seems very tenacious of life. A seaman on board, says Mr. Darwin, "sank one with a heavy weight attached to it, thinking thus to kill it directly; but when, an hour afterwards, he drew up the line, the lizard was quite active." The food of this animal consists exclusively of sea-weed. It does not appear to have any notion of biting; but when much frightened, it squirts a drop of fluid from each nostril. It is mentioned as a curious fact in this creature's habits, by Mr. Darwin, that though it is decidedly aquatic, yet when frightened, it cannot be made to enter the water. If driven down to a point overhanging the sea, it will rather allow itself to be laid hold of than take to the water; and if taken up and thrown into the sea, it will immediately return in a direct line to the shore, crawl up the rocks, and shuffle away as fast as possible. "Perhaps," says this observer, "this singular piece of apparent stupidity may be accounted for by the circumstance, that this reptile has no enemy whatever on shore, whereas at sea it must often fall a prey to the numerous sharks. Hence probably, urged by a fixed and hereditary instinct that the shore is its place of safety, whatever the emergency may be, it there takes refuge."

THE SUB-CRESTED AMBLYRHYNCHUS (*Amblyrhynchus* or *Trachycephalus subcristatus*), the terrestrial species, is confined to the central parts of the archipelago, and is a little smaller than its aquatic brother. As described by Mr. Darwin, these lizards are ugly animals, of a yellowish-orange colour beneath and of a brownish-red above, and have a peculiarly stupid look. They are exceedingly numerous, and live in burrows which they excavate for themselves in the dry soil. Mr. Darwin tells us in an amusing manner that he watched one of them forming its burrow, and looked on till half its body was buried. "I then walked up and pulled it by the tail; at this it was greatly astonished, and soon shuffled up to see what was the matter, and then stared me in the face, as much as to say—"What made you pull my tail?" They are perfectly harmless, but are not timorous. When encountered by any one, they curl their tails, and raising themselves on their front legs, nod their heads vertically with a quick movement, and try to look very fierce. If the observer, however, only stamp his foot on the ground, down go their tails, and off they shuffle as quick as they can. When cooked, these animals yield a white meat, which by many people is much relished. This species is herbivorous also, and is very fond of the cacti which grow on these islands.

Under the once dreaded name of "BASILISK," we have another species belonging to the group of perching Iguanas. The Basilisk of the ancients and of romantic fable was an animal generally referred to the serpents, but usually represented with eight feet and a crown upon its head. It was said to infest the deserts of Africa, and that no other animal dared to dwell in its neighbourhood, of which it retained the sole and undisputed dominion. It was said also to possess the power of striking its victim dead by a single glance. Lucan, in his celebrated poem of Pharsalia, thus mentions it—

> "But fiercely hissing through the poisoned air,
> The basilisk exerts his deathful glare;
> At distance bids each vulgar pest remain,
> And reigns sole monarch of his desert plain."

Seha in his great work, "Le tresor de la Nature," figures a species of lizard, with its head surmounted by projecting lines, and its back furnished with a broad vertical crest extending over the tail. This creature he calls the Basilisk or dragon of America, and speaks of it as a flying amphibious animal. The reptile from which his figure and description were taken, formed part of the collection ceded by Holland to France, and is now in that of the Museum of Natural History in the Garden of Plants at Paris. Of this species Laurenti formed the genus BASILISCUS, which has been adopted by all succeeding writers on Reptiles, and is readily distinguished from its congeners.

THE HOODED OR MITRED BASILISK (*Basiliscus mitratus* or *Americanus*) is the only species. The head of this animal is of an elongate shape, produced backwards, and furnished with a compressed, vertical, triangular crest of skin. The throat has a small pouch and a well marked cross fold of skin. The back and tail are furnished with a high compressed crest, which is much more distinct in the males than in the females, and is supported by bony rays. The tail is long and compressed, and the outer hinder toes are webbed at their base. When full grown, the Basilisk measures upwards of two feet in length, of which the tail usurps more than the half. Its colour is of a yellowish-brown, passing into whitish on the under parts; and a longitudinal stripe of white,

edged with black, extends from each eye to the sides of the back, and then blends with the general tint. Not much is known of the habits of this animal; but we do know that, notwithstanding its formidable name and aspect, it is very harmless, and that it chiefly lives upon grain and vegetables. Though its life is for the most part spent on trees, like the other species of this group, it often takes to the water like the Guana, for which purpose its compressed tail and partially webbed toes admirably adapt it. It is a native of Guiana, Martinique, and Vera Cruz.

The last of the perchers we shall mention are the ANOLIS. The genus *Anolius* of former authors contained numerous species, some of which are very rare in collections. Distinctions which used to be considered only specific, have of late been thought of sufficient importance to establish generic divisions; and these genera are now numerous enough to form a small subfamily *Anoliina*. The members of this little group are characterized by their having the toes dilated under the last joint but one into a rather broad plate, which is covered underneath with small transverse scales, like the Geckos, and which assist them in climbing trees. Their throat pouch is distinct, of considerable size, and largely dilatable. The back, in many of the species, is furnished with a crest, which is prolonged to the extremity of the tail. In others it is simple, or only furnished with a slight crest of small scales. The tail is long, swollen at intervals, and crested.

The ANOLIS are animals which live chiefly upon trees and shrubs, and feed upon insects, fruits, and berries. Their skin is generally of a green hue; and, like the chameleons, they have the power of changing their colours quickly. They are lively creatures, run quickly, and leap with agility from one branch to another. They bite rather fiercely if laid hold of, but their bite is not attended with any bad results.

THE LINED ANOLIS (*Anolius lineatus*) is one of the species which have the crest well marked and extending all along the back, and is a native of the island of Martinique, and probably several other of the West India islands. It is of a gray colour, and the body is marked with two interrupted black streaks on each side. The throat pouch is large, and marked with a large black spot, and the tail is long and compressed. Father Nicholson, the Jesuit, has given an account of this little Anolis in his "Natural history of the island of St. Domingo." It is very lively, he says, and is a bold little creature; it is so familiar that it walks without fear into apartments, creeping up on the tables, and even walking over the guests seated at them. Its attitude is graceful, and it looks steadfastly, observing everything around it with such a degree of attention, that one would almost believe it was listening to what was said. It feeds upon flies, spiders, and other insects, which it swallows entire. These Anolis often fight with each other. "When two of them commence an attack," says Nicholson, "they come forward holdy and proudly, and seem to menace each other, by rapidly shaking their heads. Their throat swells, their eyes sparkle; they seize each other with fury, and fight savagely. Several other individuals are generally spectators of these combats, and perhaps these witnesses of their prowess are the females which become the prize of the victor. The weaker of the two combatants, when worsted, takes to flight; its opponent follows up its victory, and if it can overtake it, quickly devours it; sometimes, however, it only gets hold of its tail, which snaps off in its mouth, and which it stops to swallow, thus allowing time for the wretched caitiff to escape."

THE ANOLIS OF CAROLINA, THE GREEN LIZARD OF CAROLINA of Catesby (*Anolius principalis*), has no crest on the back, and its tail is rounded, thick at the base, and furnished with a central series of larger, more keeled scales above. Catesby, in his "Natural History of Carolina," says, "These Lizards are usually about five inches long, of a dusky-green colour. They frequent houses, are familiar and harmless, and are suffered with impunity to sport and catch flies on tables and windows, which they do very dexterously, and no less divertingly. They appear chiefly in summer, and at the approach of cold weather they retreat to their winter recesses, and lie torpid in the hollows and crevices of rotten trees. These lizards change their colour in some measure like the chameleon, for in a hot day their colour has been a bright green; the next day changing cold, the same lizard appeared brown. They are a prey to cats and ravenous birds. It frequently happens that a few warm sunshiny days so invigorate them that they will come out of their winter retirements and appear abroad; when on a sudden the weather changing to cold so enfeebles them that they are incapacitated to creep to their winter holes, and die of cold."

In the second group, or those whose habits are terrestrial, the body is subtrigonal, covered with large keeled scales directed obliquely towards the back.

THE LION LIZARD (*Leiocephalus Schriebersii*), one of these, has been described by Catesby. The crest of the back and tail in this species is very small, the tail is roundish, slightly compressed; and, unlike the preceding species, the animals do not change colour, nor do they dilate their throat. The Lion Lizard, according to Catesby, is usually about five or six inches long. It is of a gray colour, streaked with lines of a lighter gray; the legs are long. "It cocks its tail with a round twirl, and looks fierce, from which it may perhaps have taken its *English name.* They are inoffensive, frequenting the rocks on the sea-shores of Cuba, Hispaniola, &c. They are nimble, and run with surprising swiftness, yet are a prey to sea-gulls and other ravenous birds."

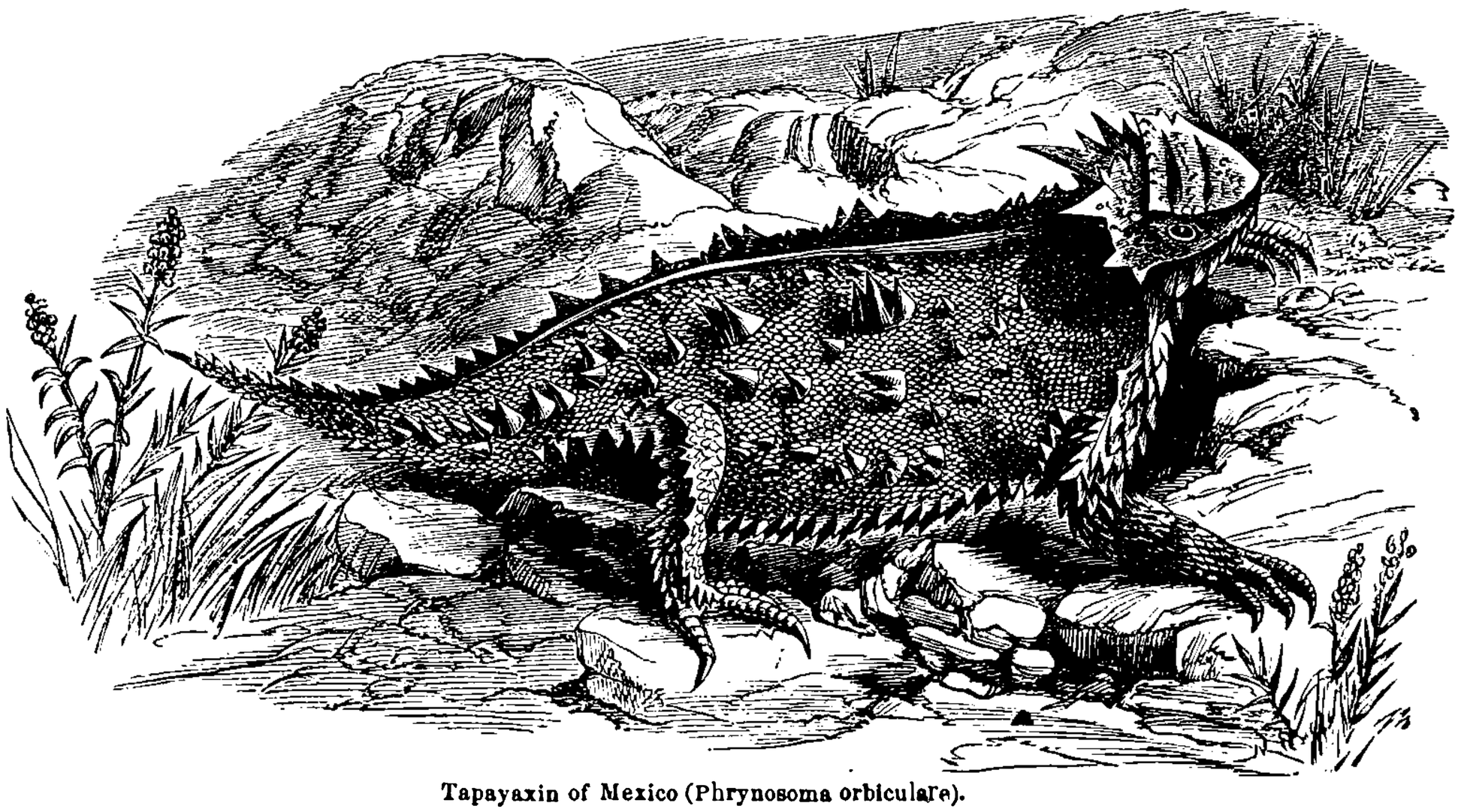
THE TAPAYAXIN of Mexico (*Phrynosoma orbiculare*) —fig. 9— another, and a singular-looking species, has been quaintly described by Hernandez in his "Natural History of New Spain." The body of the animal is short, oval, very flat, and has on each side a scaly ridge, but no crest either on back or tail. The upper parts of the body are rough with tubercles. The limbs are very short, and the tail, not the length of the body, is flat and broad at the root. Hernandez, who was the first author that has mentioned this reptile, thus describes it:—"Amongst the different varieties of the lizard, is apparently the Tapayaxin, although it has always the body of an orbicular shape and flat, resem-

bling in a certain degree the form of the ray fish, only that it is much smaller, scarcely reaching four inches either in length or breadth. It is of a cartilaginous consistence, however, and varied with many colours; it is always found cold to the touch, walks very slowly, and seldom changes its place, even if laid hold of and handled. But its head is very hard, elevated, and bristling with a number of spines, disposed in the form of a garland. It delights in being taken hold of by man, to be carried in the hand and fondled, remaining immovable, and enjoying a degree of placid security and tranquillity; wherefore it is usually called by the natives, the Friend of man. What is wonderful in this animal, and common to no other as far as I am aware, is, that if the head be compressed, or the eyes be troubled, or if it be roughly handled, it can pour out from them drops of blood and eject them to a distance, in the same way as blood is wont to be drawn from a man in sound health; sometimes it is thrown out with such force as to reach a distance of three paces." Wonderful virtues were attributed by the superstition of the natives to this blood, especially in the syphilitic diseases which, soon after the conquest of Mexico, overrun that country. The Tapayaxin lives in the mountainous and cool parts of Mexico, where it is found generally diffused.

The family of AGAMAS (*Agamidæ*) contains a considerable number of species, upwards of eighty having been described by Dr. Gray in his Catalogue. These are distributed through a variety of genera, which are distinguished by the teeth being implanted into the substance of the jaw, adhering intimately to it by their fangs. In none of them is the palate armed with teeth. The thumb of the hind feet is on the same plane as the other toes. These characters separate them distinctly from the Iguanidæ, and, moreover, they are all inhabitants of the Old World, with the exception of two or three from Australia, whereas the Iguanidæ are all natives of the New World. In other respects they resemble the latter family very much, and by many writers on reptiles are made merely a subdivision of them. Like them also they may be arranged in two groups—those which chiefly live upon trees; and those whose habits are terrestrial.

Amongst the members of the *first* group, or those which live on trees, are the harmless little FLYING

Fig. 9.



Tapayaxin of Mexico (Phrynosoma orbiculare).

LIZARDS OR DRAGONS. To no word, perhaps, are attached ideas more extraordinary, and of greater antiquity than to that of *Dragon*. In all ages and in all countries the name *Draco* has been one of fear and mystery, and has not been dropped by modern naturalists, who, however, instead of giving it to a creature of romance, have conferred it upon a real, substantial, *winged* reptile. The genus *Draco* contains several species, which are small and inoffensive, but which, nevertheless, are still equally curious in the eyes of an attentive observer. Their chief character is, in fact, one of the most beautiful examples of the resources, at once simple and varied, that Nature uses in order to arrive at her ends. Destined to live on trees, it was necessary that the Dragons, in order to move themselves with an agility equal to that of the other animals of the tribe to which they belong, should have their feet furnished with toes possessing free claws; but as the insects of which their ordinary food consists fly rapidly, in order to reach them and shoot with celerity from one tree to another it was necessary besides that they should be furnished with wings. We thus see that the skin of the flanks is expanded in the manner of a parachute, and sustained by the ribs behind the sternum, which separate themselves bilaterally, in place of converging towards the inferior line of the body, a unique example of such an arrangement—Plate 8, fig. 17. The genus *Draco* has a small head; the body covered with small imbricate scales; the throat furnished with three pouches; six ribs on each side, which are long,

exserted, and give support to the wing-like lateral expansions of the skin; a long tail, and five free but unequal toes on each foot. The species are all of a small size and very harmless. They are found living in the bosoms of the forests which cover some of the burning regions of Africa and a portion of the large islands of the Indian Ocean, particularly Java and Sumatra. Their wings are capable of being folded up and developed like a fan, at the will of the animal. In a state of repose they are horizontal, but when expanded they support the body like a parachute, when the creature leaps from branch to branch. They have not sufficient power, however, to strike the air and elevate it like a bird. Their food consists of insects, which they pursue with dexterity and quickness, and may almost be said to take them on the wing. They appear to have no objection to the water, as they have been seen swimming in a river at some distance from land.

THE COMMON FLYING LIZARD (*Draco volans*) is the species most frequently met with, and the best known. The colour of this animal is of a uniform greenish hue, with the exception of the wings, which are of a very pale brown, and are each of them marked with four transverse brown bands, fringed at their sides with little white points. Boutins tells us that this pretty little reptile, which is common in the island of Java, inflates its yellowish goitre when it flies, that it may be more light in the air, without, however, being able to traverse any great space. It only shoots from tree to tree, a distance of about thirty paces, and produces by the agitation of its wings a slight noise. It is a native also of Borneo and the Philippine islands.

THE LINED FLYING LIZARD (*Dracunculus lineatus*), the species represented in Plate 2, fig. 4, is much rarer than the former, and is found in the great woods of the islands of Java and Amboina. Its habits are, we believe, much the same as the common species, but, being rare, the animals have not been much observed. In this species the drum of the ear is hid under the skin, whilst in the other it is exposed—hence it now forms a separate genus, under the name of *Dracunculus*.

The CRESTED LIZARDS (*Lophuræ*) belong to this group also. These reptiles are remarkable for the crest which they possess, which extends from the head to the extremity of the tail, and is supported throughout its length by long rays. The toes are long and are furnished on each side with a margin of horizontal scales, which scales are so developed in the hind feet as to form a sort of web or first expansion.

THE CRESTED LIZARD OF AMBOINA (*Lophura Amboinensis*) is a handsome species, and often attains a length of three or four feet. It was first described by Schlösser as a native of Amboina, and it is also found in Java and the Phillipine islands. It is the representative in Asia of the Basilisk of America, and has by several authors been described as a species of that genus. It has a small throat pouch, with a lax fold of skin in front of the neck, and the tail is nearly three times as long as the body. It is of a green colour, with black lines above and white beneath. This reptile frequents the neighbourhood of large rivers, climbing the trees growing on their banks, and there passing its time tranquilly, feeding upon fruits, seeds, small worms, and insects, and depositing its eggs in the sandbanks and little islets of the river, as if it sought to place them there in safety. It is a timid creature, easily alarmed, and flies at the least appearance of danger, without making any attempt to defend itself. Should the river be near it plunges into it, swimming with ease and rapidity, and hastening to conceal itself under the rocks and stones. The flesh is said to be very good, superior even to that of the Guana, and hence the natives hunt them with avidity for the purpose of using them as food. They follow them into the water, and when laid hold of the poor creatures makes no attempt at defence, and utter no cry. "This mildness of disposition," says Lacépède, "has by many been called stupidity; but how often have not quiet and unostentatious qualities been designated by that name!"

We have mentioned that two or three genera of these arboreal Agamas are natives of Australia. One of the most curious of these is the FRILLED LIZARD (*Chlamydosaurus*), which has neither the crest on the back or tail, or cheek pouches, but has the neck furnished with a large plaited membrane on each side, expanded like a broad frill. The edge of this frill is serrated, and the whole of it is covered with small keeled scales. The frill increases in size, out of proportion to the size of the animal, as it becomes older. When young, it does not reach to the base of the fore limbs, but in the adult it becomes much fuller, and reaches considerably beyond the armpit.

KING'S FRILLED LIZARD (*Chlamydosaurus Kingii*), the only species known to exist, is a native of Port-Essington, and of a fulvous colour, varied with brown. The head is of a pyramidal form and short; the tail is long and tapering. Little is known of this curious lizard, but it was observed by Sir George Grey, in his travels in Australia:—"As we were pursuing our route in the afternoon," he says, "we fell in with a specimen of the remarkable Frilled Lizard. This animal measures about twenty-four inches from the tip of the nose to the point of its tail, and lives principally in trees, although it can run very swiftly along the ground. When not provoked or disturbed it moves quietly about, with its frill lying back in plaits upon its body; but it is very irascible, and, directly it is frightened, elevates the frill or ruffs, and makes for a tree; where, if overtaken, it throws itself upon its stern, raising its head and chest as high as it can upon the fore legs, then doubling its tail underneath the body, and displaying a very formidable set of teeth from the concavity of its large frill, it boldly faces any opponent, biting fiercely whatever is presented to it, and even venturing so far in its rage as to fairly make a fierce charge at its enemy. We repeatedly tried the courage of this lizard, and it certainly fought bravely whenever attacked. From the animal making so much use of this frill as a covering and means of defence for its body, this is most probably one of the uses to which nature intended this appendage should be applied."

Amongst the members of the *second* group, or the terrestrial species, are the true AGAMAS (*Agamina*), which give the name to the whole family. The name *Agama* is derived from a word used by the colonists of

Guiana to designate a peculiar kind of lizard, and which, by a mistake of M. Daudin, was conferred as a generic name upon a group of Saurians, of which the representative unfortunately happened to be a native of Africa. The genus *Agama*, as now adopted, is characterized by the species having their body thick and covered with strongly-keeled scales, amongst which there are some which form groups of spines upon the regions of the nape of the neck and ears. The skin is loose, and can be inflated at the will of the animal. In most of the species there is a crest which runs along the back to the tail, and the throat is furnished with some longitudinal and cross folds. The tail is elongate, tapering; in some rounded; in others compressed. The species known are most of them natives of South Africa and Egypt, a few being also inhabitants of the eastern portion of the world. They frequent humid places in hot countries, and never issue from their retreats till evening. Some of them are remarkable for the power they possess of changing their colours like the Chameleon. In consequence of this, Cuvier gave these species the name of *Changeants*, or Changeable lizards.

THE VARYING AGAMA (*Agama variabilis* or *Trapelus ruderatus*), one of this group, is particularly noted for this faculty. M. Isidore Geoffroy St. Hilaire, in his description of the reptiles of Egypt, thus mentions it:—"If this little animal had been known in ancient times; if, abundantly spread over some of the countries frequented by Europeans, it had happened to have become the subject of frequent observation, doubtless the name of the Chameleon would not have been so celebrated in our days, nor would *it* have been so frequently made the emblem of inconstancy and flattery. In fact, the Varying Agama is subject to changes of colour even more prompt and more rapid than those of the Chameleon, although this latter can in a few minutes paint itself with a crowd of different tints." This species of Agama is of small size, being only five and a half inches long from the tip of the muzzle to the extremity of the tail; this latter organ forming nearly the half of the total length. The head is of a very remarkable form, triangular, and as broad at its posterior part as it is long. The tail broad, and a little depressed at its base, is slender and rounded for the rest of its length. The scales with which the body is covered, are remarkable for their being all smooth, not spiny, and extremely small. "Individuals," continues the same author we have quoted above, "which have been preserved in cabinets for some years, generally appear of a brownish-gray colour above and whitish beneath. But these colours do not in any way resemble those which the animal presents when alive; it is then often of a beautiful deep blue, tinted with violet, with the tail barred with black, and with some indistinct reddish spots disposed upon the back in such a manner as to form four or five small rather regular transverse bands. In a few more seconds the blue is replaced by clear lilac; then the head and the feet are ordinarily tinted with green, and there is nothing left to recall the remembrance of the first colours except the small red spots of the back."

The species represented in Plate 2, fig. 3, is the HISPID or SPINED AGAMA (*Agama aculeata*), which is a native of South Africa, in the neighbourhood of the Cape of Good Hope.

THE STELLION (*Stellio cordylus* or *vulgaris*)—Plate 3, fig.1—is another animal belonging to this group. It is a native of the Levant, being found abundantly in the islands of the Grecian Archipelago, the Morea, North Africa, Egypt, and Asia Minor. It is usually about a foot in length, the tail forming more than the half of this. It has rather a bulky head, somewhat flattened, and of a triangular shape. The throat has a lax, posterior, cross fold, and the body is depressed, with a longitudinal plait on each side. The tail is conical, round, and ringed with whorls of spinose scales. In Greece the Stellion is called Koskordilos (κοσκορδυλος), and the Arabs know it by the name of Hardun. It appears to live in preference amidst the ruins of old edifices, amongst heaps of stones, or in the clefts of rocks, and is often also found in a kind of burrow, which it has the art and industry to excavate for itself. It is extremely agile in all its movements, and feeds upon the insects which flutter over the sand. In the scientific expedition sent by the French government for the purpose of exploring the Morea, this animal came under the especial notice of the naturalists attached to the party. "They found it," says M. Bibron, "at Delos as well as at Myconia. In this latter island especially, it is prodigiously common, and is found upon the little walls of dry stone with which the fields are surrounded. It retires into the crevices amongst the rough stones at the least noise. It is sufficient, in order to take it, to lift the stones; then it assumes a grotesquely-menacing posture, puffing and blowing, and opening a large but inoffensive throat. It is reckoned venomous; but, in spite of this, the children are every day handling them, and killing them with perfect impunity. Their colour enables them to be easily confounded with the rocks, stones, and grayish dust amidst which they live; the quickness of their movements alone calling attention to them. They leap with great nimbleness. The greater number of adult individuals are covered, or rather powdered, with whitish, mealy spots, which give them a leprous look, which, however, disappears when the animals are placed in spirits." In Egypt, according to Belon and some other authors, the people in the neighbourhood of the pyramids and the tombs of the Thebais collect with care the excrements of this animal for pharmaceutical purposes. In olden times this substance, known under the names of *Cordylea*, *Crocodilea*, and *Stercus Lacerti*, was used in Europe as a cosmetic, and is still sometimes employed by the Turks even at the present day. The Mahommedans have a particular dislike to this poor little creature. They pursue it and kill it whenever they meet with it, because, they say, it mocks them, by lowering its head in the same manner as they themselves do when engaged in their devotions!

In this terrestrial group of the Agamas are several species which are not remarkable for their beauty:—

THE MOLOCH (*Moloch horridus*), for instance, is an uncouth and horrid-looking creature from Western Australia. The body of this extraordinary reptile is covered from head to extremity of tail with numerous

spines. It is of a depressed form; the head is small and furnished with two or three very large spines over the eyebrows. "The external appearance of this lizard," says Dr. Gray, who first made it known, "is the most ferocious of any that I know, the horns of the head and the numerous spines on the body giving it a most formidable aspect." "I have named this genus," he adds, "from its appearance, after '*Moloch*, horrid king.'" These animals are highly coloured, especially on the under surfaces, which are covered with black-edged dark red spots. We do not know their habits, but they are harmless enough.

TRIBE III.—DENDROSAURA.

The third tribe of Thick-tongued Lizards, and the last of the Saurian reptiles, is that of the TREE LIZARDS (*Dendrosaura*).* In this tribe the scales of the belly, sides, and back are granular merely, and disposed in circular bands. The toes are five in number on each foot, and disposed in two groups, which are opposed to each other, and admirably adapted for grasping the branches of trees, &c.

This tribe contains only one family, that of the CHAMELEONS (*Chameleonidæ*); and this family consists of only one genus (*Chameleo*),† and eighteen species. They are all natives of the Old World, being confined to Africa and Asia, though one of them has become naturalized in Southern Europe.

The Chameleons are truly singular animals, whether we regard their internal or their external structure. They differ so much from all other Saurians, that Dumeril and Bibron place the family in a section by themselves between the crocodiles and lizards. "These animals," say these authors, "have such a bizarre structure, and so different from that of all other reptiles, that it is almost necessary to separate them from the rest of the Saurians. It is with difficulty we can observe even the slightest analogy between any species of Chameleon and any other lizard, whether we look at the granular and variable disposition of the integuments, or at the arrangement of the different portions of the skeleton. In fact, none of them have the slightest relation, either in the form and movements of the tongue, or in the structure and mode of articulation of the limbs, or, lastly, in the conformation and uses of the tail." In Dr. Gray's arrangement, however, they close the series of the Lizards, and this seems to be their true position. The essential characters which separate the Chameleons from all the other families of the Saurians are three:—1st. The existence of a cyclindrical, worm-like, very long tongue, which is terminated by a smooth, fleshy tubercle, lubricated by a viscid saliva. 2nd. Their having their five toes, in each foot, connected together as far as their last joint, but divided into two unequal sets, three in one and two in the other. 3rd. Their body being compressed, covered with a shagreened skin, and their tail being conical and prehensile.

* From the two Greek words, *dendron* (δενδρον), a tree, and *saura* (σαυρα), a lizard.

† From the Greek word *chamaileon* (χαμαιλεων), a little lion.

The integuments of the Chameleons are destitute of true scales; the skin is rugose, tubercular, and finely shagreened by unequal projecting granules, which are distributed in symmetrical groups. It appears very loose, adhering seemingly to the muscles only on the head, back, the free extremity of the tail, and the feet. Besides this, throughout its whole extent, numerous vacancies or free spaces are left, into which the air from the lungs can penetrate, so as to inflate it. In this skin there exist two layers—1st. A mucous tissue variously coloured by a pigment which appears to be gifted with a peculiar chromatic property; and 2nd. A true transparent epidermis which forms a continued layer, and moulds itself most exactly upon all the inequalities of the surface. The body is compressed or flattened sidewise, from right to left, and surmounted on the back by a projecting sharp ridge, a similar one being seen also in some species along the belly. Their legs are slender, elevated, and much longer in proportion than those of any other reptile, so that they can raise the body so high, that their belly never rests upon the surfaces upon which they walk or climb. The tail is rather long, of a conical shape, and like that organ in some of the monkey tribe is prehensile; that is, capable of twisting itself round, and grasping the various substances upon which they move. The structure of this organ and that of their feet renders those animals truly arboreal in their habits. The toes, as we have mentioned above, are divided into two sets, three on one side and two on the other, and these are disposed inversely; that is, the set containing two toes is placed externally on the fore feet, and the set containing three is placed externally on the hind feet. These two parcels of toes are opposed to each other, and thus form regular pincers, by means of which they can firmly grasp and retain hold of the branches of trees, upon which they live. The head of the Chameleons is very large and generally more or less strongly ridged, and the neck is so short that the head appears to rest upon the shoulders. There is no external ear apparent, these organs being hidden under the skin. The orbits are very large, and the eyes are particularly prominent, the globe being in a great measure situated outside the cavity. The whole of this organ is covered with a single eyelid, which is a continuity of the skin of the head, and is pierced with a small dilatable hole in the centre, forming, in fact, a true external pupil, which the animal can dilate or close at will. It can even vary the shape of the opening, for we see it sometimes become transverse or vertical. From the peculiar arrangement of the nerves and muscles, each of the eyes can move independent of the other. They can move in different directions, one upwards, the other downwards; the one forwards, the other backwards; and in all sorts of ways, without the head undergoing any change of position. "You cannot tell," says Mr. Gosse, "whether the creature is looking at you or not; he seems to be taking what may be called *a general view* of things; looking at nothing particular, or rather, to save time, looking at several things at once. Perhaps both eyes are gazing upwards at your face; a leaf quivers behind his head, and in a moment *one eye* turns round towards the object, while the other retains

upon air. They had observed its variation in form, according as its lungs were distended or not with air, and were familiar with its faculty of changing colour. These peculiarities were highly exaggerated by the early writers; and the fictions invented by them were still further embellished by the poets, who made the poor creature the emblem of hypocrisy and inconstancy. It is a dull, slow animal, languid and heavy in its movements, often remaining in the same position for hours together, basking motionless in the rays of the sun. In their natural state they live entirely amongst the branches of trees, and their mode of progression is ludicrous in the extreme. They can neither walk on a plane surface nor swim; but, from the structure of their pincer-like feet and their prehensile tail (which serves them as a fifth limb), they are able to cling to the boughs with great tenacity. When a chameleon wishes to change its position, it begins by separating the two sets of toes of one of the fore legs; it then bends the fore arm, raises it, and carries it slowly forwards. For a short time this foot remains suspended, as if the creature felt a degree of uncertainty as to the point to which to guide it, groping about with it in all directions, in order to meet with some object upon which to rest. When it has found this, it appears as if it wished to ascertain the solidity of its resting-place; and it is only when satisfied upon that subject, that the two sets of toes lay hold of it and take a firm grasp. Immediately after this, the hind foot on the opposite side begins to execute a similar manœuvre. Then the other fore foot unfolds its pincer-like toes, cautiously moves forward, and is soon succeeded by the opposite hinder extremity. Then, but not till then, the tail begins to untwist itself from its coil round the substance it had previously seized to support itself, and follows the move made by the other members. So they progress with great slowness and regularity, preserving all the time a ridiculous look of affected gravity. The only part of the animal which moves with quickness is its tongue. The food of the Chameleons consists of insects and their larvæ, &c; and they will remain motionless, perched upon a branch, watching for hours their unconscious prey. The moment it stirs, the tongue is darted at it; the insect is caught and swallowed in an instant. Mr. Slight fed his pets upon cockroaches. "I was accustomed," he says, "to put six or seven in a shallow tin vessel, and to place the Chameleon on its edge, its head projecting over the brim, to which its forceps were generally so firmly attached that it was often difficult to remove them. After making a circuit round some portion of the circle, the animal would distend the pouch beneath the jaws, expanding them two or three times in a trifling degree; and, stretching forwards its body on the fore legs, it would suddenly dart out its tongue with such force as to make a very sensible ring or noise on the opposite side of the tin; would catch the beetle or roach on the trumpet-shaped extremity of the tongue, which was retracted as quick as lightning, and [mastication and] deglutition followed." These individuals observed by Mr. Slight, did not feed more than once in three or four days. Like the rest of the Lizard tribe, they can, indeed, endure a long-continued abstinence, apparently without injury. Hasselquist kept one twenty-four days, without giving it the slightest chance of getting any food. It gradually, however, he says, began to get thin; it would fall back when it was climbing in its cage, and at the end of that period an accident put an end to its life. Mr. Martin, however, tells us that he has known individuals live for months without eating. The female deposits her eggs in holes made by her in the ground; she then covers them with earth, which she scratches up with her feet as cats do when they cover their fæces, and over all places a layer of dry leaves. The eggs are often as many as thirty, and are round, with a calcareous shell, white, spotless, and very porous. The male is distinguished from the female by the base of the tail being thickened.

Out of the eighteen species enumerated, seven are natives of Madagascar.

THE FORK-NOSED CHAMELEON (*Chameleo bifurcus*), is singular from the shape of the head. The crown is flat; but the muzzle is prolonged into two distinct branches, which are compressed, strait, and dentated along the upper and under margins. The object of this strange formation is unknown, as the animal has not been much observed in its native haunts.

ORDER II.—SERPENTS (OPHIDIA).

THE passage from the Lizards to the Serpents is by a succession of very gradual modifications of development. In general form, as we have seen in treating of the former animals, some of the species approach very nearly to that of the latter—such as the Blind-worm (*Anguis fragilis*), &c.—so much so, indeed, that some authors have considered Lizards and Serpents as constituting only one order. Serpents differ, however, in some important respects; and all zoologists are now agreed in forming them into a distinct order.

Serpents are reptiles clothed in a scaly skin; the body being always long and nearly cylindrical, though more or less produced into a point behind. The head is continuous with the body, there being nothing like a neck visible. Certain species have the body and tail very slender and nearly filiform; this is especially the case with those which inhabit trees. Others, like the Vipers, &c., have a short tail. In the Boas and Pythons this part of the body is prehensile; and in the water-snakes it is more or less flattened, so as to act somewhat like a fin. None of the serpents have any crest, either on the back or tail, such as we see in many of the Lizard order. The skin in many species is susceptible of a certain degree of extension; and the partionlar disposition and arrangement of the scales, which cover it and the head, form good characters for assisting in forming genera and species. Serpents change their skin pretty often, an operation which is generally known

by the term sloughing. It comes off in a single piece from the head to the tail, without tearing in any part; and after it has been thrown off it preserves all the external characters so well, that a person may recognize, by finding the skin, the species of serpent to which it had belonged. The eyes have no true eyelids, but are covered by the common skin, which is perfectly pellucid. They have no visible external ear, and their nostrils are situated on the side of the front part of the muzzle. Serpents have a very capacious and very dilatable mouth. This arises from the very peculiar disposition of the bones of the jaws and the muscles which move them. The bones forming the jaws and the face are all loose and disunited, being connected only by skin and ligaments. The upper jaw is in two pieces, is suspended, as it were, distinct from the cranium, and acts subordinately to the movements of the lower jaw. The lower jaw is also in two pieces, and consists of two distinct lateral branches, each branch being, in fact, itself made up of two portions, united by a loose kind of suture. Instead of being secured by firm joints to the skull, the lower jaw is attached on each side by a lax joint to a movable bone, called the tympanic portion of the temporal bone. This joint admits of a natural kind of dislocation, so that it gives way in the act of swallowing, and recovers its position when the prey is swallowed. From this mobility of the jaws and bones of the face, the mouth is rendered capable of being very much increased in size; and the animal is enabled to take into it the bodies of animals of a large size. The tongue of these reptiles is long and very movable, and is capable of being withdrawn into a sort of sheath at its base. It is slender, tapering, and forked at the tip. This forked nature of the tongue gives it somewhat of a malignant appearance, and accordingly, by the ignorant, it is looked upon as a deadly weapon, and called the dart. Shakspeare has embodied this idea in several passages of his immortal works. Thus King Lear, telling of the wrongs sustained by him from his daughter Goneril, is made to say—

> "She has abated me of half my train;
> Looked black upon me; *struck me with her tongue*,
> *Most serpent-like*, upon the very heart."

Again, in the "Midsummer Night's Dream," Hermia, reproaching Demetrius for the supposed murder of Lysander, says—

> "And hast thou killed him sleeping? O brave touch!
> Could not a worm, an adder, do so much?
> An adder did it; for with *doubler tongue*
> Than thine, thou serpent, *never adder stung!*"

This *double* tongue, however, possesses no hurtful property. It forms, in fact, the chief organ of touch; appears rather destined to seize aliments than to perceive savours; and evidently serves more for assisting the animal to swallow, than for tasting its food. The teeth of serpents are numerous, and are inserted upon all the bones of the mouth, as well as the two jaws. The number and proportion vary, and they form good characters for distinguishing genera and species.

Serpents, indeed, are generally divided into two groups, the poisonous and harmless; the chief, and sometimes almost only perceptible difference between them, consisting in the structure of their teeth. In the latter group, the harmless or Colubrine serpents, the teeth are disposed in two rows in the upper jaw, and a single row in the lower. They are sharp-pointed, regularly inclined backwards, so that the hand may be passed down over them with impunity, but not drawn back; for then they pierce the skin immediately. Hence while they offer no impediment to the passage of food, they securely detain the struggling victim. In the poisonous or Viperine serpents, on the contrary, there is only a single tooth on each side of the upper jaw, properly speaking; these are the poison fangs, the other teeth being placed in a single row on the bones of the palate. The lower jaw is only partially furnished with teeth. The poison fangs are thus decribed by Mr. Waterton:—"They are invariably on the upper jaw, but they are not fixed on the bone. They are always curved downwards like the blade of a scythe. There is a little opening on the convex part near the point. From this opening to the point, which is as sharp as a needle, the fang is quite solid, but hollow from it to the root. This point may aptly be styled the pioneer of death, as it makes the wound into which the poison of the irritated serpent flows through the hollow part of the fang. It is the fatal weapon which causes a snake to be so much dreaded, and condemns the whole race to universal detestation; although, in fact, not one snake in ten has been armed by nature with the deadly fang. When not in readiness to inflict a wound, these two poison fangs resume a recumbent position, so as not to interfere with the action of the ordinary teeth, which are firmly fixed and are very small, and most admirably formed to seize their prey, and to send it down into the stomach."* The glands which secrete the poison are found on the sides of each branch of the upper jaw behind the orbit, and almost below the skin. Two muscles destined to raise the fangs, traverse them from back to front, one outwards, the other underneath, so that they cannot act without compressing the gland and impelling the poison into its excretory canal, which conducts it to the base of the fangs, where it penetrates by a cleft which prevails throughout their whole extent, and opens toward the point obliquely, "like the cut of a pen."

When the irritated animal bites its victim, these fangs are raised upright by means of the mobility of the jawbones. They never strike their prey more than once; should they miss their aim they withdraw themselves for a time. "Armed with a poison fang," says Mr. Waterton, "the snake at one single stroke (never repeated, as far as I could see) avenges itself on the unfortunate animal which has trodden upon it, or has put it in bodily fear by disturbing its repose." The nature of these poison fangs, and the situation of the gland which secretes the venom, seem to have been known to the Jews at a very early period. David in his prayer to be delivered from Saul and Doeg, in the 140th Psalm, says—"Deliver me, O Lord, from the

* This description of the poison fangs applies chiefly to the pre-eminently venomous or Viperine group, as for instance, the rattlesnake, &c. In the poisonous serpents belonging to the Colubrine group, as the cobra de capello, &c., the poison fangs are fixed, and are not movable. See—*Cobra*.

evil man: preserve me from the violent man; which imagine mischiefs in their heart; they have *sharpened their tongues like a serpent*; *adders' poison is under their lips.*" As Kitto observes, "the usage of the Hebrew language renders it by no means improbable that the *fang* itself is called *Lashon*, "the tongue," in the present text; and a serpent might then be said to sharpen its tongue, when, in preparing to strike, it protruded its fangs. The situation of the poison, which is in a manner behind the upper lip, gives great propriety to the expression, " adders' poison is under their lips." It would appear, on good authority that this poison retains its power for some time after the death of the serpent; M. Dumeril says, even after it has been for some time preserved in spirits. It is necessary, therefore, he adds, to be extremely cautious in handling or examining specimens which have been so preserved. Wonderful stories to this effect have been told, but Dr. Cloquet in a paper communicated to the Philosophical Society of Paris in 1827, relates some experiments made by Dr. Emmanuel Rousseau, demonstrator of anatomy at the Jardin du Roi, who had at his disposal a rattlesnake which had been dead for two days, and who found that even in the colder climate of France, the poison retained its power though the snake was dead. A pigeon was procured, its pectoral muscles were pierced by the poison fang being inserted by force, and the poor bird died within a very short period indeed. From a variety of experiments made on the nature of this poison, it appears, according to Schlegel and others, to be neither acid nor alkaline. That of the viper, which has been most observed, was found not to redden the tincture of turnsol, or turn green the syrup of violets.* However fatal the poison of serpents is when introduced into the system, it is perfectly harmless when taken into the stomach. This was well-known to the ancients; the celebrated Roman physician, Celsus, was well aware of it, and Lucan in his "Pharsalia" makes Cato expound the same truth to the soldiers under his command—

> " And now with fiercer heat the desert glows,
> And mid-day gleamings aggravate their woes.
> When, lo! a spring amid the sandy plain.
> Shows its clear mouth to cheer the fainting train.
> But round the guarded bank in thick array,
> Dire aspics roll'd their congregated way,
> And thirsting in the midst, the Dipsas lay.
> Black horror seized their veins, and at the view,
> Back from the fount the troops recoiling flew.
> When wise above the crowd, by cares unquelled,
> Their awful leader thus their dread dispell'd;
> Let not vain terrors thus your minds enslave,
> Nor dream the serpent brood can taint the wave:
> Urged by the fatal fang, their poison kills,
> But mixes harmless with the bubbling rills.
> Dauntless he spoke, and bending as he stood,
> Drank with cool courage the suspected flood."

When we observe the motion of serpents, we see that to them eminently applies the term *Reptiles*, their mode of progression being truly *reptation*, or creeping. Many mistakes, however, are made with regard to their method of moving along the ground, especially by artists. Mr. Waterton very justly remarks upon this subject—" All snakes in gliding onwards take a motion from right to left, or *vice versâ*, but never up and down; the whole extent of the body being in contact with the ground, saving the head which is somewhat elevated. This is equally observable on land and in water. Thus when we see a snake represented in an up and down attitude we know at once that the artist is to blame."

The *vertebræ*, or bones of the spinal column, are very numerous, amounting in some species to more than three hundred; and are united to each other by a ball-and-socket joint, the head of each separate hone being received into a deep cuplike cavity of the one succeeding it. This mode of articulation allows of great mobility, each joint, separately, possessing a considerable degree of motion; and all, united, giving the body very great flexibility. With the exception of the first two or three next the head, all the vertebræ—those of the tail not included—give origin to two ribs, one on each side. These ribs form a great portion of a circle, so as to embrace nearly the whole circumference of the body, and are the real and efficient organs of locomotion, Serpents can glide along with considerable velocity, and it is generally said and believed, that they can spring vigorously and dart their body to a great distance. Stories are told of their springing at a single bound over the head of a man riding on horseback.* When they repose upon the ground, they generally form with their body several circles placed one above another, or around the others surmounted by the head. The body is thus coiled up by the contraction of the muscles of one side; and it is by the sudden relaxation of these muscles, and the violent and instantaneous action of the muscles of the other side uncoiling them, that the propulsion of the body is accomplished. This motion is compared to that of a spiral spring, the coils of which are distinct. These being pressed upon the table till they close, and suddenly released, the whole body of the spring is at once propelled forwards. From the structure of the vertebral column and ribs, however, as described above, we have great doubts whether any serpent has the power of raising the whole of its body at any time by a sudden bound, from the ground upon which it rested. When a serpent prepares to attack its prey, or any animal which has suddenly roused or irritated it, it raises its head and part of its body erect, and when it strikes, it darts forward merely that part which is not resting upon the soil.† The sensibility of serpents is, like that of other reptiles, very obtuse; and in winter they pass a long period of it in a state of complete lethargy. Their irritability, however, is very great; their heart will still pulsate for a long time after it has been plucked out, and they will open and shut

* Dr. Harlan on the other hand asserts, from direct experiments, that the poison from the rattlesnake, when tested with litmus paper, invariably displayed acid properties; and Dr. Cantor found the poison of no fewer than seven different species, in all his experiments, to redden litmus paper.

* Poets have often made allusions to this pretended power of serpents. Montgomery says—

> " Anon he flew
> Straight as an arrow shot from his own rings,
> And struck his victim, shrieking ere it went
> Down his strain'd throat, that open sepulchre."

† Azara, an accurate observer, in treating of the serpents of Paraguay, observes—" In order to seize their prey, they employ no other means than address and surprise. They approach it by slow degrees, *because they never leap.*"

their mouth after the head has been separated from the body for several hours. The sense of hearing does not appear to be very fine, and the sense of smelling seems to be very incomplete also; whilst that of taste is still feebler, and less developed than that of smell. The sense of touch exists all over the body, but appears to be blunted by the scales, and by the horny epidermis which embraces them in all parts. Their muscular power is very great. The Boa constrictor for example, by twining itself round them, can suffocate the largest quadrupeds between its folds.

The growth of serpents is rather slow, but they sometimes attain a very great size. There are some species which in time acquire a length of thirty or forty feet. Adanson mentions one in Senegal which was nearly fifty feet long and two and a half in diameter; and Mr. Waterton tells us, that a Spaniard in Angostura, the capital of the Orinoco, showed him part of a serpent's skin, which, judging from its amazing thickness, could not have been less than seventy feet in length. An immense serpent is recorded in ancient history, which was said to have occupied a situation on the banks of the river Begrada, between Utica and Carthage. Many of the soldiers, then under the command of Regulus, were said to have been destroyed by it, whilst going to the river for the purpose of procuring water. No ordinary weapons could produce any effect upon the huge monster, and Regulus was obliged, according to the statement of Valerius Maximus, to use the military machines then employed for throwing large stones. A ponderous stone at length laid him low, and his skin which the commander took with him to Rome, is asserted to have measured one hundred and twenty-three feet in length! The food of serpents consists of living flesh. The smaller mammalia, birds, and frogs constitute their usual food; but in default of such prey, they will content themselves with the eggs of birds and fishes, insects and mollusca. By far the greater number of them attack their prey while alive, and although deprived of limbs, they easily make themselves master of them. Their food is swallowed entire. The œsophagus or gullet is very dilatable, and this, along with the capacious mouth and mobile jaws, enables these reptiles to swallow animals of much larger diameter than themselves. The common snake of this country will swallow frogs, rats, and mice, whose bodies much exceed their own in size; and the Pythons and Boas of warmer climates will engulf within their capacious throat deer, goats, and even, it is said, small oxen. One repast will suffice them for many weeks; and we have evidence to show that adders and vipers can be kept six months without any aliment whatever, and without losing a particle of their energy and activity.

The generality of serpents are oviparous, though there are some, like our common viper, which bring forth their young alive. The eggs are arranged in two ovaries in the form of chaplets, to the number of fifteen or twenty, and not agglomerated in a mass. They are rounded, ovoid, and enveloped by a soft membrane, not porous, and slightly encrusted with a calcareous shell. The yolk is orange-coloured and oily. Hot-beds, heaps of manure, and similar places, are generally chosen by the female, in which to deposit them; but the larger kinds, as the Pythons, have been observed to surround them with their folds, and thus cause them to undergo a kind of hatching. They often take care of their young in early age, and some are said to have been seen to receive their family into their œsophagus at the moment of danger, and eject them again as soon as the alarm was over.

Serpents are spread all over the warm and temperate parts of the globe; but, like other reptiles, they are larger and more numerous in hot countries. A small number are circumscribed within narrow limits. Rattlesnakes for instance are peculiar to North America; Boas are almost confined to South America; and Pythons to the torrid climes of the Old World. Some prefer wooded countries for their habitation, some live in marshy places, while others are only found in dry sandy plains; and others still are aquatic in their habits, living in the sea, and being seldom seen except far from land. The most exaggerated notions prevail with regard to the numbers of serpents in hot climates, and especially the numbers of poisonous species. Modern travellers, however, unite in ridiculing the terrors thus inspired by such ideas. Mr. Waterton, as far as regards the New World, says upon this subject:—When we consider the immense extent of tropical America, and view its endless woods, we are forced to admit that snakes are comparatively few. I have seen more monkeys in one day, than I have found snakes during my entire sojourn in the forests. I have been for weeks together in the swamps of the river Orinoco, barefooted and up to the knees in water; but as for snakes, I seldom saw them." Dr. Davy, in his "Interior of Ceylon," thus speaks as regards a portion of the Old World:—"It is commonly supposed that Ceylon abounds in snakes, that they are very dangerous, and that they cannot be too carefully avoided. All this is greatly exaggerated. Where the fears are much concerned, the reason is generally weak; and snakes from time immemorial—indeed in all ages and countries—have been objects of aversion and dread, and subjects for superstition and fable. Snakes are neither numerous in Ceylon, nor much to be apprehended. Those who have most experience have the greatest confidence; the old sportsman, in pursuit of game, plunges into the wildest jungle without dread or apprehension, whilst the newly-arrived European does not cross a lawn but with fear, almost amounting to trembling, of snakes in the grass. The latter is terrified by his imagination—the former is fearless from the knowledge of his security. One of the best and keenest sportsmen in the island, who has lived several years in the Megam-pattoo, a district almost deserted by man and extremely infested with wild animals, has assured me, that in all his rambles and excursions he has never met with a poisonous snake. My object in making these remarks is to endeavour to remove senseless horrors, which apprehension of snakes in Ceylon too often gives rise to, and which if not opposed or subdued detract more from the comfort and happiness of life than can well be imagined, excepting by those in whose mind is still impressed the memory of the miseries produced in childhood by the dread of hobgoblins." Fortunately for man, only a small proportion of the known species

of serpents possess the property of secreting a poisonous liquid. Out of the twenty different species found by Dr. Davy in Ceylon, only four were really poisonous. Multitudes are harmless, at least as far man is concerned, and many are as beautiful in their colouring as graceful in their forms; still, few or none are favourites. It is well, however, to remember, that serpents very seldom attack man without provocation; on the contrary, as all people who have been in hot climates know, they usually appear to dread his presence. Although cunning, they are timid and fearful. The common snake of England, for instance, may be domesticated, and the coral snake of Florida, which is very beautiful and gentle, is often kept tame, and allowed by the women to entwine itself round their necks as a necklace. It is gratifying to find from travellers and others who have seen serpents in their native abodes, that their fear of these reptiles diminished as they became better acquainted with them, and found from experience how safe they were in countries which their fears had previously depicted as almost uninhabitable.

But though we have thus attempted to do away with the exaggerated notions of the immense numbers of serpents, and tried to lessen the too great fear and horror entertained by people in general against them, we by no means wish to make light of the formidable nature of the weapons of defence and offence carried by the poisonous species, or the fatal and deadly effects produced by them. Instances of death in the human subject from the bite of snakes, even in this cold climate, are too numerous and too well authenticated to be lightly treated.

Many persons have attempted to express in a clear manner the characters by means of which we might be able to distinguish venomous serpents from those which are not so, but they have not succeeded. Mr. Martin says "that there is something more than usually repulsive in the aspect of poisonous serpents. Their thick broad head, their wide jaws, armed with horrible poison fangs, together with their brilliant eyes, give them a ferocious expression; and man and beast instinctively recoil from their presence." The eyes of all serpents are brilliant, the mouth in all is wide when opened, and it is only when the jaws of poisonous snakes are extended that the fangs can be seen. There remains, therefore, of this definition, only the thick broad head which can be of use in distinguishing them; and though this is correct in the case of the Viperine serpents, it is a character which cannot be depended upon in all the poisonous species, as the Cobra de capello and many others in form and general characters belong to the Colubrine group, or those which are for the most part harmless. We will enlarge, however, a little more upon the characters which mark the eminently poisonous or Viperine serpents when we come to treat of them more particularly. Serpents are said to possess a peculiar power of fascinating their intended victims, so that their prey is literally drawn into their mouths. According to some authors and travellers, who assert they have witnessed the fact, we are assured that, being fixedly regarded by a serpent hissing, and darting its forked tongue out of its mouth, squirrels and birds are constrained, as it were, to fall from the summit of the trees into the mouth of the reptile, which immediately swallows them up. Hares, rats, frogs, and other animals, seem to be petrified by terror; and far from attempting to fly, will precipitate themselves upon the fate that awaits them. Even when they are at a sufficient distance to escape, they are paralyzed by the sight of their dreaded foe, and deprived of all their faculties in a manner that appears wholly supernatural. Much has been written upon this subject, and many arguments have been used both for and against. Mr. Waterton, already quoted, does not believe in the fascinating power of serpents. "I am not a believer," he says, "in the evil eye of snakes. Their eyes are very beautiful, and no doubt they would be much admired did the beholder lay aside his prejudices, and consider that the snake before him has no intention to create alarm, nor to meditate a work of mischief." Sir Andrew Smith, on the contrary, speaking of this power in some of the snakes in South Africa, observes—"Whatever may be said in ridicule of fascination, it is nevertheless true that birds, and even quadrupeds, are, under certain circumstances, unable to retire from the presence of their enemies; and, what is still more extraordinary, unable to resist the propensity to advance from a situation of actual safety into one of the most imminent danger. This I have often seen exemplified in the case of birds and snakes." The subject is still involved in a considerable degree of obscurity. The most probable explanation of the fact, however, is, that in the case of squirrels, rats, &c., fear of their known and dreaded enemy deprives them of all energy; they are unable to escape, and thus fall easy victims. In the case of birds, in all probability, it is the instinctive desire, natural in them and strongly developed, of protecting their nests and young, that leads them into danger. The mother sees the reptile gliding up the tree, and along the branches, to where her nest is placed; she endeavours to oppose the serpent's progress, and thus exposes herself to the most imminent hazard; she will often attack it with her wing, her beak, or her claws, and venturing thus too near the creature's mouth, falls a prey to its voracity. Kalm, the Swedish traveller and naturalist, says, in regard to the rattlesnakes of North America, that the assumed fact of squirrels and birds being fascinated by the gaze of the reptile, and dropping from the trees into its mouth, may be explained thus:—The animals have been wounded by the snake, and have made their escape to the tree, where they expressed by their cries and emotions the violent action of the poison left in their blood by the fangs of the reptile. Becoming enfeebled by the continued action of the venom, they have hopped and fluttered from branch to branch, and at last have fallen close to where the serpent lay, who has been following, with inflamed eyes and eager looks, every motion of the poor creatures, and then anew darted upon them when nearly deprived of life and motion. It is commonly believed, and certainly frequently asserted, that serpents emit from their bodies a disgusting odour, especially after gorging themselves with food. When opened after death, some time after they have had a full meal, the fœtor exhaled from their body is very great; but that in a living state

they should send forth such a fœtid emanation as some authors assert is extremely doubtful. We rather agree with Mr. Waterton upon this subject, who gives his opinion thus:—"The nauseous smell, or fœtor, which is said by some authors to come from the bodies of these monster snakes (the large Boas of Guiana), and to infect the atmosphere, is fabulous. The whimsical account of it deserves a place on the shelves of a nursery library. I have never perceived anything of the sort, although it has been my good fortuue to come in contact with great serpents. Did such a fœtor really exist to the extent which authors have described, other animals could not live with any comfort under its suffocating influence, and it would be a salutary warning to them that an enemy was in the neighbourhood. Their precipitous retiring from it would be the means of starving the serpent to death for want of ordinary nourishment." Serpents have numerous enemies always on the look-out for them. They are pursued without relaxation, Azara tells us, by all kinds of eagles, hawks, falcons, storks, herons, and by individuals of the same order to which they belong. In self-defence they have almost no other resource than their fangs, or concealing themselves in the holes of mice, armadillos, or other burrowing animals, or in the pasture grounds where the grass is high. The manner in which the secretary bird, and some others of the rapacious order, attack serpents, is worthy of observation. As if well aware of the danger they encounter, the birds approach the serpent in a sidelong manner, making a shield of one of their wings, which they half open and allow to fall on the ground. They try at the same time to strike with their beak the reptile's head. Succeeding in this, they are sure to kill them, and then they devour them.

In all times, and amongst almost all nations, serpents have fixed the attention of the human race. The great tempter of mankind assumed the form of a serpent, and under its guise crept into Paradise. When in the wilderness the Jews were bitten by "fiery-flying serpents," Moses made, by command of God, a brazen serpent, which he placed upon a pole, so that those who looked upon it might live. In the times of their idolatry this very brazen serpent, being preserved by them, became an object of their idolatrous worship; "for unto those days," the days of Hezekiah, "the children of Israel did burn incense unto it." Amongst the Egyptians, as would appear from some of the bronze relics in the British Museum, the Cobra de capello was regarded in some sense as sacred. A serpent was one of the gods of Babylon; and in the Hindoo mythology serpents were regarded as malignant genii which tenanted the infernal regions. The serpent Python figured as an important agent amongst the ancient Greeks. Amongst the Romans the serpent was sacred to Æsculapius, and he himself was worshipped under the form of that reptile. The ancient Mexicans worshipped the Boa, and offered human sacrifices to it; and in Africa some of the nations paid similar honours to a serpent.

Notwithstanding all this respect and adoration, and in spite of the natural dislike almost all people have for them, serpents are often used as food. They are also regarded in many countries as affording aid in curing some diseases. The Anacondas and other Boas supply the natives of the countries which they inhabit with wholesome nourishment. Rattlesnakes are much sought after in some parts of North America, where they are considered excellent food; and vipers are eaten by many people in the South of France.

The method of dentition, and the structure and distribution of the scales, form the great characters upon which the arrangement of serpents is based. In most popular works they are divided into two large groups, solely from their possessing venomous fangs, or being destitute of them. In the arrangement of Reptiles which we have adopted, viz., that of the British Museum, serpents are divided (see p. 5) into two sub-orders, the Viperine and Colubrine—both of which groups contain species that are poisonous.

SUB-ORDER I.—VIPERINE SERPENTS (VIPERINA).

THE species of this sub-order are pre-eminently poisonous, and their mischievous nature is indicated by many external characters. Their general appearance and physiognomy have something so peculiar in them, and the impression which their look creates is so vivid, that they may be for the most part immediately recognized by any one who has ever examined a single species. Their jaws are generally weak. The under one is provided with a series of sharp-pointed teeth; but the upper jaw is destitute of any, except the movable poison fangs, which have been fully described in a previous page (p. 35). The head is extremely broad, flattened on the crown, and heart-shaped or trigonal. Instead of being covered with plates, like the Colubrine snakes, it is clothed in scales similar to those of the back. Their eyes are small, have a vertical pupil, are sunk deep in the sides of the head, and are shadowed by the projecting plates of the eyebrow. The upper lip is swollen and hangs down, in order to conceal the long fangs. In form they are heavy and squat, the body being pretty thick in the middle, somewhat compressed; the back slightly keeled, covered with rough, keeled scales; and the belly broad, convex, and covered with broad, band-like shields or scuta. The tail is short, conical, thick, but never blunt at the tip.*

Their manners, habits, and method of living assist

* The differences visible between the poisonous and innocuous groups of serpents were known to early observers. "The viper," says Catesby (meaning by the term *viper*, the whole of this sub-order), "hath the neck small, the head broad, the cheeks extending wide, their scales rough, the body short and thick in most; is slow of motion, can swell his head and neck; when irritated, bath the aspect terrible and ugly. Whereas snakes (the Colubrine species of serpents) have the head small, the body long, the scales smooth, are nimble, and of a harmless aspect."

materially likewise in distinguishing the Viperine from all other serpents. Their dull, heavy disposition, their slow mode of progression, the extreme sluggishness of all their movements, would naturally render their search after prey unavailing; but gifted with a tranquil nature, they calmly wait till chance bring past their retreats the animals destined for their food. When these approach, or when they are disturbed by an enemy, they then display their activity; they raise erect their head which was negligently, as it were, elevated while in a state of repose; they open their mouth so wide that the two jaws form an obtuse angle; they erect their fangs; the body uncoils like a loosened spring; and the serpent, aiding the sudden assault by resting upon its tail, darts at a single bound upon its victim, to inflict the fatal wound. The act is the work of an instant; the head, by the sudden and violent contraction of its flexor muscles, executes, with the rapidity of lightning, and sometimes (though Mr. Waterton denies this) reiteratedly, a movement, by which it plunges its fangs deep into the flesh of its prey. The poor creature, feeling the effects almost immediately, and being unable, in consequence, to make its escape by flight, falls into the power of its enemy. "We have reason to believe," says Schlegel, "that this mode of attack is peculiar to these Ophidians, and that the other poisonous serpents seize their prey in the same manner as the non-venomous species; that is, seizing it after pursuing it and holding it between their jaws at the moment of biting it, never letting go their hold, after making sure of their victim by giving it a mortal wound. The Viperine serpents, on the contrary, never keep hold of their prey, after having bitten it; or, more correctly speaking, they do not bite at all. It is only a blow of the head executed with extreme violence, and almost always seconded by a bound which determines the direction. The fangs are withdrawn immediately after having given a deep wound, the lower jaw appearing to take no part in the act at all." The Viperine serpents are viviparous; that is, they all bring forth their young alive, whilst the Colubrine species lay eggs, from which the young are afterwards hatched.

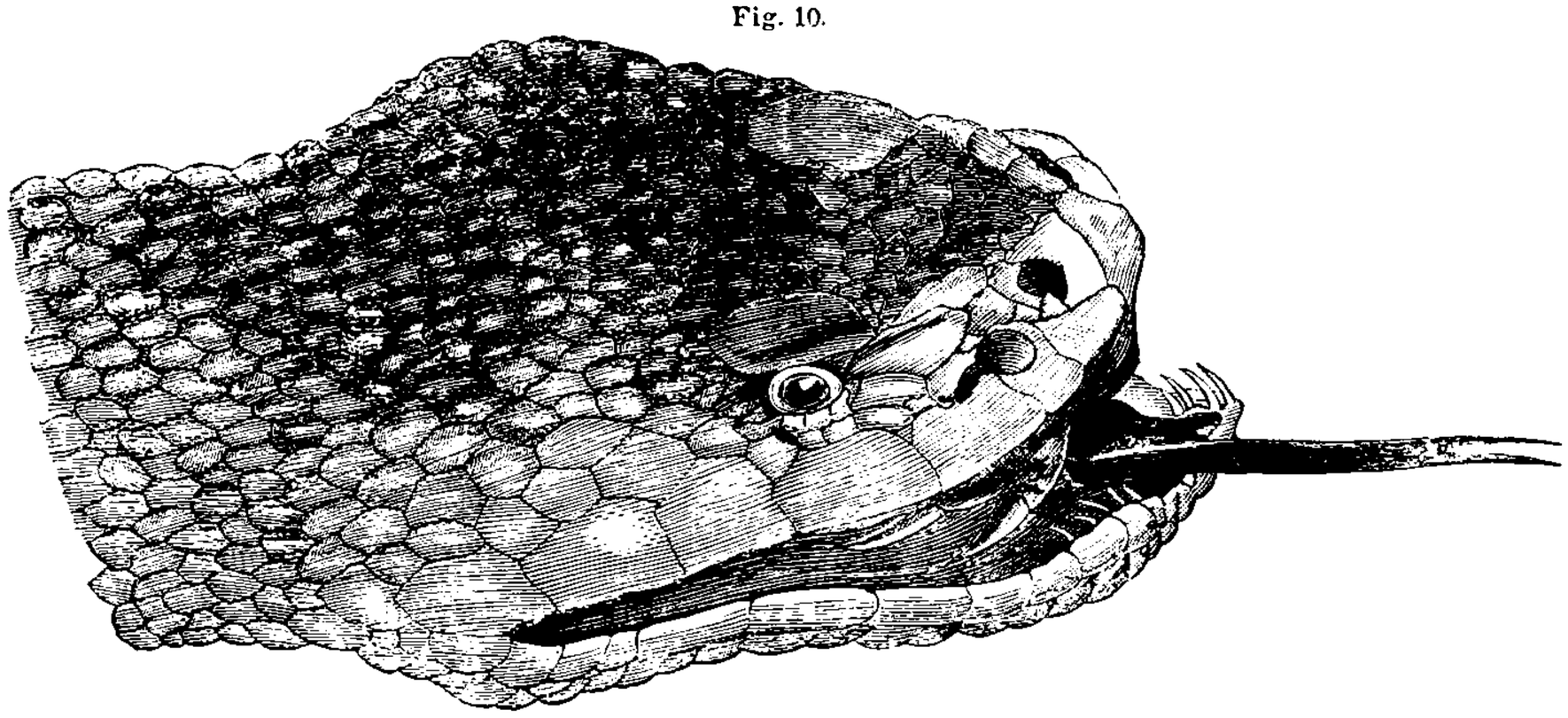
The Viperine serpents are arranged in two families, the Rattlesnakes (*Crotalidæ*), and the Vipers (*Viperidæ*).

FAMILY I—CROTALIDÆ.*

The species belonging to the Rattlesnake family are distinguished by having a large pit on each side of the face placed between the eye and the nostril. The head is large behind, and the crown is flattened. It is covered with scales, or small shields, except in the genus *Crotalophorus*, it which it is covered with large shields. The jaws are weak; the upper ones being furnished with long fangs in front, and being destitute of teeth. The belly is covered with broad band-like shields, or *scuta;* those under the tail being undivided. They differ from the Boas (family *Boidæ*), to be afterwards described, in having no spurs on each side of the vent. The species are all venomous, most of them eminently so; and they produce their young alive, or are viviparous. Some of them have the tail ending in a spine, while others have this organ terminating in a rattle.

Amongst the former, or spine-tailed species, are the LANCE-HEADS (*Craspedocephalina*) of the New World. Several species are natives of the West India islands, as well as the continent of America, where they inspire the natives with great fear and horror. The poison of their fangs is very deadly, and yields in nothing to that of the Rattlesnake. They are bold, fierce, and powerful, and, as if aware of their superiority, appear tranquilly to await the approach of their enemies. Rolled up in spiral convolutions, or negligently stretched on the ground in the midst of the warm and humid forests, they lie in wait for their prey. Once touched with their deadly fangs, the poor animal attacked soon dies, and affords a meal for their powerful foe.

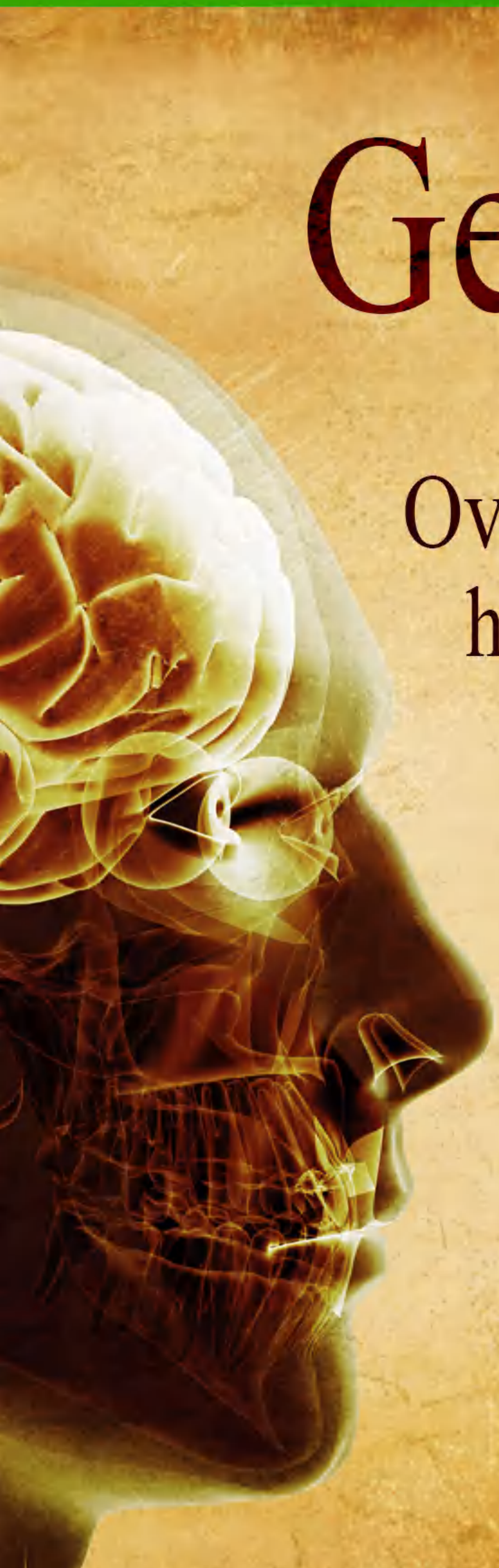
Fig. 10.



The Fer-de-lance (Craspedocephalus lanceolatus).

THE FER-DE-LANCE of the West Indies (*Craspedocephalus lanceolatus*)—fig. 10—is one of the most deadly species of this group. This much-dreaded serpent is generally, when adult, about five or six feet long, though specimens have been taken which measured seven and a half feet in length, and from four to five inches in circumference. It varies very much in colour. Some are of a yellow hue of different shades; some are brown,

* From the Greek word krotalon (κροτάλον), a bell or rattle.



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thick, swollen-looking body, becoming slightly more slender towards the tail. The colour is dark olive above, and yellowish-white beneath. It is found in Bahia, and the hotter parts of Brazil towards the banks of the river Amazon, where it feeds upon birds and small mammalia, as squirrels, &c. In length it varies from three and a half to four and a half feet, with a circumference of four inches about the thickest portion of the body.

THE BODROO PAM of India (*Trimesurus viridis*)—Plate 4, fig. 2. As the Lance-heads are natives of the New World, so the *Trimesuri* are confined to the hot regions of the Old World. They are almost all found in Asia. The head of the Bodroo Pam is flat, and much broader than the neck, and its mouth is large and furnished with very long fangs. It is about two feet six inches in length, and is of a fresh green colour. The first and almost the only account we have of this snake is given to us by Dr. Patrick Russell, in his "History of the Serpents of India." A specimen was brought to him by some natives of the upper country from Tranquebar. When he first saw it, he tells us, it looked fresh and lively, was very alert, hissed, and snapped at everything opposed to it, yet did not offer to touch a chicken which was walking about in the same room. In preparing for an attack, it wreathed its neck and part of its trunk into rather close turns, and at the same time retracted its head. "The remarkably long slender fangs, exposed on opening the mouth, betokened its being highly noxious; but the peasants who brought it affirmed that its power of killing extended only to the smaller animals—not to dogs or sheep; and that to man its bite caused various disorders, but never death.

THE SOUROUCOUCOUS, belonging to the genus *Lachesis*, are natives of Brazil and Peru. They are known also by the name of the Dumb Rattlesnakes, from their resemblance to the real Rattlesnakes, with the exception of their tail having no rattles, and their being therefore incapable of making the noise these latter serpents produce by means of that organ.

THE BRAZILIAN SOUROUCOUCOU (*Lachesis mutus*) is one of the best known of all the poisonous snakes of that country. It is also the largest, for Spix informs us that it sometimes acquires a length of nine or ten feet, and a circumference in body of more than twelve inches. It is found in tolerable abundance throughout the whole of Brazil, inhabiting dark, sombre forests, where it keeps concealed under leaves. Its food consists of small mammalia, birds, and some kinds of reptiles. The bite of this snake is said to be fatal.

The CENCHRINA are also natives of America, but appear to be confined to the United States.

THE WATER VIPER, or WATER MOCCASIN (*Cenchris piscivorus*), is a native of the Carolinas, of the Floridas, Alabama, and the tributaries of the river Mississippi, as far as Tennessee. It is about two feet in length, and five inches in circumference round the body, which is very robust and thick, even to the tail, where it contracts suddenly. The tail is short and thick, convex, and terminates in a horny point. The head is very large and triangular, and the eye is large, though it does not appear so at first sight, from the projection of the superior orbital plate. Catesby, in his "Natural History of Carolina," was the first to describe this snake. "The back and head of this serpent," he says, "is brown, the belly marked transversely with black and yellow alternately, as are the sides of the neck. The neck small, the head large, armed with the like destructive weapons as the rattlesnake, which next to it is reckoned the largest of any viper in these parts, and, contrary to most other vipers, are very nimble, and particularly dexterous in catching fish. In summer great numbers of these serpents are seen lying on the branches of trees hanging over rivers, from which, at the approach of a boat, they drop into the water, and often into the boat on the men's heads. They lie in this manner to surprise either birds or fish; after these last they plunge, and pursue them with great swiftness, and catch some of a large size, which they carry on shore and swallow whole." Holbrook, in his "North American Herpetology," gives a similar account of this snake, adding a few particulars in addition to what has been given above by Catesby. He informs us that it is found about damp, swampy places, or in water—far from which it is never observed. "In summer numbers of these serpents are seen resting on the low branches of such trees as overhang the water, into which they plunge on the slightest alarm." Catesby, he thinks, is wrong in considering that they select these places in order to watch for prey. They merely choose them, he says, in order to bask in the sun, for in situations deprived of trees, such as the ditches in rice fields, they may be seen basking near these on dry banks. "They are the terror of the negroes that labour about rice plantations, where they are dreaded more than the rattlesnake, which only bites when irritated, or in self-defence, or to secure its prey. The Water Moccasin, on the contrary, attacks everything that comes within his reach, erecting his head and opening his mouth for some seconds before he bites. I have placed," continnes Mr. Holbrook, "in a cage with the Water Moccasin several of the harmless snakes at a time; they all evinced the greatest distress, hanging to the sides of the cage, and endeavouring by every means to escape from the enemy, who attacked them all in turn. Two animals of his own species were then thrown into the cage; he seemed instantly aware of the character of his new visitors, and became perfectly quiet. Indeed, I have often received four or five of these animals in safety, after their having peaceably travelled together a journey of fifty miles in the same box. The food of the Water Moccasin is such fish as he can overtake—and few exceed his velocity in swimming—and whatever small reptiles, as frogs, toads, tadpoles, &c., that fall in his way."

The species belonging to the second group, or those which, instead of a spine at the end of the tail, have this organ terminated by a series of plates called a rattle, are few in number. Three of these belong to the genus CROTALOPHORUS, a genus in which the rattles at the end of the tail are few in number and not well developed, and consequently make but a feeble noise, or even sometimes none at all.

THE GROUND RATTLESNAKE, or SMALL RATTLESNAKE (*Crotalophorus miliaris*) is the best known

species of the three. This serpent has a very large head of a triangular shape, broad behind, and truncate at the snout. It has large eyes, with black pupils and a brilliant iris, the upper half being very bright yellow, and the lower black. The mouth is large, and provided with strong jaws. The neck is greatly contracted, and the body is elongated, but thick in proportion, even to the tail. This organ is short, conical, and sustains an uncertain number of rattles. The general colour is pepper-and-salt gray, with a central series of brown spots along the back, and a double series of blackish spots on each side. It is about sixteen inches in length. The Ground Rattlesnake is very common in the Southern States of America, and has a wide range, abounding in Carolina and Georgia, passing round the southern extremities of the Alleghanies to Alabama, Mississippi, and Louisiana. It is chiefly in dry places where it is found, living amongst leaves and in high grass, amongst which it may be often seen searching for small field-mice, on which it feeds. Holbrook informs us that it is greatly dreaded, as it gives but a very slight warning with its rattle. Hence it is often trodden upon; and, from its habit of frequently coiling itself on fallen trees, logs, or the stumps of felled timber, persons have been known to sit upon it, ignorant of its presence till bitten. It is a bold animal, will frequently be the aggressor, and will not retreat when threatened By the common people its bite is erroneously thought to be more destructive, and its venom more active, than some of the species which are much larger.

TRUE RATTLESNAKES.

There are two distinct species of Rattlesnakes—one peculiar to South, and the other to North America. They have been celebrated from the earliest periods after the discovery of the New World, both from the dangerous nature of their bite, and the peculiar appendages, called rattles, attached to their tails. When that vast continent was sparsely inhabited, and formed the abode only of the wild Indian; before civilization had spread her blessings over the country—Rattlesnakes must have abounded to a much greater extent than they do at the present time. Indeed, were we to trust to the relations of many of our earlier travellers, America would appear to have been almost uninhabitable, in consequence of their ravages, and the terror they inspired. Like other wild and savage animals, however, Rattlesnakes fly before the advance of civilized man. According to the statements of some of the early writers on America, these snakes were often found seven, eight, and even ten feet in length, and Bartram assures us that he has often seen them six feet long, and as thick as a man's thigh. At the present day, however, few are found which arrive to any great size. To the religious respect in which they were originally held by the savage occupiers of the soil, who regarded the death of one of these serpents as a public calamity, has succeeded a hatred so inveterate that in many settlements a price has even been set upon their heads. They have accordingly become so rare, that M. Bosc says that some years ago, in the neighbourhood of Charleston, he saw but six or seven individuals in the course of a year. A later writer still, Mr. Holbrook, says:—"At present the Rattlesnake is seldom met with, keeping far from all settlements where its greatest enemy, the hog, is to be found. Even sportsmen are seldom under any apprehension on this account." The Rattlesnakes have a peculiar aspect. Their head is large, broad, triangular, and generally flattened through its whole extent. The hinder part of the cranium is covered with scales like those of the back; but the muzzle and temples are clothed in large scales in the form of plates. The body is stout and of a robust form, elongated, cylindrical, and covered above with keeled scales. The tail is short, cylindrical, and rather thick, and is terminated by a series of large, dry scales, termed the rattle. The number of these is very uncertain, varying from one to thirty, or even more. These rings or scales are all exactly like each other in form, and often even in size. They are composed of a brittle, elastic, and semi-transparent matter, of the same nature as that of the ordinary scales. The one nearest to the body; and with which it is immediately connected, forms, as do likewise all the rest, a sort of a hollow quadrangular pyramid, the two opposite faces of which are much larger than the two others. United, they form a kind of sheath which envelops the last joints or vertebræ of the tail, being moulded upon them. They are all received within each other, to such an extent that only one-third of each is visible externally. The ring situated at the end of the rattle, is the only one the whole form of which is seen, and thus the rattle is composed externally only of that ring and the upper thirds of the others. The two lower thirds of each ring, which cannot be seen, are placed within the following piece; they occupy the hollow of it, keeping the ring in its place, and preventing it separating from the rest of the rattle. But, as the diameter of that portion of the ring is less than that which receives it, each one plays freely within the other. None of them, except the one nearest the body, is united to the skin of the animal, nor do they hold any connection with the body by any musole, nerve, or bloodvessel. They consequently receive no nourishment from the body, and do not increase in size; they form only an external envelope, which moves when the animal agitates its tail, in the same manner as any foreign body would move, which might be attached to it. All the rings of the rattle being very dry, placed one above the other, and having all sufficient play within each other, to rub mutually against each other when they are shaken, it is not surprising that they should produce a very sensible sound. "Indeed," says Lacèpéde, "we have proved that a rattle of moderate size will produce a noise similar to that of the crumpling of a piece of parchment, which may be heard at the distance of more than sixty feet; and it is much to be desired that it could be heard still further, in order that the approach of a Rattlesnake, being less unforeseen, might also be less dangerous." Mr. Bosc, however, who has had opportunities of seeing these reptiles alive, says that the noise produced by them could not be heard further off than from twelve to fifteen paces; and that when the animal was moving at its usual rate, it was necessary to be close to it, and even listen very attentively to dis-

tinguish the sound. Rattlesnakes are said by many of our earlier writers to exhale a nauseous and fetid odour, which spreads to a considerable distance around them. By many fond of marvellous tales, this is believed to be the secret of the fascinating power ascribed so commonly to this reptile. With regard to this attribute of serpents we have already made some general remarks at page 38, to which we refer the reader. We will only further quote Mr. Holbrook's opinion upon this power in the Rattlesnake: — "As to the fascinating or charming power of the Rattlesnake, I have every reason to believe it a fable; a modification of that of the basilisk of the ancients, a creature whose deadly glance would alone prove fatal. The Rev. Dr. Buchanan, an excellent naturalist, also informs me, that he has more than once observed Rattlesnakes watching for hours at the root of large trees, on the branches of which sported some innocent squirrel, unconscious of the 'charmer below;' but woe betide him should he descend to the earth in search of water, or of fallen nuts or acorns. There are even still more tales of the charming power of the Black snake than of the Rattlesnake, to whom it would be useless; for he is bold, lively, active, and climbs the loftiest trees in pursuit of his prey, while the Rattlesnake waits patiently below." The food of the Rattlesnake consists of birds, squirrels, rabbits, rats, &c.; and in addition to his so much vaunted fascinating power, he has been endowed by some writers with the gift of climbing trees with great dexterity. This, however, does not seem to be the case, and as Mr. Holbrook justly observes, his organization seems ill adapted for it. His body is thick and clumsy; the tail is short, and not apparently calculated for laying hold of objects; and the rattles too which terminate this organ would form an awkward appendage in climbing. On the contrary, in those serpents which do climb trees with facility the body is slender, the tail very long and delicate, and may with ease be used as a prehensile instrument. When full-grown, the Rattlesnake is naturally of an indolent and sluggish nature. His movements are slow and inactive, and he lies quietly in wait for his prey, stretched on the ground in the form of an S, and never attacks man unless provoked or irritated. He seems to have somewhat of a magnanimous dispositiou, and never wantonly destroys other animals, except as food for himself. A very slight touch, however, or even a noise close at hand, will disturb his repose, and he then immediately coils himself up, shakes his rattles violently in sign of rage, and strikes at whatever is placed within his reach. In his native woods one may pass within a few feet of him unmolested, though aware of the passenger's presence. He either lies quiet, or glides away to a more retired spot. Mr. Holbrook says, "He never follows the object of his rage, whether an animal that has unwarily approached so near as to touch him, or only a stick thrust at him to provoke his anger, but strikes on the spot, and prepares to repeat the blow; or he may slowly retreat like an unconquered enemy, sure of his strength, but not choosing further combat. It is remarkable that he never strikes unless coiled; so that if once thrown from this position, he may be approached with less danger."

Though the natural habit of the Rattlesnake is that of indolence and sluggishness, his movements, when he is roused to bite, are extremely rapid; and, contrary to the ordinary custom of most serpents, he is not content with biting once, but bites again and again with astonishing celerity. Spix describes the motion of his head at such times to be like that of the woodpeckers tapping the trees in search of insects; and Lacèpéde informs us that, in reference to this rapidity in striking his prey, the Rattlesnake is called in Mexico *Ecacoatl*, or *the Wind*. In the colder parts of America, Rattlesnakes pass the winter in a lethargic state. They take up their abode in secluded spots, in holes in the ground along with toads, &c., or under masses of the sphagnum or bog moss, in marshy soils, and remain there till after the vernal equinox. During this time they appear to have no inclination to bite; and even when they do, as long as the cold weather continues, their bite is not dangerous. In the summer months, however, and more especially in the month of August and in the beginning of September, their poison is very fatal. The slightest prick at such times, it is said, will suffice to kill the largest animal. The effects of the poison of this reptile upon man are very alarming. They depend, however, a good deal upon circumstances. It does not affect all individuals equally. For example, it is said—and experience seems to confirm the fact—it has less influence upon a fat than upon a thin person; less upon an Indian or negro than upon a white man, and more upon a stranger than a native. It is less dangerous, also, according as it has wounded only fleshy parts; whilst it is almost sure to be fatal if the fang has punctured the smallest bloodvessel, especially if it be on the upper part of the body. Many remedies have been employed against the direful effects of such poison, but up to the present time few are known that possess any efficacy. Rattlesnakes, as has been already mentioned, are viviparous, and they have, most probably unjustly, been accused of eating their young. M. Palisot de Beauvois, and most naturalists who have observed them in their native haunts, deny this; and this last-mentioned traveller accounts for the assertion so boldly made by some writers, by stating as a fact that they, in times of danger, receive their young into their mouth and throat as a place of refuge. In the first journey made by this naturalist in the country of the native *Tcharlokee* he saw a Rattlesnake in his path, and approached it as softly as possible. At the moment when he was about to strike it, the animal shook its rattles, opened its throat wide, and received into it five little ones, each about as thick as a goose quill. At the end of ten minutes, however, during which he had watched the reptile's motions, believing itself out of danger, he observed it open its mouth again, and let the young ones out, receiving them into it afresh at the appearance of a new danger. These reptiles have many foes, but their chief foe is the common hog, which devours them in great numbers in places where they may happen to abound. Other serpents, too, larger than themselves, destroy them; and man, with his progress of civilization, is now sweeping them before him. In former times, and to a certain extent in some places still, the Indians never

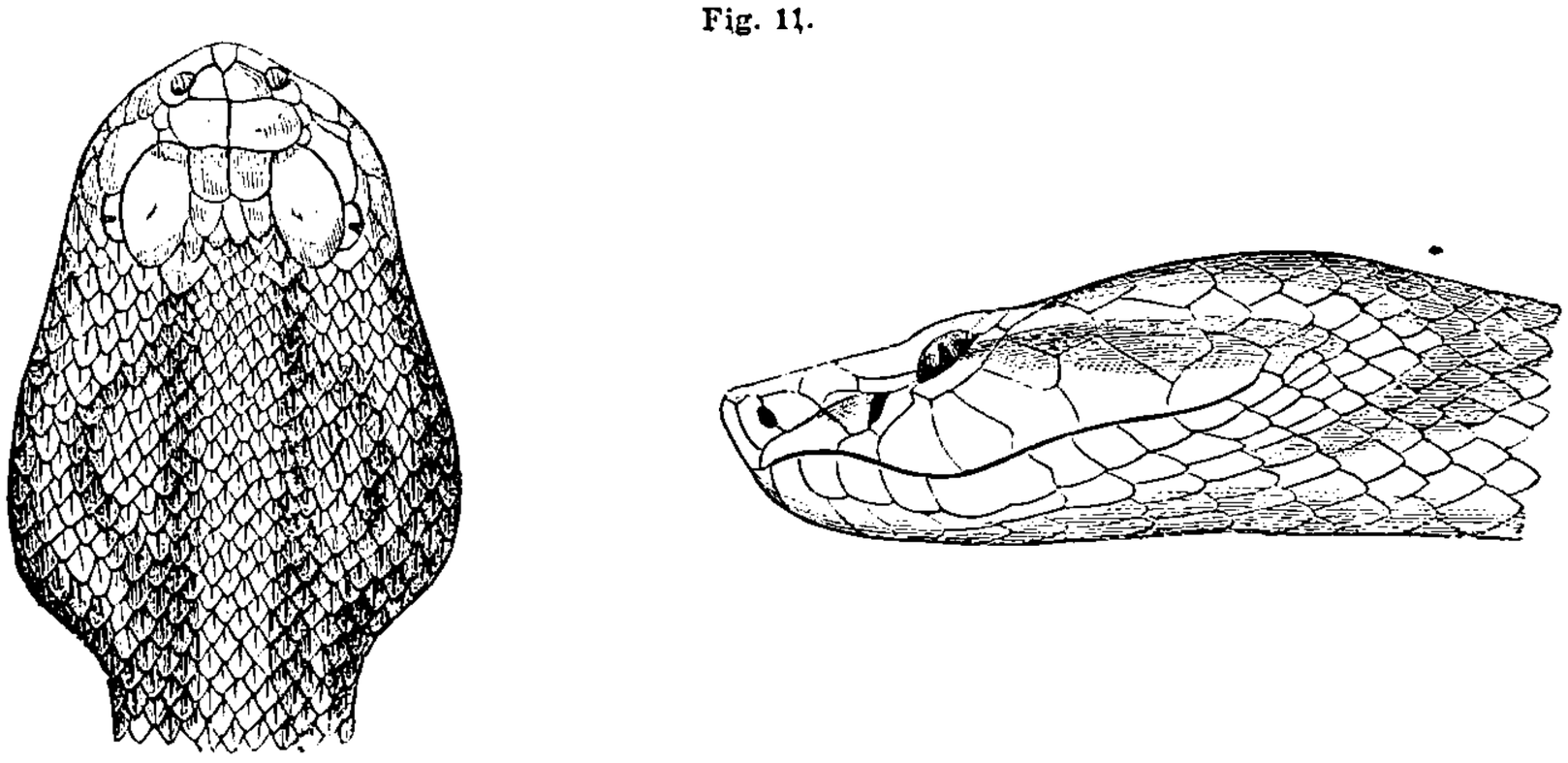
killed the Rattlesnake, as they believed that if they did, the spirit of the killed snake would cause his living kindred or relations to revenge his death upon them. Bartram relates some amusing instances of this superstition among these people in his "Travels in the United States."

THE COMMON OR BANDED RATTLESNAKE (*Uropsophus durissus*) has the widest range of all the species of this family, being found, according to Mr. Holbrook's account, in nearly all parts of the United States. Kalm, the Swedish naturalist and traveller, saw it in north lat. 45°, near Lake Champlain, and Mr. Holbrook says he has seen specimens from the borders of the Gulf of Mexico and as far west as Red river, while Say met with it in north lat. 40°, on the Mississippi. It is the species figured in Plate 4, fig. 3. The head is very large and triangular, broad, and truncate anteriorly, covered with plates only in front, and with minute scales on the crown and back part; the nostrils are large, and very near the snout, but open laterally; the eyes are large, and extremely brilliant when the animal is enraged; the mouth is large, and the jaws strong; the neck is very much contracted, and covered with carinated scales larger than those on the head; the body is elongated, but thick, and covered with rough, carinated, rhomboidal scales above, and broad plates below; the tail is short, slightly conical, and sustains a greater or less number of rattles; the neck and body are of a pale ash colour, with a line of yellow along the back, including three scales; the body is marked with a triple series of dark irregular blotches and bars along the back; the belly is of a dirty reddish-straw colour, freckled with minute black dots.

The Banded Rattlesnake was first made known to naturalists by Catesby. In his description of poisonous snakes in the Carolinas, he says—"Of these Vipers the Rattlesnake is most formidable, being the largest and most terrible of all the rest. The largest I ever saw was one about eight feet in length, weighing between eight and nine pounds. These are commonly believed to be the most deadly venomous serpent of any in these parts of America. I believe they are so, as being generally the largest, and making a deeper wound, and injecting a greater quantity of poison."

THE BOIQUIRA, or CASCAVELLA, by which names the other species of Rattlesnake is known (*Crotalus horridus*)—represented in Plate 8, fig. 3 and 3*a* (skeleton and skull), and fig. annexed—is a native of Brazil, Peru, and many other parts of South America; ranging indeed, according to Spix, as far as the Straits of Magellan. It was first made known by Marcgrave,

Fig. 11.



Head of Boiquira or Cascavella.

who described it soon after the discovery of America, and names it the Boicininga. Its habits are much the same as the species described above. It is larger, however, and, Spix says, may easily be distinguished by its very strong musky smell. Being larger and more powerful than the Banded Rattlesnake, it is no wonder that in the early periods after the conquest of America, the Cascavella should have created great dread and fear amongst the Europeans. In Brazil, Spix says, the bite of this reptile is generally fatal within thirty-six hours.

FAMILY II.—VIPERIDÆ (*Vipers*).

The second family of the Viperine snakes consists of the true Vipers (*Viperidæ*),* and form a very natural group. They are distinguished from the Rattlesnakes (*Crotalidæ*) by their face being destitute of the pit or depression which, in these latter, is observable on each side between the eye and the nostril. The rostrum or muzzle is covered with large scales, or shields, which are broad and hand-like. The scales of the body are (with one exception—the genus *Acanthophis*) always keeled, and those of the head are, in many species, elongated into a point, so as to form a kind of horn, which, placed as they generally are above the eye, give a very peculiar physiognomy to these reptiles. In form they are generally more thick-set and heavy-looking than the Rattlesnakes, and their tail is always short and conical. They rarely grow to any considerable size, varying from two or three to four feet. Their food consists of mice, frogs, lizards, and birds, &c. They prefer as their place of abode, open places, dry, arid, sandy, or covered with a sparse vegetation, and are exclusively natives of the Old World. With the exception of one species

* From the Latin word *vivipara*, viviparous.

discovered in Australia, and one which inhabits Great Britain, they are chiefly found in India and Africa, or in the South of Europe.

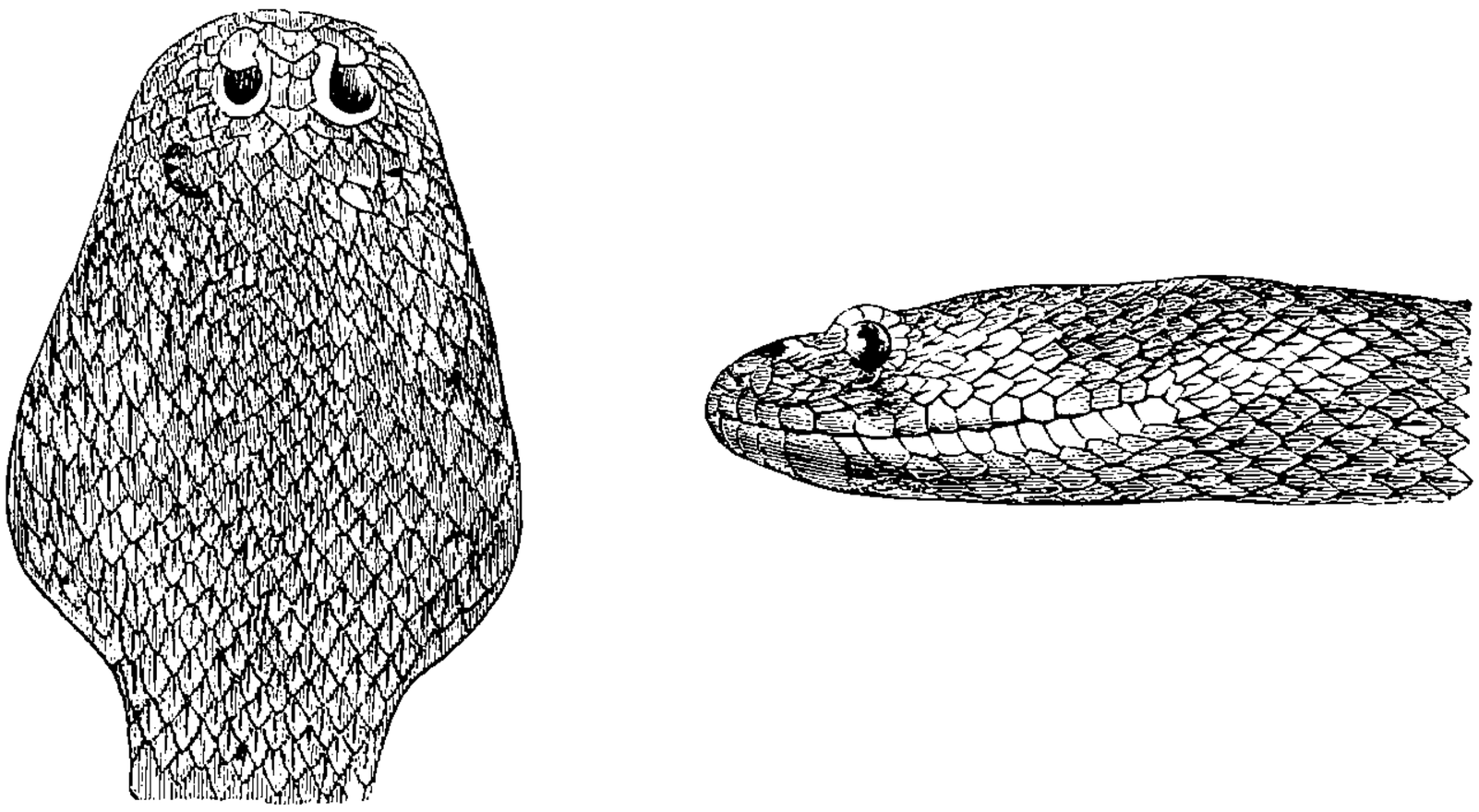
In some of the species belonging to this family, the head is covered with acutely-keeled scales; whilst in others it is covered more or less with large scales, plates, or shields.

GENUS CLOTHO.

In the first group the genus *Clotho* is most numerous in species, all of which are natives of Africa. The scales of the body are acutely keeled, the keels often terminating in spines.

THE PUFF-ADDER—fig. 12—of the Cape of Good Hope (*Clotho arietans*) is one of the best known species. This serpent is one of the most dreaded of all the colonists of the Cape, and is particularly alluded to by Dr. Burchell, who met with this serpent in the interior of that colony.

Fig. 12.



Head of Puff-Adder (Clotho arietans).

THE HORNED SNAKE (*Clotho cornuta*) is another species found at the Cape and in various parts of the colony, and is equally dreaded with the last. It is called by the colonists the *Hornsman*, from the fact that the scales over the eyes are prolonged into a clump of lengthened spines, forming a sort of short horn. In form this species is robust, the body being thick in the middle, and the tail short, conical, and pointed. It is from fourteen to eighteen inches in length, the tail measuring only about one and a half. Sir Andrew Smith has given a good description and figure of this serpent in his "Illustrations of the Zoology of South Africa." "Dry sandy districts," he says, "constitute the favourite *habitats* of this viper, which manifests all that indolence of character so remarkable among the various species of the family, and on account of which they are more dreaded by the natives of South Africa, than even snakes possessed of more virulent poison, but disposed to action on the approach of danger. According to good testimony, this species will continue for days together in one position; and as in South Africa, and is sometimes met with three and even, though rarely, four feet in length. The body is squat-shaped, and there are few species which have such a heavy-looking form. The tail is thick, blunt, a little compressed near the tip, and very short. The head is exceedingly broad, very much flattened, quite distinct from the neck, heart-shaped, and rounded on the sides. The eyes are small and nearly lateral, and the nostrils are placed near the extremity of the muzzle. It is of a yellowish-brown colour on the upper part, and is marked with three rows of large brownish-black spots, edged with yellow. The under surface is of a uniform yellow. It receives its name from its habit of attack. It is said that it can never injure a person placed in front of it, because, when it bites, it does so by making a spring and moving its head backwards. This is the common opinion amongst it never seeks to avoid danger, however imminent, its presence is rarely discovered unless when trampled upon, and the offending parts wounded by its fangs. Though generally inactive, it is by no means so when injured; its movements are then performed with activity; and when once it seizes the obnoxious object, it retains its hold with great determination, and some considerable exertion is often required to detach it."*

GENUS CERASTES.

In describing the Horned Viper of the Cape (*Clotho cornuta*), we mentioned the circumstance of some of the keeled scales of the head being prolonged so as to form a kind of horn, and in our preliminary remarks upon the *Viperidæ* (p. 45) we stated the fact as one peculiar to this family. This disposition and structure of these scales is in none of the vipers so remarkable as in the *Cerastes* or Horned Viper of Egypt. Over each eye we see one of these scales

* This description of the bite of this viper is different from what is observed in the species of the Rattlesnake family. See what we have said upon this subject at p. 44, and compare with p. 47 in the case of the common viper, *Pelias berus*.

developed much more than any of the others, elongating themselves into a point, and presenting exactly the appearance of a horn on each eyebrow. As Schlegel remarks, this anomaly in the organization of this serpent, more curious than of any real scientific value, has not failed to excite in the highest degree the admiration of mankind, and to occupy their imagination from the earliest periods of time to our own days. The Egyptians, of whose country this viper is a native, and who were fond of the marvellous, have accordingly frequently figured it in their hieroglyphical writings on their ancient monuments. It was pointed out by them to strangers as one of the most redoubtable of beings, and it was related of this formidable reptile, that in some remote period of antiquity an invasion of a host of them had actually depopulated a part of their country. The name of the genus, *Cerastes*, has been given to it from these horns, being derived from the Greek word *keras* (κερας), a horn. These appendages, however, do not exist in all individuals, and perhaps are peculiar to the males; though the want of them has induced some naturalists to describe those in which they were absent as constituting a distinct species.

THE CERASTES (*Cerastes Hasselquistii*)—Plate 4, fig. 4—resembles in general form our common viper, but its body is much thicker in the centre and less compressed. The back is somewhat keeled, and the tail is slender, very short (only about a tenth of the whole length) and terminates in a very fine point. The head is very large, distinct from the body, and covered with scales of an irregular form, smaller than those of the trunk, and all keeled. In the males, one of these scales developes itself into a lengthened point two or three lines long, which rises immediately over the eyes on each side, and gives a resemblance to a small horn. They are furrowed throughout their whole length, and are very movable. Their uses, if they can be at all of use to the animal, are entirely unknown, but numerous conjectures and assertions have been made about their nature. The eyes have a yellowish-green iris, and their pupil is narrow and vertical. The Cerastes is generally of a very pale brown colour, or a pale yellow shading into grayish-brown, on the upper part of the body, with five or six rows of deeper spots of rather irregular shape and unequal size, but generally pretty regularly disposed. The under part of the body and throat are usually white. The tail is often black at the tip. The usual length of this species of serpent is about two feet, though Bruce says, it is only thirteen or fourteen inches. We are indebted to this traveller for many interesting particulars with regard to the Cerastes. It inhabits the vast, burning deserts of Northern Africa. Shunning humid and marshy situations, it is found only in the hot, arid sands of Egypt, Syria, and Arabia. It lies all day in holes in the sand, and is found in close contiguity to the Jerboa, which lives in similar habitations, and which forms part of this reptile's food.

GENUS VIPERA.

In the second group of the true Vipers, or those in which the head is more or less covered with large scales, plates, or shields, the genus *Vipera* is pre-eminent. There are three species natives of Europe, and all resembling each other in general appearance. They differ, however, in the arrangement of the plates, and in the shape of the head; and according to some of the latest writers, have even been divided into two distinct genera. In form they are rather less squatly-shaped than the species which we have just been describing, and they are more slender at the two extremities. The head is not so large as in many of the other viperine snakes, and is more elongated. It is flat on the crown and scaly, high on the sides, and shielded in front. The muzzle is rounded. The eyes are always shaded by a plate over the eyebrows, and the pupil is oblong and erect.

THE COMMON VIPER or ADDER (*Vipera* or *Pelias berus*, represented Plate 4, fig. 3) is the most abundant and the widest-spread of the three species. It seldom exceeds two feet and a half in length, and in this country perhaps never reaches that extent. The circumference of the body is generally that of a man's thumb. The head is somewhat depressed, almost oval, slightly widening behind the eyes, and terminated by a somewhat conical muzzle bluntly rounded at the tip. In general it is of an olive or brown colour, with a series of confluent, rhomboidal, black spots along the back, and a row of small, irregular, triangular spots on each side. The colours, however, vary considerably according to sex, age, climate, &c., and in the female the body is somewhat thicker than in the male, while the tail is shorter and more slender. This species is spread over the greater part of Northern and Central Europe, extending probably to some parts of Asiatic Russia. It is common in Great Britain, and is happily the sole representative of the poisonous serpents in these isles. It is abundant in many parts of Scotland, England, and Wales, but has never been met with in Ireland. It frequents heaths, dry woods, and banks; preferring districts exposed to the rays of the sun, where there exists a plentiful supply of food, and which contain numerous holes which may serve it as places of retreat. Its food consists in great part of field-mice, and thus we find the Adder always most abundant in such places as these little mammalia are in the habit of frequenting, and it is such holes as they dig that these reptiles choose as their place of abode. On the continent of Europe it appears to shun places covered with large trees, and forests where the rays of the sun do not penetrate, preferring on the contrary rocky places, or situations covered with small brushwood. Wherever it is found it is universally dreaded. In this country its bite is seldom or never attended with fatal results; but at the same time the symptoms produced by the venom are distressing in the extreme, and in warm countries, and during the height of summer, may even terminate in death. The manner in which the Viper inflicts a blow is thus described by Professor Bell:—"The animal generally throws itself in the first place into a coil more or less close, and the anterior part of the body is raised. The neck is bent somewhat abruptly backwards, and the head fixed almost horizontally. In an instant the head is, as it were, launched by a sudden effort toward the object of its

anger, and the erected tooth struck into it, and withdrawn with the velocity of thought. The action, however, by which it takes its prey is very different from that which it employs in its defensive attack, and resembles that employed by the harmless snakes. It seizes its prey at once, and immediately begins to swallow it. In winter the Viper seeks some safe and secret place where it passes the cold weather in a state of torpidity, and in this retreat—holes made by field-mice, &c.—we may often see several twined together. The Viper is ovoviviparous; that is, the moment the mother expels the egg, the membrane investing it bursts, and the young serpent immediately crawls about and assumes all the activity and virulence which distinguish the species, throwing itself into an attitude of defence if molested, and hissing with anger. The number of young produced at each birth varies from twelve to twenty, or even more. We have already said, that the bite of the Viper seldom or never proves fatal in this country. "We are not aware," says Mr. Broderip, "of any well authenticated case of a person bitten by a Viper terminating fatally;" and to this fact, more than to the remedies used, is perhaps to be attributed the exemption from evil consequences of the old viper-catchers who, in Dr. Mead's time, used to parade their experiments and vaunt the efficacy of their infallible cure. In the presence of this physician some of these men, confident of their remedy, suffered themselves to be bitten by active-looking vipers. The method of cure consisted in rubbing the wound with olive oil over a chafing-dish of coals, and taking large doses internally. Formerly the flesh of vipers was considered to possess wonderful virtues in the cure of disease, and the belief in the efficacy, as an invigorating restorative, of "viper broth," lingers still in many parts. "Sir Kenelm Digby's beautiful wife was fed on capons fattened with the flesh of vipers."

THE ASP OF LINNÆUS (*Vipera aspis*), another European viper, is considered by many naturalists as merely a variety of the common viper. It is, however, a distinct species, and the mistake has arisen from the fact, that in France the common viper is not sufficiently well known, and thus some varieties of the asp, which is the more common of the two species in the southern parts of that country, have been mistaken for it. It differs, however, in being of a thinner shape, in the head being broader, the crown being covered with small smooth scales, and the nose being somewhat elevated and recurved. The general colour is olive, and it has along the back four rows of dark, generally isolated spots, the two rows along the spine being close together, and sometimes running one into the other. The asp is very common throughout all France from 49° of N. lat. to Savoy, the Pyrenees, and the coast of the Mediterranean. It abounds at Fontainbleau and in the woods of Montmorency; but towards the north of France, and in Burgundy, it is replaced by the common viper. It is found also in the dry rocky countries of Italy, has been observed in Switzerland, and extends from that as far as Venice. The habits of the asp are much the same as those of the common viper. This species must not be confounded with the asp of Cleopatra, which is a species of *Naja*, see p. 65.

THE AMMODYTE (*Vipera ammodytes*), the "Sand-natter" of the Germans, is the third species of European vipers. Though similar in colour and general appearance to the other species mentioned above, it nevertheless varies in several respects. Its body is very thick in the middle, narrowing towards either extremity, especially the hinder, and terminating in a very short and slender tail. The principal characteristic mark, however, and one which separates it from the others, is the tip of the muzzle being elongated into a conical, fleshy nose, elevated perpendicularly. This organ is covered in front with two pairs of small plates, and behind by several small scales. The prevailing colour, like that of the two preceding vipers, is an olive, the back being marked with a broad streak of brownish-black, of an angular or zig-zag appearance. The under surface is pale, and the sides are closely, darkly punctulated. The tip of the tail is most frequently of a fine red hue. The Ammodyte attains to a large size. Schlegel mentions an individual being as thick in circumference as a child's arm. It inhabits Dalmatia and Illyria. Carinthia and Hungary possess it; but it is doubtful whether it occurs at all in France, though it has lately been discovered in Sicily and in the Morea. Its habits are much the same as those of our common viper, and its places of abode are dry, rocky, or sandy countries, open or covered with a sparse vegetation. M. Cantraine informs us that he very often met with it in Dalmatia in the course of his rambles, and that it is so common in certain places, that people are obliged, when walking out, to wear thick boots to protect themselves from its bite. When it bites it raises its head and draws it backwards, previous to inflicting the stroke. Though naturally of an indolent disposition, it becomes more lively and active during the hot weather of summer. The Ammodyte, according to the testimony of M. Host, appears to be a nocturnal species of serpent, and commits great havoc amongst field-mice, small birds, and many lizards. It falls a prey itself, however, to one of that tribe of animals. The Scheltopusik (*Pseudopus Pallasii*) is one of its most redoubtable and bloody enemies. Shielded by its cuirass of tile-like, hard scales, it is proof against the fangs of the viper, attacks it with impunity, and devours it at leisure.

poison gland is also less developed than in the true venomous serpents, forming a narrow pear-shaped sac. The skin which covers the body, is very loose and easily detached, and the scales upon it are generally small, in some so much so, that when the skin is distended the body looks as if deprived of its epidermis. There is a peculiarity in the structure of the lung (for there is only one) in sea-snakes which adapts them for their method of living. It is a long narrow canal, swollen out in some parts of its course into tolerably sized sacs; and as it extends as low down as near the extremity of the intestine, it fulfils at once both the function of an organ of respiration and a swimming bladder.

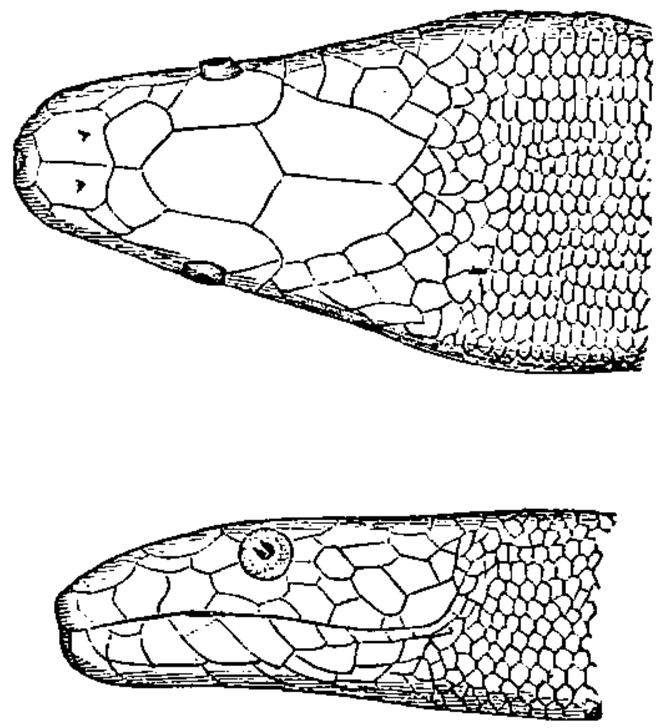
Sea-serpents were known to the ancients, but unfortunately they often confounded with them various fishes of an elongated eel-shaped body. They seem to be confined to the intertropical seas, or those in the neighbourhood of the tropics. They are sometimes found in the open ocean at great distances from land, but in general they appear to prefer living near the shore, or in the mouths of large rivers where they find an abundant supply of food; such places as the Sunderbunds which form the delta of the Ganges. All the species belonging to this family, without exception, are venomous, though some naturalists have asserted the contrary. Differences of opinion, too, exist with regard to their nature and disposition; several naturalists and travellers asserting them to be of a gentle and peaceable temper, while others maintain the opposite. Dr. Russell found in one or two species, that no provocation could excite them to bite. M. Lesson, after inclosing them in vessels with fowls, was not able to make them attack the birds. M. Siebold, on the testimony of Schlegel, asserts that the pelagic serpents are not of a fierce disposition, and that during his voyage from Batavia to Japan, he has caught many with a hand net, landed them into the boat, and that the sailors handled them without fear or any bad effects. Professor Reinwardt, who has frequently met with these serpents, confirms Siebold's account of their quiet, gentle disposition. Dr. Cantor, on the contrary, who had abundant opportunities in India of seeing them, declares that they are highly venomous and dangerous. After taking notice of the opinions mentioned above, he says, "an assertion like this, may easily mislead travellers, who by carelessly handling animals provided with weapons of the most dangerous description, are, if wounded, certain to pay with their life for their temerity. I must therefore from my own experience, assert that those species which I have observed in the Bay of Bengal and the Gangetic estuaries, are of very ferocious habits, as well in as out of water."

Their motion in the water is very active and graceful, and is described as being a sort of gliding on the surface, when the sea is calm, raising from time to time their head above the wave, perhaps to breathe. They are able swimmers, and their movements are executed by repeated strokes of the tail from right to left, succeeded by a lateral and undulatory motion of other parts of the body. At times their agility is described as being extreme, and their swimming most rapid. When removed from the sea, however, they become blinded, by the light contracting the pupil; and then, in addition to the difficulty which they experience whilst attempting to support their sharply-keeled bodies on dry land, their movements become just as uncertain and maladroit as they are nimble and swift in their own element. Taken from the sea, and placed on dry ground or in fresh water, they soon die.

The size of these serpents varies in the different species. Some are not more than two feet and a half long, whilst others reach a length of five feet. The females are ovoviviparous, but the sexes cannot be distinguished externally. These sea-serpents are usually of a yellowish colour, shading sometimes to a green, sometimes to a blue, or to white, and most frequently relieved by numerous blackish bands, or by large lozenge-shaped spots disposed in a transverse manner along the back. In the young the colours are generally of a brighter hue than the adults, and these feed upon small floating crustacea.

THE BLACK-BACKED PELAMIS (*Pelamis bicolor*), or the NALLA-WHALAGELLEE PAM—represented in Plate 4, fig. 5, and fig. 13 annexed—being common in all the parts of the sea frequented by sea-snakes, is perhaps the one best known in European collections. It is about two feet four inches in length, and about three inches in circumference in the thickest part. The skin is very loosely attached to the body, and is uniformly covered with small hexagonal scales disposed in such a manner as to resemble the stones of a pavement. The body is strong and thick, of a cylindrical form in the anterior part, but becoming compressed posteriorly, and terminating in a short, thin, flat tail, of a

Fig. 13.



The Black-backed Pelamis (Pelamis bicolor).

lanceolate form, and broadest at its extremity. The head is long, compressed, and projecting into an obtuse beak. The mouth is large, and the eyes are lateral and of good size. The head and beak are of a black colour, and the sides and belly yellow, with some obscure, black, round spots towards the tail, which is singularly spotted with white, black, and yellow. This species is the most widely diffused of all the Pelagic serpents. It is common on the coast of Coromandel, Pondicherry, Malabar, and Bay of Bengal. It has been met with on the coasts of Java, Borneo, New Guinea, in the Sea of the Moluccas, near the Celebes,

off Port-Jackson in Australia, and on the coast of New Zealand. It occurs also in the Pacific Ocean, and is said to be eaten by the natives of Tahiti. Dr. Russell says that the fishermen of Vizagapatam assert that it seldom approached the shore, and that it was a very dangerous reptile.

THE KADELL NAGAM (*Microcephalophis gracilis*) is also a native of the Indian seas; Dr. Russell, who was amongst the first to describe it, having received his specimens from the coast of Tranquebar. It has a very small head, a very long and slender neck, and the body, which is of a considerably larger size, becomes a little compressed as it approaches the tail, which is short, flat, and two-edged. It has a narrow mouth, small teeth, and very small globular eyes. It attains the length of two feet nine inches, and is of a bright blue colour, with cross yellow bands, more especially on the neck and tail. The belly is of a lighter yellow, with faint blue bands. According to Dr. Russell, the bite of this serpent is reputed by the natives of India to be not less dangerous than that of the cobra de capello.

THE VALAKADYEN (*Enhydrina valakadyen*), from the Indian seas, has a cylindrical body, of nearly equal thickness throughout, or slightly swollen in the middle, and a short, compressed, double-edged tail. It has an oblong, compressed head, a wide mouth, a blunt muzzle, and small round eyes, placed high on the head. It is about three feet three inches long, the tail of itself being four and a half inches. The upper part of the body is of a bluish-gray colour, and the belly yellow.

The Valakadyen, as it is called by the natives of India, is represented by them as very venomous, its bite being asserted to be infallibly mortal, if proper remedies are not instantly applied. Schlegel considers this species to be identical with another serpent described by Dr. Russell under the name of the Hoogli Pattee. This snake was one of which Russell had living specimens, and which he kept in order to test their venomous powers. A fowl bitten in the thigh by an individual of this species expired, he says, in five minutes.

THE ACROCHORDIANS (*Acrochordina*) are intermediate between the Pelagic or Sea serpents and the Fluviatile species. In this small family the head, instead of being covered with shields, is covered with small scales like those of the body, which are described by Dumeril and Bibron as granulated tubercles inserted into the skin. The species too, are for the most part found living in rivers. Schlegel considers them as boas adapted by their organization to live in water. They have the prehensile tail of these larger serpents, but at the same time this organ is in general flattened so as to serve the purpose of an oar or rudder. The head and teeth are on the same type as the boas; but the position of the nostrils and eyes, the manner in which the mouth can be hermetically closed, the compressed form of the body, which is furnished with a keel on the under surface, and the absence of the spurs or hooks at the side of the vent, all bring them more closely to the Pelagic or Sea serpents. They have not yet been experimentally proved to be poisonous, nor are they incontestably innocuous. The species are few, and as yet have only been observed in intertropical Asia.

THE BANDED CHERSYDRUS (*Chersydrus granulatus* or *fasciatus*) is found in the rivers and on the edge of the sea, in the peninsula of Malacca and neighbouring islands, in the Bay of Manilla, New Guinea, Timer, Java, Sumatra, and the coast of Coromandel. In size it does not exceed three feet. Dr. Cantor found it in tolerable abundance in the Sea of Malacca, where it often occurs amongst the fishes taken in the fishermen's nets. A female taken in that way, he says, three or four miles from the coast of Penang, measured three feet long and four inches in circumference, and had six eggs. These were cylindrical, soft, or with a whitish membranous shell, and were an inch and a half long. Each egg contained a young one, eleven inches long. By its mode of feeding and its general habits, he adds, this serpent resembles the venomous Pelagic species. In the water it is lively; but on land, and especially in the light of day, it appears blind, and its movements slow and uncertain.

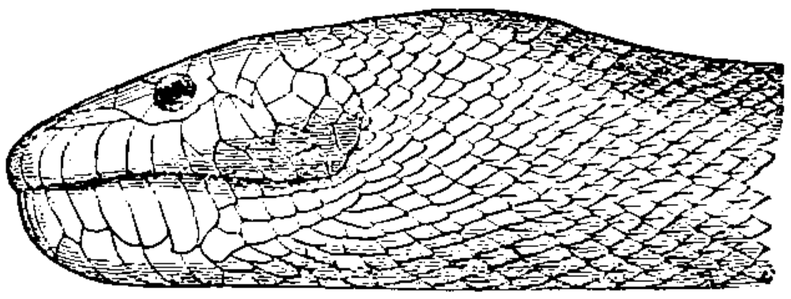
THE ACROCHORDE OF JAVA (*Acrochordus Javanicus*)—represented in Plate 4, fig 6—is of a very robust form, with a flattened belly and a conical tail, which is very short in proportion to the body, and terminates in a point rough with tubercles. The Swedish naturalist Hornstedt was the first to describe this serpent as occurring in the island of Java, and Dr. Cantor has since found it in the island of Penang. The Malays, says Dr. Cantor, declare this serpent to be rare. During a sojourn of twenty years at Singapore, Dr. Montgomery only observed a specimen once. The Malays know it by the name of *U'lar Karong* or *U'lar Laut*. The physiognomy of this serpent is said by Dumeril to resemble very much that of an English bull-dog, the head being broad and the muzzle short and blunt. The individual mentioned by Hornstedt measured eight feet in length.

THE FLUVIATILE OR FRESH-WATER SNAKES (*Homalopsina*) are nearly equal in number to the Pelagic group, about thirty-six being described in the Museum catalogue. We know relatively very little of their habits, most of the species which have been observed living almost continually in the water. They are almost all natives of intertropical countries, and have been met with in India and China, Java, Borneo, the West Indies, and the warm parts of North and South America. Many of them attain considerable dimensions, but they rarely exceed four feet in length, though they are as thick as a man's arm. The great proportion of them are truly aquatic, and appear particularly formed for peopling the immense extents of fresh waters found in the intertropical countries of Asia and America, and which swarm with fish, of which they make their chief food. They have a peculiar appearance. The great disproportions of form —a short, conical, and robust tail; a head extremely broad, thick, blunt, short, and covered with plates of a very irregular and inconstant form; a short obtuse muzzle; small nostrils, and little eyes directed upwards —all these characters concur to render the aspect of these animals at once hideous and disgusting. Nevertheless they are quite harmless, in spite of the malignity

of their appearance. The species are, generally speaking, of a very sombre hue. The upper part of the body is of a brownish olive or blackish tint; the under part is generally yellow, marked with large square spots, and some of the species are spotted, while others are adorned with rays or transverse bands. The young are usually marked with more lively colours than the adults.

THE LARGE-CHEEKED HOMALOPSIS (*Homalopsis buccata*)—fig. 14—is one of the most characteristic species of the group, and one of the best known. This serpent attains the length of four feet, and a circumference of an inch and a half. The body is a little compressed, and the tail, which occupies about a quarter of the total length, is conical, robust, and is not distinct from the trunk, which, however, becomes considerably more slender towards the posterior extremity. The head is broad at the base, extremely thick, high, conical. The muzzle is short, and truncate at the tip. The muscles connected with the jaws are well developed, and the salivary glands are very large. This produces a swelling in the region of the cheeks, which are very projecting, and gives the head a heart-shape that causes it to resemble that of the vipers. Indeed

Fig. 14.



The Large-cheeked Homalopsis (Homalopsis buccata).

this serpent has been described as venomous, and some authors have, on account of the viperine aspect of the head, actually placed it amongst the truly venomous species. The teeth too of this Ophidian are much more curved posteriorly than in ordinary cases, and at the posterior part of the jaw they show a grooved or furrowed structure, which has given rise to strong suspicions as to its venomous nature. Schlegel, however, asserts that all the species of this group are innocuous. It was considered at one time that this serpent was peculiar to Java, where it was originally found inhabiting the large fresh-water lakes in the western parts of that island. Besides Java, however, it has been found in Bengal and Sumatra.

THE WAMPUM SNAKE (*Farancia fasciata*) is another species of this group, but instead of inhabiting Asia is found in America. It attains a length of near five feet, and a circumference of three and a half inches. The body is elongated and almost cylindrical, tapering only towards the commencement of the tail, which is remarkably short, conical, and terminates rather abruptly in a slight point. It is of a bluish-black colour above, the sides being marked with transverse blotches of bright red. A specimen was kept alive in the menagerie of the Garden of Plants at Paris for fifteen months, but during the whole of that time it could not be induced to take any nourishment which was presented to it. It is a native of North America, being found in Louisiana and South Carolina. Catesby was one of the first authors to make this species known. He says it "receives its name from the resemblance it has to Indian money called *wampum*, which is made of shells cut into regular pieces, and strung with a mixture of blue and white. Some of these snakes are large, being five feet in length; yet there is no harm in their bite; but as all the largest snakes are venomous, so will they devour what animals they are able to overcome."

FAMILY II.—BOAS (*Boidæ*).

The family of Boas (*Boidæ*) contains a considerable number of species, upwards of forty being described in the Museum catalogue. They are, generally speaking, the largest of all the serpent tribe, and are characterized by several very distinctive marks. The greater number of them have, in the proper signification of the word, a prehensile tail, which, though short, is excellently fitted for grasping branches of trees or other such objects. They possess rudimentary hinder extremities, which are developed under the skin. These consist of several small bones, which terminate in a horny spur not unlike the spurs of the common fowl, and which penetrate the skin and project externally a little in front of the vent. The body is particularly well organized for twisting and twining round other bodies; and the scales which cover it are small and numerous. As they advance upwards upon the head and forwards upon the belly, it causes the abdominal plates to be small and very narrow, and those on the head to be of a less regular form than in most others of the Colubrine order.

According to Pliny and some later authors, the name *Boa* is derived from the Latin word *bos*, an ox, because they believed that the young reptiles were in the habit of following the cattle in the fields, and living on the milk of cows. This fable is not the only one that is current in early writers concerning these huge creatures as is the case for instance with regard to their size. Aristotle speaks of African serpents of such a length as to be able to overturn a galley with three oars. Pliny tells us of an Indian species swallowing large stags and bulls. Elian mentions huge serpents of from eighty to one hundred cubits in length, and Suetonius asserts that there was exhibited at Rome, under Augustus Cæsar, a living serpent fifty cubits in length. Modern travellers and writers are not much behind these ancient authors in their marvellous tales of the size of the Boas. George Andersen, in his "Travels in the East," tells us that in the island of Java there are serpents large enough to swallow men entire. Baldæus, in his "Description of Ceylon" informs us that he found serpents there, eight, nine, and ten ells long (from thirty to thirty-six feet), but that there are much larger ones in Java, as well as in Banda, where one was taken which had swallowed a stag, and another which had swallowed a woman entire. Charles Owen, in his "Natural History of Serpents," says, that in Batavia there are serpents fifty feet in length. Marco Polo tells us in his "Travels," that in the island of Carajan very large serpents are seen, ten paces in length, and ten hands-breadths in circumference. Father Gumilla, in his "History of Orinoko," mentions the occurrence there of serpents upwards of forty feet long. Bosman,

in his "Description of Guinea and the Gold Coast," informs us that though the largest he saw himself was twenty feet, that there existed many much larger in the interior, where his countrymen often found in their stomachs not only whole animals, but men entire. Labat tells us that on the river Kurbali, on the west coast of Africa, serpents are to be seen thirty feet long, and capable of swallowing an ox; and in the Moluccas we are told of serpents upwards of thirty feet in length and one foot in circumference. Schlegel, however, a cautious and conscientious author, remarks upon this subject, that though the Boa constrictor is generally held up as of an enormous size, he is perfectly satisfied that it rarely attains a length of nine or ten feet; that the largest Pythons seldom exceed eighteen or twenty; and that the Anaconda itself (the largest species of the family) is now-a-days never met with exceeding twenty or twenty-five feet, and of the circumference of a man's thigh. M. Boie, who in his travels in India had many opportunities of observing these animals, tells us that in spite of his assiduous researches he was never able to procure Pythons even of the size we have mentioned.* It is said that after having killed their prey, they lubricate the body all over with a thick layer of saliva, in order to accelerate its putrefaction and facilitate its deglutition. Now, says Schlegel, the mouth of the Boas is really not wider than in many other serpents, the jaws are not more dilatable, and the salivary glands, which ought to be able to secrete such a prodigious quantity of saliva, and therefore ought to be very large, are on the contrary much less developed than in a great number of other serpents. Mr. Broderip, in the article *Boidæ* in the English Cyclopædia says, "There is generally in these descriptions an account of the fleshy tongue of the reptile, and of its application to the dead animal for the purpose of covering it with saliva previous to the operation of swallowing it. We have frequently watched constricting serpents while taking their prey,and it is almost superfluous to add that they never covered their victim with saliva from their tongue before deglutition. The mucus is not poured out till it is required to lubricate the dilated jaws and throat for the disproportioned feast." M. Boie, quoted above, in India, and the Prince of Neuwied, in America, agree in stating that these large reptiles only prey in general upon mammalia of a small size, adult individuals alone being able to master young pigs and those small deer known by the name of Muntjac. Large mammalia and man, they affirm, are never in danger of being attacked by these creatures, and the natives could not inform them of even a child having ever run any risk. Enough of sober truth, however, remains to make the study of these large serpents exceedingly interesting. The body diminishes in size gradually towards the two extremities, being much thicker in the middle. It is always considerably compressed. The tail is short, somewhat conical, and most frequently terminated in a short, blunt point. It is always prehensile—that is, owing to the direction of the articular surfaces of the vertebræ it can easily roll itself inwardly, fasten itself to objects which permit themselves to be laid hold of, and is thus able to sustain the weight of the whole body without the serpent being obliged to employ much force for that purpose. The head is always distinct from the trunk, broad, rather long, conical, depressed, and terminated by a muzzle, which is most frequently elongated and blunt at the tip. The plates or scales which cover the edges of the lips (the *labial plates*) are in a number of species (more particularly the Pythons) hollowed out in the form of more or less deep pits, an organization peculiar to these animals, and of which we do not know the use. The bones of the head are exceedingly strong. The teeth are pretty large, all solid, close set, and pointing backwards, and increase in size as they approach the tip of the muzzle. The palate is in general provided with teeth also, nearly as well developed as those of the jaws. The ribs are robust, long, and curved; and the articulating surfaces of the vertebræ are directed in such a way that the body of the serpent can easily be rolled spirally inwards. We have already alluded to the existence of rudimentary hinder extremities in this family. These consist of a legbone, or *tibia*, two *tarsal* bones, and a *metatarsal* bone, all developed under the skin, and to the last of which is attached a horny spur, or nail, which penetrates the skin and projects externally.—See Plate 8, fig. 18. These spurs are moved by small muscles attached to the bones, and are useful to the animal in climbing trees and perhaps in holding fast its prey. Boas are endowed with prodigious muscular force, and though this may be also exaggerated, we may yet conceive, from an inspection of the muscles attached to the ribs, of what amazing power a serpent twenty feet long, and as thick as a man's thigh, may really possess.

They are very rarely seen, however, to use this power in captivity. Such as have been seen in Europe are generally very gentle, no provocation being able to incite them to put forth their strength, and their movements are very slow. They are, many of them, of brilliant colours, though these disappear after death. Unlike the generality of serpents, their colours do not become pale with age, but, on the contrary, become more vivid, the design remaining very distinct at all periods of their life. "As far as our experience goes," says Schlegel, "the females appear to be thicker in the body than the males, while the rudimentary legs, on the other hand, appear to be more strongly developed in the male than in the female." The Boas are well known to take their prey by stratagem. "Hot steaming morasses, the swampy margin of rivers, the borders of lakes, the tangled underwood that skirts the dark and marshy forest—these are their favourite abodes;" and there, with its prehensile tail twisted round some aquatic shrub or tree, the huge reptile lies in wait silently and patiently, stretched on the bank, or half floating in the water, till some unfortunate animal chance to pass that way, or ventures to the water to quench its thirst, when, with amazing velocity, it darts upon its victim, seizes it with its sharp strong teeth, and, with the quickness of thought, twists its huge bulk in many folds round the body of its prey, and crushes

* The largest specimens of stuffed snakes in the collection of the British Museum are as follows:—*Python Sebæ*, fifteen feet; *Boa constrictor*, thirteen feet; and *Anaconda*, twelve feet.

it to death. When thoroughly flattened out, it slowly begins to swallow it, commencing always with the head. If the animal it has devoured be large, the act occupies some considerable time, and the huge creature then sinks into a state of lethargic stupor, and may easily be mastered. Boas may be tamed as well as Rattlesnakes, and both in America and Africa have had religious rites and homage paid to them.

The species of the family *Boidæ* are divided into two large sections:—I. Those which have the tail strongly prehensile, the spurs large and exposed, the head elongate, distinct from the neck, and the muzzle truncated. The eyes are nocturnal, the pupil being oblong, erect. II. Those which have the tail very short and only slightly prehensile, or, in some, not prehensile at all. The head in these is very small, and not distinct from the body. The spurs are small, in some being quite distinctly visible externally, but in others hidden under the skin.

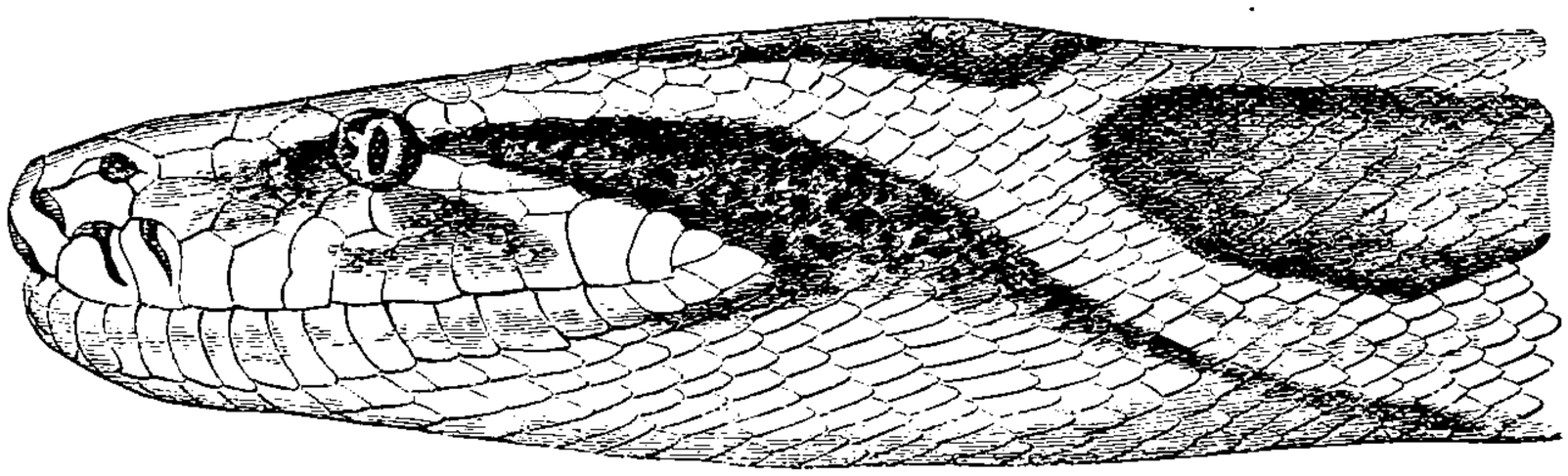
In the first division we have two subfamilies, the Pythons (*Pythonina*) and the Boas (*Boina*).

The Pythons are distinguished by their having the plates under the tail (subcaudal plates) in two rows; distinct intermaxillary or canine teeth; the upper part of the orbit formed by a particular bone; and the plates on the lips (labial plates) more or less deeply pitted.

The Boas are distinguished by their subcaudal plates being entire, in only one row, and no intermaxillary or canine teeth at all. The Pythons are all natives of the Old World. The greater number of the Boas are natives of America.

THE ROCK SNAKE (*Python molurus*)—represented in Plate 5, fig. 1, Plate 8, figs. 2, 2a (skeleton and skull), and fig. 15 annexed—is one of the most remarkable species of this subfamily, and is a native of India, and some of the large islands, as Java, &c. It generally occurs from seven to thirteen feet in length, but even Schlegel mentions having himself seen one that measured twenty feet. The colours are brilliant and lively. A pale yellowish coffee-brown colour predominates on the upper parts, losing itself in numerous gray marblings on the flanks, which scarcely allows the beautiful yellow colour of the ground to be seen, but which spreads uniformly over the belly. The head is variegated with red; the muzzle is marked with a square brownish-black spot, another is seen above the eye, and a third, broad and club-shaped, is prolonged from behind the eye to the neck. The iris is of a golden yellow colour. The adults are more brilliantly coloured than the young. The head is distinct from the body, is tolerably broad, elongate, depressed on the summit, and terminates in a narrow rounded muzzle. The nostrils, large and round, are slightly distant from each other, and are directed backwards. The eye is nearly lateral, and directed slightly forwards. The tail is much smaller in circumference than the trunk, and is rather short and conical. On the continent of India this serpent is known to the natives by the name of the *Bora* or *Pedda Poda*, but by the English is called the Rock Snake. Russell, who describes it, says he never saw one exceeding ten feet in length, and states that he has observed them twisting themselves round the arms of the snakemen, who merely complained of the arm being benumbed by their grasp. In the island of Java, however, they would appear to grow to a much larger size. M. Reinwardt, as Schlegel informs us, brought from thence to Europe a skeleton of this species which exceeded seventeen feet. "The Malays of Java," he says, "call it Onlar-Sawa or Onlar-Rava. It inhabits low, shady, marshy, or inundated places, and appears to delight in rice-fields. It is said to reach the length of twenty-five feet, but the largest I have ever seen only measured seventeen. The natives draw a good omen from the neighbourhood of this serpent. I have sometimes found in its stomach the hoofs of deer, and it attacks also pigs." M. Boie, a correspondent of Schlegel, and who has been mentioned before, thus writes:—"This Python sometimes attains an enormous size. It attacks pigs, and the deer called Muntjac, but human beings have nothing to fear from it. Its muscular power is astonishing. An individual, the thickness of a man's thigh, which had just been taken, escaped from a cage made for containing wild animals, breaking the iron bars which closed the entrance. Individuals of such a size, however, are very rare." Specimens of this species have not unfrequently been brought alive to Europe, and not long ago four examples of it were to be seen in the Zoological Gardens, Regent's Park. An account of the habits of some which were kept alive in Paris has been given us by Schlegel. They were from seven to ten and thirteen feet long, and were brought from Bengal. In their general disposition they were mild and gentle, and very slow in their movements, even although provoked. They were kept in a box enveloped in flannel,

Fig. 15.



Head of the Rock Snake (Python molurus).

and lay quite tranquil, allowing themselves to be taken out to be exhibited to the numerous spectators who visited the menagerie. They appeared to be in a continual state of stupefaction, not paying the slightest attention to anything that passed around them. Food was given to them once in eight days, but even then they were not always disposed to seize the animals given to them, refused even to attack them for two or three days, and sometimes were absolutely obliged to be provoked to bite them. When they did attack them, they always seized hold of them by their teeth, and having once secured their prey by plunging their teeth into the poor creature's head, they twisted their body in folds around it, and crushed it to death at once. Having killed the animal, they licked it before they began to swallow it, and made no haste to execute this operation, which, on the contrary, lasted sometimes two or three hours. They always began with the head, and the prey was evidently introduced into the gullet by the efforts of all the muscles of the anterior part of the body being brought into action simultaneously. This action being repeated only at considerable intervals, the process of deglutition occupies a pretty considerable space of time. In the *Zoological Journal* Mr. Broderip gives a very interesting account of the method of these creatures' seizing, killing, and swallowing their prey, as observed by him in the menagerie of the Tower of London, but we must refer the reader to the original. It is a curious fact in the history of serpents that the Pythons place their eggs in a group and cover them with their body, as if hatching them. This circumstance was first noticed by Mr. Bennett in this country, who gives in his account of it a figure of the snake on its eggs. M. Lamare Picquet communicated this fact to the Academy of Sciences in Paris, when the fact was also verified in the Garden of Plants. A specimen of Python was sent over by Mr. Kuhl, and placed in the menagerie there. She laid fifteen eggs, collected them together, and coiled herself round them in the shape of a spiral cone, her head at the top, the eggs lying within. The temperature of the snake, it was observed, was increased during the time, and she ate nothing, but drank greedily, during fifty-six days. Directly the young were born she left them to themselves, though she had never quitted the eggs during the above period.

THE ULAR-SAWA (*Python recticulatus*) is another East Indian Python. This species is a native of the continent of India, the island of Java, and Borneo. It has often been confounded with the preceding, and in Java both are designated by the same name. It is rather smaller, attaining to the length of from twelve to sixteen feet, and the circumference of rather more than a man's arm. Lacèpéde says it is one of the most beautiful, and at the same time largest serpents of the island of Java, and receives from the inhabitants the name of Oular-Sawa (serpent of the rice fields), because it prefers to make its dwelling in these places. Its general length in such situations, he says, is about nine feet; but individuals which live in thickets in open, elevated regions, attain a much larger size, and have been compared to the height of a tree! Its chief food consists of mice, rats, and birds, but occasionally much larger animals are made its victims. The predominating colours of this serpent are blue and yellow, or gold and black.

The African species of Python are equally remarkable with those of India.

THE GUINEA ROCK SNAKE (*Hortulia Sebæ*), considered by some authors as a mere variety of the preceding species, is peculiar to Africa, especially the west coast, and attains to a large size. Adanson mentions having seen individuals in Senegal twenty-two feet in length, and eight inches in circumference. Two or three years ago a live specimen was to be seen in the Zoological Gardens, Regent's Park, which was estimated to weigh about a hundredweight. It is remarkable for the brilliancy of its colours and the lustre of its scales. The upper part of the body presents, on a yellow ground, a series of large rings of a brown or black colour, edged with grayish-white, and so placed as to form a sort of chain along the back. This species of serpent has been described by several travellers, who mention it as being held sacred by the natives of the west coast of Africa. In the beginning of last century, Bosman, a Dutch traveller, in his description of the coast of Guinea, gives us a good many details of the worship paid by the inhabitants of that coast to this serpent. Desmarchais, a French traveller, gives a somewhat similar account of this serpent-worship amongst the natives of the kingdom of Whidah. This serpent, he says, is one of the most remarkable species that superstition has made a divinity of. In the kingdom of Juida (Whidah), on the west coast of Africa, it is very common, and altars are erected for its worship. This pretended god, which is called the *Serpent Fêtiche*, which signifies the *Preserver*, has as magnificent a temple erected to it as can be made by the rude art of the Negroes. It receives there the richest offerings: stuffs of silk, trinkets, the best meats and drinks of the country, and even herds of cattle. Thus the priests who serve it enjoy a considerable revenue, possess immense lands, and command a great number of slaves. In order that nothing might be wanting for the gratification of their pleasures, they force the priestesses, each year about the time the maize begins to grow green, to run all over the town of Juida and the neighbouring villages. Armed with a thick club, and seconded by the priests, they knock down without pity all who dare to resist them, and force the most beautiful Negresses to follow them into the temple. The load of superstitious credulity weighs so heavy on the head of the Negroes, that these girls believe that they are going to be honoured by the approach of the Protector Serpent, and that it is to his love they are to be given up. Previous to the time for being admitted into the presence of the pretended deity, they are obliged to submit to a painful and barbarous ceremony, for cruelty almost always springs from superstition. Their skin in all parts of their body is stamped, by means of iron bodkins, with figures of flowers and animals, especially serpents. The priestesses thus consecrate them to the service of their god; and it is in vain that the unfortunate creatures utter the most plaintive cries in order

to arrest the torment they are experiencing; nothing stops their inhuman zeal. When the skin of these poor victims is healed, it resembles, it is said, a flowered black satin, and renders them for ever afterwards the object of the veneration of the Negroes. When the time arrives for the god to receive the favoured Negress, she is made to descend into a dark cave, whilst the priestesses and the other young girls celebrate her destiny by dances and hymns, which they accompany with the music of many clamorous instruments. When the young Negress leaves the cavern she receives the title of the *serpent's wife*.

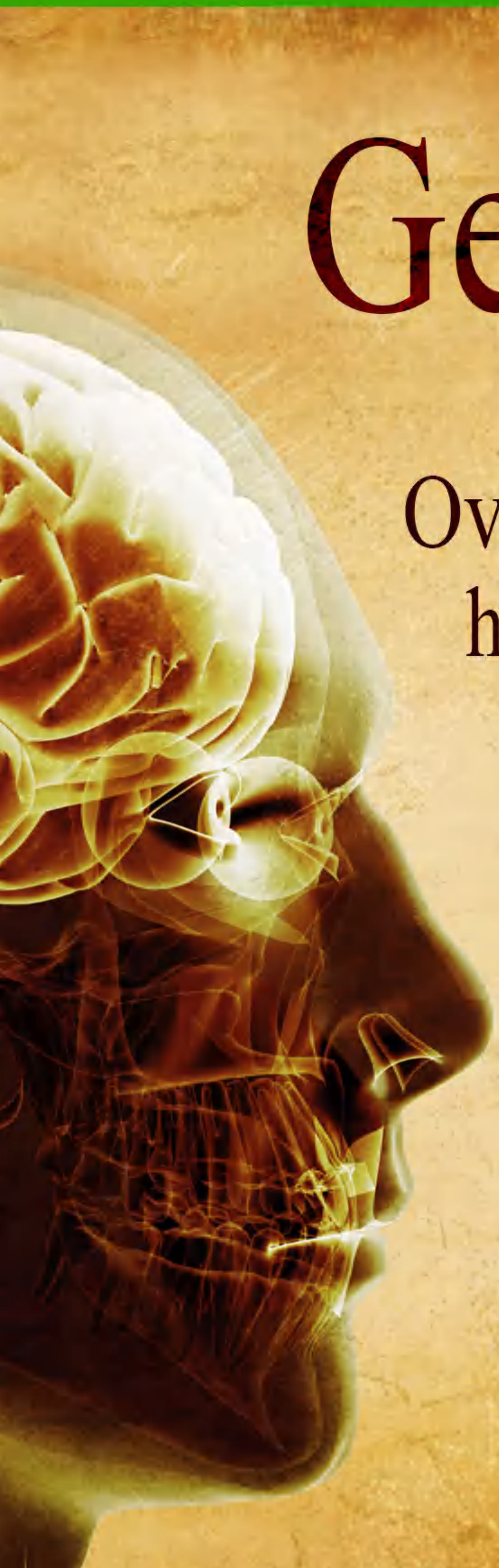
For a long time this Rock Snake was very rare in European collections, because the natives in that part of Africa in which it is found were prohibited, under pain of death, from sending specimens out of the country, or even giving any skins to strangers. They were not allowed to be killed or even injured in the slightest degree. "The reverence and respect which the *Negroes* preserve for this snake is so great," says Bosman, "that if a Black should dare touch one of them with a stick, or any otherwise hurt him, he is a dead man, and certainly condemn'd to the flames. A long time past, when the *English* first began to trade here, there happen'd a very remarkable and tragical event. An English captain being landed, some of his men, and part of his cargo, they found a snake in their house which they immediately killed without the least scruple; and not doubting they had done a good work, threw out the dead snake at their door; where being found by the *Negroes* in the morning, the English preventing the question who had done the fact, ascrib'd the honour to themselves; which so incens'd the natives, that they furiously fell on the *English*, kill'd them all, and burned the house and goods." The habits of this serpent are very gentle, because it has no enemies in that part of the country to fear or to defend itself against. Out of their religious respect for it, the natives try to remove all such animals as might prove hurtful to it. Even such as might prove beneficial to the country otherwise, are excluded from their shores should they threaten to injure their venerated snake. The hog especially, which preys particularly upon several species of these reptiles, and which is well known to attack with impunity the most venomous of them, is pursued in the kingdom of Whidah as a public enemy; the Negroes seeing only in this valuable animal an enemy which devours their god. In consequence of this protecting care and kindness to them, these large snakes appear to be quite familiar with man, and are said to be so tame as to readily allow themselves to be taken up and handled and played with, without the slightest danger being incurred. They make a good return too for the kindness they receive at the hands of the natives, for they attack and destroy the venomous serpents with which the kingdom of Whidah abounds, and seem to confine their antipathy to injurious reptiles, and insects, and worms which devastate their fields.

THE NATAL ROCK SNAKE, another species of Python (*Hortulia natalensis*), is found is South Africa, where it attains a large size. It was first described by Sir Andrew Smith. The specimen figured by him in his "South African Zoology" measured only twelve feet three inches; but he says it occasionally attains a much greater size, and the natives informed him that individuals have been seen whose circumference was equal to that of the body of a stout man. He himself saw a skin which measured twenty-five feet, though a portion of the tail was deficient. Though not worshipped by the natives of South Africa, there is a superstitious regard for it, mixed up with the horror with which they view it, that is something akin to the respect paid to its relative by the Negroes of Western Africa. When it has gorged itself with food, like the rest of its species, it remains for some time in a nearly torpid state, and may then easily be killed. But the South Africans, we are told, seldom avail themselves of these opportunities of ridding themselves of a reptile they view with horror, as they believe it has a certain influence on their destinies; and they affirm that no person has ever been known to maltreat it, without sooner or later paying for his audacity. Dr. Savage tells us also that three or four individuals having made their appearance upon a certain piece of land, the owner abandoned it from the superstitious notion that it could not, in consequence, yield a crop. The Natal Rock Snake has the body of a fusiform shape, and the head nearly of the same thickness as the neck, is depressed and much broader behind than before the eyes. The whole surface has a strong metallic gloss in certain lights. According to Sir A. Smith, this snake was formerly an inhabitant of the districts now within the Cape Colony, "and the traditions," he says, "of the older Hottentots abound with instances of its miraculous powers. At present it is not to be found within hundreds of miles of the boundaries of the colony, and few specimens have been obtained nearer than Port Natal."

Boas (*Boina*).

Linnæus described a large species of this family (*Boidæ*) by the name of Boa constrictor; a name which has now become familiar to all the world, and here in Great Britain has even passed into an English word. It has, indeed, given the name to the whole family, so that by travellers and early writers all the accounts of the huge serpents met with in various parts of the world, whose immense size and incredible voracity have been so variously described and highly exaggerated, have been indiscriminately referred to that species as the type of the family. The species, however, belonging to the Old World, we have already shown, form now a separate sub-family under the name of Pythons, whilst the true Boas, those which are for the most part inhabitants of the New World, and which contain the real Boa constrictor, form a subfamily by themselves under the name of *Boina*. About twenty species of these have been described, two or three of which are very remarkable.

THE BOIGUACU (the true *Boa constrictor*)—Plate 5, fig. 2—is the one which is most widely known, by name at least. This serpent is remarkable for the beauty and variety of its colours, and is in general easily recognized. It has a heavier look than any other species of the family. The body is very thick in the middle, and a little



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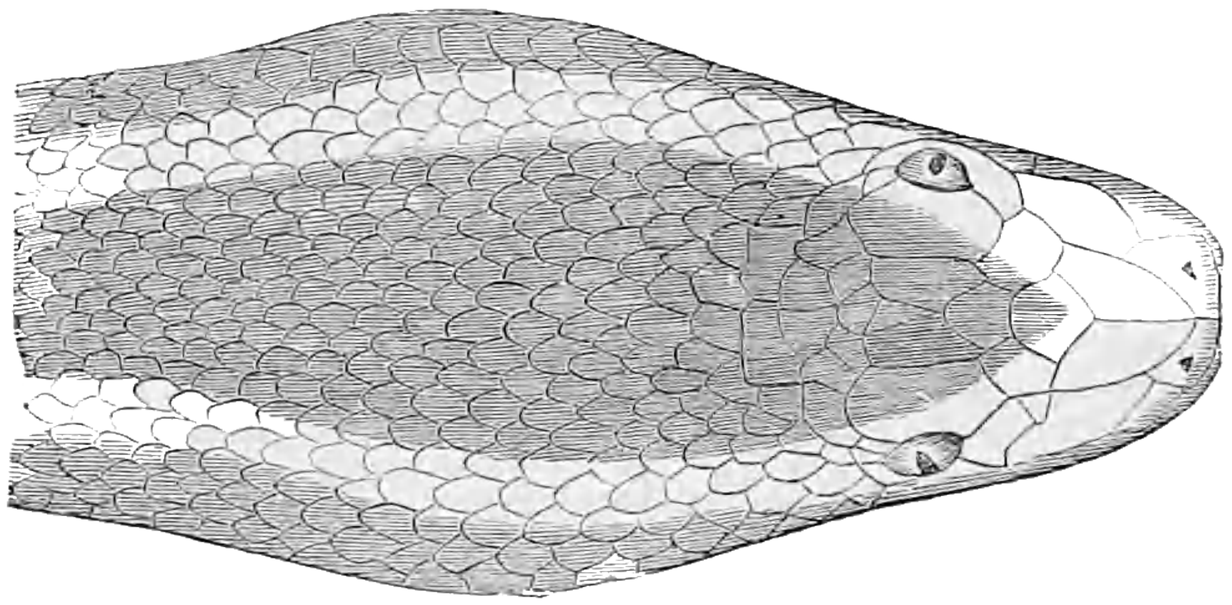
the description of plants, for instance, and various mammiferous quadrupeds, &c., the account given by these writers is often very correct, and not at all exaggerated. Why should they then, when they come to treat of serpents, alligators, &c., launch out into what appears to us now-a-days to be such highly-coloured tales? Dr. Shaw in his lectures has noticed this, and says that it is probable that many ages ago much larger specimens of such animals might have occurred than are to be found at the present day, the increased population and cultivation of most countries having tended more and more to lessen the number of such creatures. It is the same in our own country with other classes of animals. Take, for instance, the account given us by anglers and zoologists of repute as to the size and weight of our salmon in the river Tweed only a few years ago, and compare them with the dimensions of the largest individuals taken now. Formerly salmon were taken in that river "weighing seventy or even eighty pounds. Such, however, are never seen now, owing to the perfection of the means of capturing them at the mouth of the river, by which the chances are very greatly against any fish escaping the various dangers by which it is environed, for such a succession of years as is likely to admit of its attaining to its full dimensions."* So we suspect it may have been with reptiles in former ages, living in the wild uncultivated tracts of marsh and forest lands in America and Africa. Undisturbed by man and enjoying abundance of food, they acquired a size and bulk which they are seldom or ever permitted now to attain. The Anaconda appears to be spread over a considerable portion of intertropical America, being common in Brazil and in Guiana. It is of a rather more slender form than the Boa constrictor, the body not being so thick, and the tail being only about a fifth of the total length. The head, too, is much smaller and thinner, and nearly of the same size as the body, and the muzzle is elongated and rounded at the tip. The nostrils are placed on the summit of the muzzle, close to the extremity, and are very small, which marks the animal as an inhabitant of the water. It is also less varied in colour than the Boa, being, on the upper parts, of a fuliginous brown shading into olive on the head, with two rows of round black spots extending along the back. Underneath it is of an ochre-yellow colour, and the flanks, which are of the same hue, are marked with a double row of eye-shaped spots. The Prince of Neuwied, in his "Travels in Brazil," has recorded a number of interesting facts connected with the history of the Anaconda. The native name for it in Brazil, he says, is *Cucuriuba* or *Cucuriu*. Speaking of its size, he says he has seen individuals twenty feet long, but that the inhabitants assured him that it arrives at a much greater size in uncultivated and uninhabited places. It passes the greater part of the day in the water, sometimes swimming with great facility, at others allowing itself to float on the surface and be carried down the stream by the current without exerting the least motion. It dives, he says, with great dexterity, and often remains a long time at the bottom of the water, where it reposes, if it is not deep, only exposing its head at the surface. At other times it lies stretched out on the banks of a river, on the sand or on trunks of trees, where it patiently waits for its prey coming to quench its thirst at the water's edge. Its principal food consists of small mammalia, such as the capybaras, the agoutis, and pacas; and it is said that it even preys upon fishes. Their pairing season is from November to February, at which period they are most frequently to be met with, and may be heard uttering a dull bellowing sound. It is a very timid animal, and is always on the watch, so that it can only be surprised by chance. The natives kill it whenever they can, either by shooting it with a gun or bow and arrow when in the water, or by beating it with cudgels if they meet it on dry land, for its movements then are very slow. It is tenacious of life, and the body has been seen to move after it has been disembowelled and the skin stripped off. The flesh is eaten by some of the natives; the fat is melted down and used for various purposes, as in rheumatic pains, sprains, &c.; and the skin is made into shoes, portmanteaus, &c. The Anaconda appears to be viviparous. Schlegel received a specimen from Surinam, which upon opening he found to contain twenty eggs, each containing a fœtus, nearly quite developed, from one foot to eighteen inches long, and possessing very bright tints, but similar to those of the mother.

Fig. 16



The Anaconda (Eunectes murinus).

The specific name *murinus* (*Eunectes murinus*) was given to it because it was believed to prey chiefly upon mice, and the French naturalists have adopted the same name, and call it the *Boa rativora* or rat-eating Boa. But though these small animals may form the principal food of the young Anacondas, the adults are powerful enough to attack and overpower much larger game. One of its provincial names is *El Traga Venado* or Deer-swallower, and sufficiently indicates the idea the natives have of the nature of its food.

THE ABOMA (*Epicrates cenchria*) is another species of Boa, but much smaller than the last mentioned. It

* Baird's Cyclopædia of the Natural Sciences. Art. *Salmonidæ*.

is about six feet long, about as thick as a child's arm, and is remarkable for its fine colours. The ground colour is a more or less deep but clear reddish-brown fading into yellow, and a double row of round brownish-yellow spots edged with black runs along the upper parts, which, however, often become confluent, running into each other and then forming a single row of large spots. On the flanks, three other rows of a blackish-brown colour may be seen. The head of the Aboma is nearly of the same size as, and on a line with the trunk, is small, narrow, elongate, conical, and flattened on the crown. The muzzle is very compressed and prominent, forming a kind of nose. The nostrils are open, lateral, and are placed very near the extremity. The tail is very short, conical, always curved inwardly and terminates in an obtuse point. The Aboma is a native of South America and the West Indies. The Prince of Neuwied observed it on the east coast of Brazil, where the natives call it the *Jiboya*, and say that it possesses similar habits and manners of living to the Boa constrictor, which they also know by that name. It ascends trees and often establishes itself in hollows in the ground, but never frequents the water. Its food consists of small mammalia.

In the second group of the family *Boidæ*, or those with only a slightly prehensile tail, and the spurs small or even hidden under the skin, the head is very small and indistinct. It is nearly of the same size as the neck, and the body is cylindrical, and of nearly equal circumference throughout all its length. The throat is not wide, nor does it admit of such extension as in the greater part of the Ophidians, and the eyes are small. The scales with which they are covered are almost always smooth, and are all of the same form, with the exception of those which are on the head and under part of the body. The species which, according to Schlegel's idea, form only one family, the *Tortricina*, are arranged in the British Museum catalogue in four small families, their characters being taken from the distribution of the scales of the head, the presence or absence of intermaxillary teeth, &c., &c. As these characters, however, are only important for the purpose of methodical arrangement, and as there is not much known of the habits of many of the individuals belonging to the group, we will consider them here as all being referrible to one subfamily.

THE BURROWING SNAKES (*Tortricina*) are peaceful and harmless serpents, mild in disposition, and slow in their movements. They are always found living on the ground, and prefer for their place of abode open and sandy places. For enabling them to move with celerity on such kind of ground, nature has furnished them with a cylindrical body, a narrow belly, and a short but strong and sometimes prehensile tail. Their teeth are short, but pretty strong, conical in shape, and not very numerous. The nostrils are either orbicular or elliptical, and most frequently vertical. The eyes are very small, somewhat vertical, and except in one or two species, with a round pupil. The prevailing colours are red, brown, and yellow, but they vary much in different species. In general they are iridescent and exhibit a considerable play of colours. They never acquire any great size, and it is rare to find individuals exceeding two or three feet in length. The young are more brilliant in hues than the adults, and possess a somewhat longer tail. The species have been found in the hot parts of both Old and New Worlds. They have, in particular, been noticed in several of the Polynesian islands, in Java, Bengal, and in Surinam. Individually they are not widely spread, with the exception of the *Eryx*, which inhabits temperate climates, and is found in the South of Europe, Western Asia, and the North of Africa, being a native of Greece, Tartary, Persia, Arabia, Syria, and Egypt. They frequent dry grounds open and exposed to the sun, such as sandy deserts. Living continually on the ground, they form little burrows to shelter themselves from their enemies. They are never seen on trees, and appear to avoid the water. It appears that they are not much embarrassed in their choice of food, as they swallow indiscriminately small quadrupeds and reptiles, &c., provided the size of the prey is not too much for them. Mice, cecilиæ, &c., are what have been chiefly found in the stomachs of such as have been opened. Their bite is attended with no bad effects; but by the common people of the countries where they are found they are believed to be dangerous. The species of this family are most probably oviparous. They are few in number, ten having been described in the Museum catalogue.

THE CORAL SNAKE (*Tortrix scytale*) is one of the best known, perhaps the most beautiful of all, and is the only species found in the New World.* It is a native of Surinam, and is often brought to Europe by sailors. The body, which is well marked by alternate rings of red and black, is of a cylindrical form, elongate, and of the same thickness throughout its entire length. The head is nearly of the same size as the trunk, somewhat conical, and with a rounded muzzle. The nostrils are round and very small, as also are the eyes, which are placed vertically on the head. The prevailing colour in the living specimen is a beautiful vermilion red. Numerous rings, close set, of a deep shining black, often divided into two, or interrupted and alternate, surround the body and the tail throughout all its length. A broad ring, which occupies the posterior part of the head, and the red pointed tail, are more constant than any other characters. The points of the scales on the body are often marked with black, giving the appearance of a very pretty network pattern. With the exception of size, the young and old resemble each other closely, as do also the two sexes, which are not distinguishable from each other by any external characteristics. When full-grown, the Coral Snake is ordinarily about two feet, or from that to two feet six inches in length. A curious fact has been noticed in this reptile with regard to its eyes. When old, the eye often becomes opaque, the covering of the eye being hardened, and blindness is the result. It is very common in Guiana, but is scarcely ever seen to the north of Surinam. In the colony it is known by the names of the Serpent with the two heads and the Coral Snake. It is erroneously believed by the natives to be venomous, a belief entertained also by

* With the exception of one from California (*Charina bottæ*), of which very little is known.

some writers, such as Laborde and Father Gumilla. It is always found living on the ground, and appears to feed chiefly upon small reptiles, such as the ceciliæ, typhlops, &c. Schlegel informs us that he possessed an individual which was killed at the moment it was occupied in devouring a cecilia of the same size as itself. The female is viviparous.

TRUE COLUBRINE SERPENTS.

The second section of the Suborder Colubrina, or those in which the belly is covered with broad band-like shields, and which have a conical, tapering tail, are exceedingly numerous, and form the true Colubrine serpents. The number described by Dr. Günther in the British Museum catalogue amounts to three hundred and eighty-eight species, and they have been divided, according to the structure of their teeth (or method of dentition), into three groups.—I. Those which are perfectly harmless, and are *destitute of either grooved or perforated fangs* in front of the jaws—the Innocuous serpents (*Ophidia innocua*); II. Those which have a *permanently erect, grooved fang* in front—the Venomous colubriform serpents (*Elapidæ*); and III. Those which have a *permanently erect, perforated fang* in front (*Atractaspididæ* and *Dendraspididæ*).

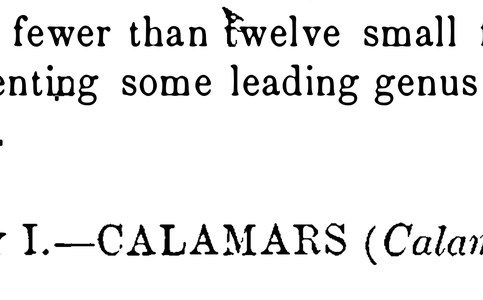
GROUP FIRST—THE HARMLESS COLUBRINE SERPENTS (*Ophidia innocua*).

This group contains by far the greatest number of species, not fewer than three hundred and forty having been enumerated. They are widely distributed, being found in all parts of the world. Dr. Günther divides them into no fewer than twelve small families—each family representing some leading genus in the former arrangements.

FAMILY I.—CALAMARS (*Calamaridæ*).

This, the first family we shall mention, is termed by Schlegel the "vermiform snakes." The Calamars are small terrestrial snakes, which present a sort of worm-like or vermiform appearance. Their body is almost cylindrical, sometimes resembling a piece of whipcord,

Fig. 17.



Head of Linnæus' Calamar (Calamaria Linnæi).

and terminating in a tail usually short, cylindrical, and tapering. Their head is usually about the same size as the body, and not distinct from the neck; and the muzzle is rounded or pointed.

Forty-four species have been described.

LINNÆUS' CALAMAR (*Calamaria Linnæi*)—fig. 17—is one of the best known. It is a native of the island of Java, and is about a foot in length. The colours vary very much, but generally the ground is a fine red carmine or vermilion, deeper beneath, where it often passes into brown, black, or bluish-black, and variegated with quadrangular black spots. It is said to be very common in Java, lives always on the ground, and is very slow in its movements. The Malays know it by the name of Ular-lema, and it is looked upon by them as perfectly harmless.

FAMILY II.—CROWN-SNAKES (*Coronellidæ*).

The Coronellas or Crown-snakes exceed the Calamars in size, but never attain large dimensions. Their body is of moderate size, nearly cylindrical in form, but slightly thicker towards the middle. The tail is rather short, more slender than the body, and tapering insensibly to a fine point. The head is more or less distinct from the neck, rather depressed, and generally with a short rounded muzzle.

The genus *Coronella* contains seventeen species, and representatives of them are found in almost every part of the globe. Two are European.

THE SMOOTH CROWN-SNAKE (*Coronella austriaca*) appears to be spread over nearly the whole of Europe. It was first observed by Laurenti in the humid valleys in the neighbourhood of Vienna. It has since been described as a native of various parts of France, Italy, Hungary, Thuringia, Switzerland, Germany in several quarters, Hanover, the Low Countries, Sweden, and also in Sicily, &c. Still more recently, it has been found in England. It differs from most of the other species of this family in its habits and manner of living, preferring in general as its places of abode dry, heathy, rocky, and wooded situations, instead of moist meadows. In Thuringia it is found living on high ground, even near the summit of lofty mountains, where it has been observed taking refuge under stones, moss, or herbs. It is easily known by its shining skin, which is of a rather sombre brown colour, marked with rounded, irregular, dark spots, somewhat like the common viper; and indeed it is often found in company with both it and the ringed snake. The peasants often confound it with the viper, and dread it much in consequence. When full grown the Smooth Coronella seldom exceeds two feet in length. Its body is elongated and cylindrical in shape, slightly tapering at the two extremities. The head is distinct from the trunk, the eye is small, and the iris is of a lively red. The colours vary very much in the adult specimens, but the young at first leaving the egg are quite white. Small animals, as mice, moles, little birds, lizards, worms, and insects, constitute its food. It is very alert in its movements, and makes its escape with great swiftness when any one approaches it. When attacked it defends itself with boldness and energy, bites with fury, and does not easily let go its hold. If laid hold of by the tail, it will twist itself up and seize with its teeth the hand which holds it. Its bite, however, is perfectly harmless. According to the observations of Lenz, this serpent is viviparous; the eggs require three or four months' time to develope, and the young are about the number of twelve. In captivity it retains its wild disposition for a length of time after

it has been caught, but if taken quite young it may be rendered very gentle and familiar. When provoked it makes no hissing noise unless some mice are introduced into its cage, of which it is very fond. It does not leap, but it can climb trees; and though it does not frequent water, yet it has been seen to swim well.

Several species of Coronella are natives of Africa; while others, remarkable for the brilliancy of their colours while alive, are found in South America.

THE CORAL SNAKE (*Erythrolamprus venustissimus*) is one of these, and is indeed one of the most beautiful of the whole order of Ophidians. The ground colour of this beautiful serpent is a strikingly fine vermilion; the scales are all pointed with black, and the body is encircled with from twelve to fifteen pairs of black rings, edged with greenish-white, and placed at regular intervals. It is a native of Brazil, being found in the forests in the neighbourhood of Rio Janiero.

FAMILY III.—FRESH-WATER SNAKES (*Natricida*).

This family contains forty-two species, by far the greater number of which are natives of India and America, though species are found in almost all parts of the world. They are of moderate size, with the body rather stout, generally depressed, and the belly flat, or in some cases rounded. With the exception of one species from West Africa (*Grayia siluruphaga*) the tail is rather short, more or less distinct from the trunk, and tapering to a point. In the greater number of the species the head is depressed, rather broad, and distinct from the neck. The muzzle in most is rounded, and the mouth is very large. They are generally found living in the immediate neighbourhood of fresh-water lakes or streams, into which they often plunge in search of shelter or food. By far the greater number of the known species of the family are contained in two genera, *Xenodon* and *Tropidonotus*. We have only space for the latter.

The genus *Tropidonotus* contains twenty-four species, which are found scattered in nearly all parts of the world. They are of moderate size, and appear to prefer for their place of abode the neighbourhood of fresh water, which they very often frequent, either for the purpose of withdrawing themselves from the pursuit of their enemies or of searching for food. This habit is so well known in the various countries where they are found, that they are almost universally called "Fresh-water serpents." The various species are all closely allied in form. Some of the species are small; others, on the contrary, attain a length of four or five feet, with a circumference of about an inch and a half or thereabouts. The greater number are natives of India and America. Two are European, and only one has as yet been discovered in Australia. They abound especially near lakes, rivers, or brooks, the banks of which are shaded with trees. Stretched there upon a rock, or clinging upon the branches of the shrubs near the water, they rest waiting for their prey, which consists chiefly of frogs and fishes. Upon these they dart with great rapidity, the moment the poor creatures show themselves at the surface of the water. They swim with great ease and elegance, holding the head and neck above the surface; they even dive with much dexterity, and are able to remain a length of time at the bottom of the water without requiring to renew the air in their lungs. Although they are able to creep on dry land and climb upon trees and other elevated objects, yet, being able and expert swimmers, they prefer taking to the water, when in danger, to seeking their safety in flight upon the ground. All kinds of situations are apparently indifferent to them as places of abode, provided they are such as can furnish them with sufficient food; and this accounts for the fact that frequently the same species is found inhabiting plains covered with brushwood, meadows, the borders of woods removed from water, equally with dense forests. and the sides of mountains to a considerable height above the level of the sea. Other species, however, never appear to quit the immediate neighbourhood of fresh-water lakes and rivers. They take up their abode in holes in the ground which have been excavated by burrowing animals, and to these they retreat at the approach of danger; or, in temperate climes, at the approach of winter. They are oviparous.

THE COMMON RINGED SNAKE (*Tropidonotus natrix*) is the best-known species. It is common throughout almost all Europe and part of Asia. When full grown, it sometimes attains a length of five feet, though in this country it seldom exceeds four at the utmost. The body is long, the middle of the back elevated; the neck is narrow, and the tail very tapering and rather pointed at the extremity; the head is broad and depressed, distinct from the neck, and the gape of the mouth is as long as the head, slightly curved, and rising posteriorly; the teeth are small, curved backwards, and the tongue is long, excessively flexible, and bifid to about one-third of its length. The upper parts of the body and head are of a light brownish-gray colour, with a green tinge, sometimes approaching to a dull pale olive. Behind the head, on the upper part, is a broad collar, or two lunate spots, of a bright yellow colour, and immediately behind these are two broad transverse spots of black; down the back run two rows of small black spots, arranged alternately, with larger ones at the sides. The colours and markings, however, vary very much. It is gentle in its habits, and may be easily tamed. When attacked, or seized by the hinder part of its body, it rolls itself up in a spiral form, and defends itself by ejecting at its assailant a disgusting fetid liquor, secreted by certain glands within the vent. It seldom bites when taken hold of; but Schlegel says, that occasionally it has happened to him, when he has suddenly approached the edge of a wood where a numerous society had established themselves for the purpose of laying their eggs, that a large individual of the number attacked him with fury, whilst the others were making their escape into the holes in the ground, where they took up their abode in times of danger. The holes they prefer to burrow in are such as are made by moles, mice, and other small mammalia. They seldom form them for themselves. Loving heat, they often frequent the neighbourhood of human habitations, and are

occasionally met with in dung-heaps, &c. In England, with the exception of the little common lizard, it is the most abundant of all our true reptiles It inhabits all our woods, heaths, and hedgerows, especially in the neighbourhood of water, where it finds the principal part of its food. This consists chiefly of frogs and other batrachians and fishes, though it also eats small birds and their eggs, mice, lizards, insects, and worms. Frogs, however, in this country, appear to be its favourite diet. In temperate climates the Ringed Snake becomes torpid during winter. When the temperature falls, it seeks some deep hole in the ground where the cold is not able to penetrate, and there it remains, often in company with several others, till the genial warmth of spring brings it forth again. In the month of April it changes its skin, and this process may be repeated several times during the summer. It is easily tamed, and may be made to distinguish those who caress and feed it. It contracts habits of great gentleness. Mr. Bell says that he had one which knew him from all other persons, and that when let out of his box would go to him and crawl under the sleeve of his coat, where it seemed to enjoy the warmth. It used also to come to his hand for a draught of milk every morning at breakfast, which it always did of its own accord; but it flew from strangers, and hissed if they meddled with it. This serpent is truly oviparous, depositing its eggs a considerable time, generally three weeks, before they are hatched. This process takes place by the heat of the sun, or the artificial warmth of a dung-heap, in which the mother often places them. The eggs are generally laid about the month of August, are usually from sixteen to twenty in number, and are connected together by glutinous matter.

FAMILY IV.—TRUE SNAKES (*Colubridæ*).

The species of this family are about forty-six in number, and are chiefly natives of Europe, India, and America. Almost all of them attain a considerable size, measuring generally four or five feet in length, though individuals occasionally occur that reach from seven to eight.

The True Snakes are terrestrial animals, living principally upon the ground, and only taking to the water when compelled. The greater number climb with ease upon shrubs and branches of trees, where they remain lying in wait for their prey. Some inhabit marshy countries; others frequent large woods and forests; whilst there are others again which prefer open, dry, and sandy localities. Their food consists of small mammalia, birds, and reptiles. There are several species found living in Europe.

THE SERPENT OF ESCULAPIUS (*Coluber Esculapii*) is one of the most remarkable, and is perhaps the best known. "The ancient Greeks," says Schlegel, "adored the god of medicine in different places and under very different forms. They gave to him, as his attribute, a serpent, the emblem of wisdom, and so renowned for its healing qualities, that several Greek tribes took the serpent for the god himself. It was particularly at Epidaurus, a flourishing town of Peloponnesus, that the inhabitants erected, in a sacred wood frequented by snakes, a magnificent temple in honour of these reptiles. The Romans, terrified by a dreadful pestilence which ravaged their capital in the year 461, sent an embassy from Rome to Epidaurus to inquire for this imaginary deity—one which they might have found in abundance in their own country. The island formed by the Tiber was the place where these serpents were kept, and where the figure of one sculptured in marble may still be seen in the gardens of St. Bartholomew." Chandler, in his travels, tells us that the neighbourhood of Epidaurus abounds at the present time with harmless serpents, which are of gentle habits, and are not molested by the inhabitants. And though those described by him are of a yellow colour, and may therefore not be this species, yet this serpent is one of the most widely distributed of all the genus to which it belongs, and inhabits the greater part of Europe. It is found in Austria, Hungary, Dalmatia, Italy, France, and the southern parts of Switzerland. In the neighbourhood of Rome it is called *Saettone*. It attains a considerable size, reaching from four to five feet in length. The body is rather compressed, the belly somewhat angular, the tail of moderate dimensions, thick at the base and pointed at the extremity. The scales of the trunk are of a rhomhoidal form, of moderate size, and generally smooth, though on the hinder parts of the body they are slightly keeled. The head is scarcely distinct from the neck, is of an oblong shape, and has the muzzle somewhat conical, blunt, and rounded. The upper parts are of a more or less deep uniform brownish gray, the under parts yellowish or marbled with gray. The lips, and a large spot on the neck, forming with that of the opposite side a kind of collar, are of a pale yellow, becoming effaced, however, in old individuals. This serpent is very nimble in its movements, and readily climbs up trees, but never takes to the water except when compelled. It is oviparous. Its food consists of frogs, lizards, and small birds; but in a state of captivity it will never take any sustenance. When attacked it defends itself with boldness and vigour, but a few days are sufficient to render it tame. Schlegel tells us that there used to be always a number of these serpents kept alive at the museum in Vienna, and that they had such gentle habits that they allowed themselves to be caressed by children and played with by them for hours together.

FAMILY V.—WOOD SERPENTS (*Dryadidæ*).

This family comprehends a number of species that are intermediate between the last family, or True Serpents (*Colubridæ*), and the long and slender Tree Serpents (*Dendrophidæ*). Many attain a considerable length, while others do not exceed two feet. They climb upon trees, resting on the branches in order to wait for their prey, and are far more at ease in such situations than upon the ground, upon which they move with much less facility. They are rather fierce animals, springing with surprising velocity upon their aggressors, and attacking them with fury.

THE COACH-WHIP SNAKE OF NORTH AMERICA

(*Herpetodryas flagelliformis*) is one of the most remarkable species of the family. The neck of this serpent is small, and the body very long. The tail is long and slender, one-fourth the length of the body, and attenuated like a piece of whip-cord, which it further resembles in appearance from the peculiar arrangement and form of the scales. It is from this circumstance that it has derived its name. The upper part of the head and neck, and nearly a third of the body, are of a glossy raven-black colour, gradually becoming paler as it approaches the tail, which is of a light brown or tawny colour. The colour, however, varies very much, as they have been seen of a cream colour, a clay colour, and sometimes almost white, but always raven-black near the head. Catesby was the first to describe the Coach-whip Snake. He says:—"This is a very long, slender snake, particularly the hind part; it diminishes gradually to the tail, and from the resemblance of a coach-whip has received its name. The colour of it is brown; it is very active and nimble, running very swiftly. They are inoffensive, yet the Indians report (not without gaining many proselytes to their silly belief) that they will by a jerk of the tail separate a man in two parts." It is inoffensive in its manners, but defends itself with great dexterity when attacked, by twining its long body round the enemy. Bartram witnessed such a scene, and thus describes it. When riding along he observed, he says, "a large hawk on the ground in the middle of the road. When coming up near him I found him bound up by a very long coach-whip snake, that had wreathed itself several times round the hawk's body, who had but one of its wings at liberty. Beholding their struggles a while, I alighted off my horse with the intention of parting them; when, on coming up, they mutually agreed to separate, each seeking his own safety, probably considering me as their common enemy." According to Mr. Holbrook, though in general this serpent is about five feet long, individuals are said to occur seven feet in length.

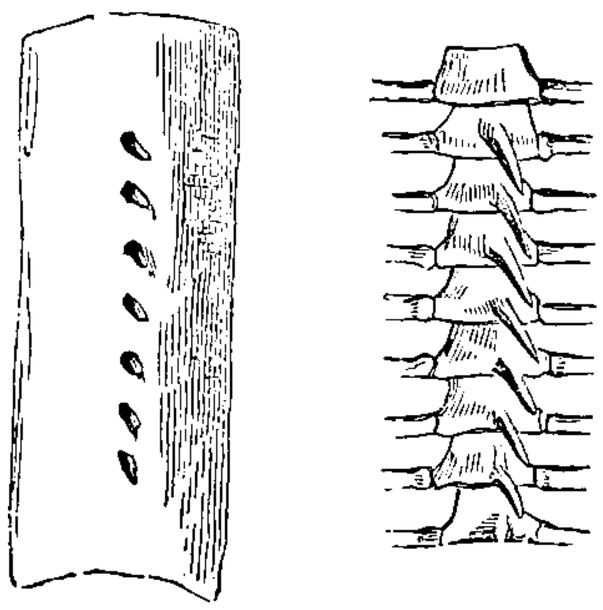
Passing over the next family of Innocuous Serpents, the *Psammophidæ*, which have nothing particularly interesting in them, and which muster only about eight species in all, we come to—

FAMILY VII.—THE SPINE-TOOTHED SERPENTS (*Rachiodontidæ*).

This family is small in number, but very interesting from the peculiar method of dentition or conformation of their teeth. Only two species are known, and both are natives of Africa. They are almost destitute of maxillary teeth, having only from four to seven in their mouth, and these exceedingly small. Their throat or gullet, however, is furnished with a series of instruments which supply the place of teeth, and are admirably contrived for enabling the reptile to take its natural food. This consists of the eggs of birds; and the instruments in the throat supplying the place of teeth, consist of the inferior spinous processes of the seven or eight vertebræ of the neck, the extremities of which are capped by a layer of hard cement, and penetrate through the upper surface of the gullet. Sir Andrew Smith and Professor Owen have both particularly pointed out this curious contrivance, and wonderful adaptation of means to an end. The latter, in his "Odontography," observes—"If the teeth had existed of the ordinary form and preportion in the maxillary and palatal regions, the egg would have been broken as soon as it was seized, and much of its nutritious contents would have escaped from the lipless mouth of the snake in the act of deglutition; but owing to the almost edentulous state of the jaws, the egg glides along the expanded opening unbroken, and it is not till it has reached the gullet, and the closed mouth prevents any escape of the nutritious matter, that the shell is exposed to instruments adapted for its perforation."

THE ROUGH SPINE-TOOTH (*Dasypeltis scabra*)—fig. 18—is a native of the Cape of Good Hope, in the south-eastern districts of the colony and in Kaffirland, and is frequently found concealed under the loose bark of

Fig. 18.



The Rough Spine-tooth (Dasypeltis scabra).

dead trees. Sir Andrew Smith had frequent opportunities of seeing this reptile in a living state, and found that it subsisted entirely on eggs. After describing it at some length, he says:—"The paucity and smallness of the teeth in the mouth are favourable to the passage of the egg, and permit it to progress without injury, whereas, were they otherwise, many eggs which have very thin shells would be broken before they entered the gullet, and the animal in consequence would be deprived of its natural food when within its reach. The instant the egg is broken by the exertions of the animal, the shell is ejected from the mouth, and the fluid contents is conveyed onwards to the stomach."

FAMILY VIII.—THE TREE SERPENTS (*Dendrophidæ*).

The Tree Serpents are particularly adapted for inhabiting the vast forests of hot climates, and are more particularly abundant in America and India. They usually have a very elongated form, attaining a length of four or five feet, and only a thickness of the little finger. The tail, being very fine and slender, round or flattened underneath, is well calculated for assisting these animals to cling to the branches of trees, to suspend themselves there while they lie in wait for their prey; while at the same time it seconds

the sudden spring which they make upon it, and thus enables them to twist themselves round their victim and strangle it in its numerous folds. They have in general a mild, gentle look, and are usually adorned with lively colours, elegantly disposed. The species all inhabit the intertropical regions of both hemispheres. They are very brisk in their movements, and climb with extreme agility. They seldom quit the forests, where they are always to be met with upon the branches of shrubs and trees, reposing themselves amongst the leaves, and lying in wait for the small animals upon which they feed, such as birds, small saurian reptiles, &c., and which inhabit similar situations. They also feed upon mice, frogs, toads, &c., to obtain which they are occasionally obliged to descend to the ground.

THE BOOM-SLANGE (*Bucephalus capensis*) is the only species we have time to mention. It is long and slender, with a high, subquadrangular head, very distinct from the neck, very large eyes, the body covered with elongate, narrow, strong, and keeled scales, and the hinder teeth larger than the others, and furrowed. In colour it varies very much, and these varieties differ greatly in size. It has been well described and figured in several of its varieties by Sir Andrew Smith. "The Boom-slange," he says, "is generally found upon trees, to which it resorts for the purpose of catching birds, upon which it delights to feed. The presence of a specimen in a tree is generally soon discovered by the birds of the neighbourhood, who collect around it, and fly to and fro, uttering the most piercing cries, until some one more terror-struck than the rest actually scans its lips, and almost without resistance becomes a meal for its enemy. During such a proceeding the snake is generally observed with its head raised about ten or twelve inches above the branch round which its body and tail are entwined, with its mouth open and its neck inflated, as if anxiously endeavouring to increase the terror which it would almost appear it was aware would sooner or later bring within its grasp some one of the feathered group.

We must pass over the remaining four families without notice, and hasten on to the consideration of the venomous species of Colubrine serpents.

GROUP II.—THE VENOMOUS COLUBRIFORM SERPENTS (*Elapidæ*).

In this second group of true Colubrine serpents, or those which have a permanently erect grooved fang in front, many are exceedingly interesting, and some are even of classic and historic renown. Forty-three species have been described by Dr. Günther in the Museum catalogue.

These serpents, though furnished with venomous fangs, and endowed with highly poisonous qualities, approach in general outward form so nearly to the harmless species, that even an experienced eye has no little difficulty in distinguishing them at first sight. They differ from the venomous sea-snakes by the absence of the flattened tail; and they cannot be confounded with the Viperine serpents, as they have neither the heavy shape, the broad, triangular head, the vertical pupil, nor the keeled scales. Their body is more slender than either of these two families. Their tail is rather short, often conical, or of equal thickness throughout, and rounded at the extremity. The head, which is generally of the same size and on a line with the neck, is small and short, with a thick, slightly conical, and most frequently a blunt or rounded muzzle. The eyes are rather small, sometimes vertical, and the pupil is round. The scales with which the body is covered are numerous, and, with one exception, always smooth. The organs constituting the poison apparatus are much less developed than in the Viperine species; they do not appear to have the power of opening their jaws so wide as these latter serpents have, and consequently are not able to elevate the fangs so much, nor cause such deep and dangerous wounds. The venomous teeth or fangs are fixed in the maxillary bone, are less developed, and are open on the anterior surface by a groove or furrow, which unites the two orifices.

One of the most important of all the genera contained in the family is the genus *Naja*. Though, as now constituted, it contains only two species, yet these are both of great interest, and are well known. One of them is a native of India and the large islands in the Indian archipelago; the other of Africa, from Egypt to the Cape of Good Hope.

THE COBRA DE CAPELLO, THE HOODED SNAKE, OR SPECTACLE-SNAKE (*Naja tripudians*)—represented in Plate 5, fig. 5—is remarkable alike for the elegance of its form, the strength of its body, and the danger which attends its bite. It derives its name of *Spectacle-snake* from a black mark it has on the extensible part of the neck, and which gives a more or less exact representation of a pair of spectacles, such as used to be worn, and were called *barnacles*. The pattern consists of two large eye-shaped spots, white, with a black centre and border, and united in front by an arched line. It is sometimes very distinct, but at others it is not visible at all, or consists of a number of black irregular marks. The predominating colour of the Cobra is a yellow-ochre with a brownish shade, sometimes very clear, at others very dull. The body is of rather stout proportions, and the tail, which is not very long, is robust and conical towards the extremity. The head is pretty large, and not very distinct from the body; the occiput is swollen and broad, and the muzzle is rather short and rounded. One of the most striking characters, however, shown by this serpent, is the power it possesses of expanding the skin of the neck and raising it in form of a hood. Hence its name of *Hooded Snake*. This remarkable expansion of the skin is a voluntary action, and is quite distinct from that inflation which all serpents when irritated are more or less capable of. The Cobra is a bold and courageous reptile, and as it attains considerable dimensions, measuring often from four to six feet in length, it becomes a formidable antagonist. When surprised by some imprudent traveller, or irritated and roused to anger, it rises on the lower part of its body, elevates its head, expands its neck, hisses loudly, and by its actions and the bright glance of its eye, evinces

THE ASPIC (*Naja hajé*).—This is the serpent so celebrated among the ancients under the name of Aspic. It is nearly of the same size as the Cobra de Capello, and besides resembles it very much in general appearance. The colours are somewhat different ; the spectacles-mark is generally absent, and the neck is less expansible ; the muzzle is more conical, and the plates or scales belonging to the lips differ in structure.

The Aspic owes much of its European reputation to the belief that it was this serpent which produced the death of the celebrated Cleopatra, queen of Egypt. The story, as told by almost all historians, is well known. Abandoned by fortune, who had so long smiled upon her, she commanded a reptile of this species to be brought to her, concealed in a basket of flowers and fruit. Placing the serpent in her bosom, she caused it to bite her, and thus put a period to her existence. Amongst the monumental and hieroglyphical paintings of the ancient Egyptians, the portrait of the Aspic is seen in great abundance. Engraved upon the portals of a great number of ancient temples, it testifies the veneration of which their superstition has made it the object. The figure of this serpent may be still seen printed in colours on the covers of their sarcophagi, and its effigy cast in bronze was used in the form of bracelets and other ornaments. One of their chief deities was represented, in symbolical writings, under the form of a serpent twisted round a globe, or placed in the centre of a disc; and the figure of this serpent surmounting the royal crown, or attached round the arm, was the distinctive ornament of the high priestess. In fact, the ancient Egyptians revered the Hajé, as it was called by them, as the emblem of the protecting divinity of the world, and the faithful guardian of their fields. This opinion appeared to take its origin from a remarkable habit this serpent has. As soon as it perceives any person approaching it, the Hajé raises its head, evidently watching for its own safety, and taking care not to be surprised without being ready for its defence. Misinterpreting this movement, the superstitious Egyptians gave it the character of benevolence to man and a certain amount of wisdom, as if it were really watching the fields it inhabits. We are indebted to the celebrated expedition of the French into Egypt under Napoleon, and to the naturalists attached to it, for a knowledge of the fact that this serpent was the true Aspic of the ancients. This classic reptile had been by many referred to the species of viper called the Asp, and which was known to inhabit the forest of Fontainebleau, *Vipera Aspis*. By Bruce and others it was considered to be the Horned Viper, or *Cerastes;* while the traveller Forskahl maintained that it was the Libetina, *Echis arenicola*. The French savans, however, during the expedition referred to, and still more recent travellers, have proved that the serpent known to the natives of Egypt by the name of Hajé was the true Aspic of Cleopatra. It is spread, according to M. Isidore St. Hilaire, who has given an excellent account of the species in the great work on Egypt, in considerable abundance over that country. It lives, he says, sometimes in the ditches, but more frequently in the cultivated fields. The labourers are thus frequently exposed to encounter it; but although they are not ignorant of the danger of its bite, its presence near them seldom compels them to leave off their ordinary work. Understanding the habits of this formidable reptile, they know well that they have no reason to fear an attack, unless they are imprudent enough to go too near it. They know that as long as they keep at a respectable distance from it, the Hajé will content itself with keeping its eyes upon them, and raising aloft its head in an attitude of attention. When irritated, however, it swells out its neck, raises its body, and springs with a single bound upon its enemy. The poison is very virulent, as many sad accidents have proved, and Forskahl found, in making experiments with the venom, that the bite was always fatal. In one instance, the smallest quantity introduced into an incision made in the thigh of a pigeon sufficed to produce immediately profuse vomiting, violent convulsions, and finally death at the end of a quarter of an hour. Many singular opinions of the effects of the poison produced upon human beings were entertained by the ancients. They believed, for instance, that though inevitably mortal, it produced no pain, and merely occasioned a gradual loss of strength, which was followed by a quiet and lethargic sleep that "knows no waking." Galen tells us that in Alexandria, to shorten the punishment of criminals condemned to death, they were bitten in the breast by an Aspic, of which he declares himself to have been an eye-witness, and that it was with much difficulty the traces of the wound could be discovered. A variety of the Hajé is found in South Africa, and has been well described by Sir Andrew Smith, who observes, that he could not detect any specific differcucos between it and the common Egyptian species. This opinion is confirmed by Schlegel, who, after a comparison of many specimens from both South and North Africa, declares them to be mere varieties of the same. The colour of the South African variety is generally either entirely yellow or purplish brown, or they have the two tints existing distinctly, more or less, in the same individual. These serpents are known by the name of the *Yellow snake* and the *Brown snake;* and another variety is called by the colonists the *Spuugh-slang*, or Spitting-snake. This appellation is bestowed upon it from a belief that it possesses the power of ejecting its poison to a considerable distance.

In the course of this work we have several times had occasion to refer to the practices, with various reptiles, of the jugglers of Egypt. Of all the reptiles used by these men, this Hajé is the one which they know how to turn to most account. After having taken out the venomous fangs, they tame it, and teach it a great number of tricks more or less singular, and produce effects with it which astonish the ignorant people of Egypt, and which, as M. Isidore St. Hilaire says, "would without doubt astonish still more the savans of Europe." One of their cleverest tricks is, as they profess, to change the serpent into a stick, and oblige it to counterfeit death. The celebrated French naturalist quoted above informs us, that when the jugglers wish to produce this effect they spit into its throat, force it to close its mouth, and lie down on the ground. Then, as if to give it the final command, they press their hand on the nape of its neck, and immediately

the serpent becomes stiff and immovable, falling into a sort of catalepsy. Afterwards they waken it up whenever they please, by seizing its tail and rolling it briskly between their hands. From the earliest times the saliva of man was considered to possess great efficacy and power over serpents. Pliny mentions this; but though the use of the saliva is still kept up by the modern serpent-charmers and jugglers of Egypt, it would appear that the chief effects just mentioned are caused by the pressure on the back of the head. "My father," says M. I. St. Hilaire, "having often been an eye-witness in Egypt of these remarkable effects, was persuaded that of all the actions of which the practice of these men consisted, one alone had any efficacy in producing sleep (if one might use such an expression). Wishing to verify this suspicion, he tried to induce a juggler to confine himself to touching merely the upper part of the serpent's head. The man, however, received the proposal as one full of horrible sacrilege, and refused to comply with the request, in spite of all the offers that could be made. The conjecture of my father, however, was well founded; for having pressed his finger rather strongly upon the head of the Hajé, he saw it immediately manifest all the phenomena which usually attended the mysterious practice of the juggler. The man, at the sight of such an effect, believed that he was the witness of a prodigy, as well as at the same time a frightful profanation, and he fled struck with terror."

THE BANDED BUNGARUS (*Bungarus fasciatus*)—another venomous species of this group, represented in Plate 5, fig. 4—is a native of India, China, Java, and Ceylon, and is known on the coast of Coromandel by the name of *Bungarum Pamah*. It attains a length of six feet, and is considered by the natives of India as very deadly. The body is nearly of equal size throughout, the head being rather small, and scarcely distinct from it. Its tail is short, keeled above, nearly of equal size as the body, and terminating in a conical top or round blunt point. It is only about five inches in length. Its body is encircled by large black bands, and generally, either in an adult or young state, there is a large white spot on each side of the neck, sending off a white streak to the crown, the two meeting there and forming an arrow-shaped mark. Dr. Russell tells us that he had a live specimen sent to him from Manoor Cottab, but in a very languid state. Being set at liberty, it remained for some time without moving, but soon began to crawl slowly towards a dark corner. A chicken was presented to him, but he took no notice of it, though when placed on his back the claws of the bird were so fast that he dragged the snake a little way. After the lapse of an hour it was forced to bite the chicken on the naked thigh, and the poor bird died within twenty-six minutes after being bitten.

Of the third group of Colubriform serpents, viz., those which have venomous fangs permanently erect, the species are few and little known. We must therefore pass them over, and hasten to the consideration of the remaining orders of reptiles, the Tortoises and the Crocodiles.

SHIELDED REPTILES (CATAPHRACTA).

IN the synopsis of the orders and families of Reptiles, pp. 5, 6, we have already mentioned that the Shielded Reptiles (*Cataphracta*) are divided into three Orders—the Tortoises and Turtles (*Chelonia*), the Crocodiles and Alligators (*Emydosauria*), and the Amphisbænians or Double-walkers (*Amphisbænia*).

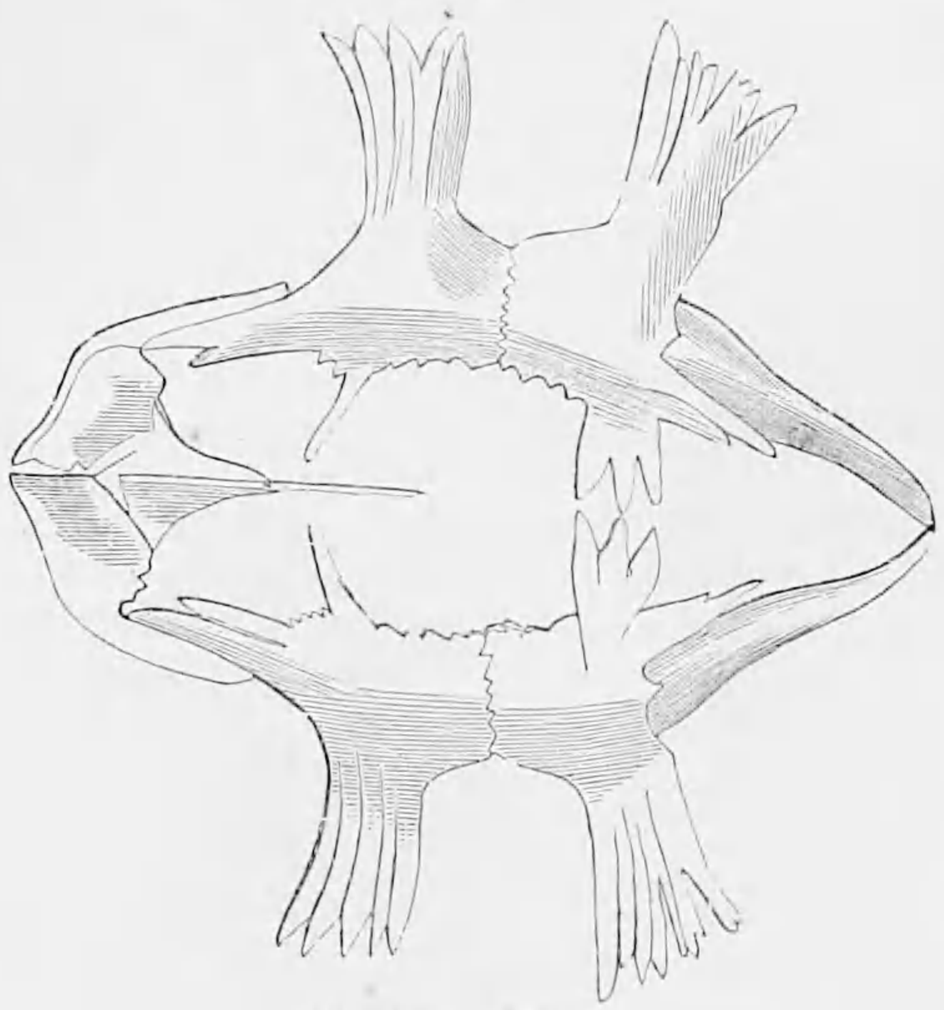
The number of species contained in these three orders of reptiles are very few compared with the Lizards and Serpents, and as we have devoted so much space to the consideration of these latter and more typical forms, we must now limit ourselves to a more brief description of the present group.

ORDER I.—TORTOISES AND TURTLES (CHELONIA).

The form and structure of Tortoises are such that they cannot be confounded with any other order of animals in existence. They appear, in fact, to be animals turned inside out, for their skeleton is external, and the muscular and vascular systems are internal. They may be all arranged in three large groups, according to their habits of life, viz., Land tortoises, Fresh-water tortoises, and Marine tortoises or turtles. The same general structure, however, is found in them all, as the body is inclosed within a case or double buckler, which only allows the head and neck, the tail, and the four limbs to be protruded or withdrawn (in the greater number) when the animal requires to do so in order to protect these parts. This case or double buckler acts the part of a solid armour. Invested with it, they can shelter themselves very effectually from the attacks of all their adversaries except man, and some few animals of great strength and power. The upper portion of this case, which has always a more or less rounded and vaulted form, is called the *carapace*, and the under part is called the *plastron*, and is usually of a flattened form. These two parts are united by their margins. The carapace, which is equivalent to the *thorax* or chest in the higher classes of animals, is formed by the soldering and welding together into a compact vaulted plate, of the ribs and back-bone, the former being broad, and consisting of eight pairs, and the latter retaining motion only at

its two extremities, the head and tail. The plastron is equivalent to the breast-bone or *sternum* in birds and mammals, and is composed of nine pieces, which in general are firmly united together—fig. 21. It covers all the lower part of the belly of the animal, is solid in the land and most of the fresh-water species, but varies very much in form and structure. Round the edge of the carapace there are a series of bones joined together, which represent the cartilages which join the ribs to the sternum in birds, &c. From this structure

Fig. 21.



Sternum of Chelonia.

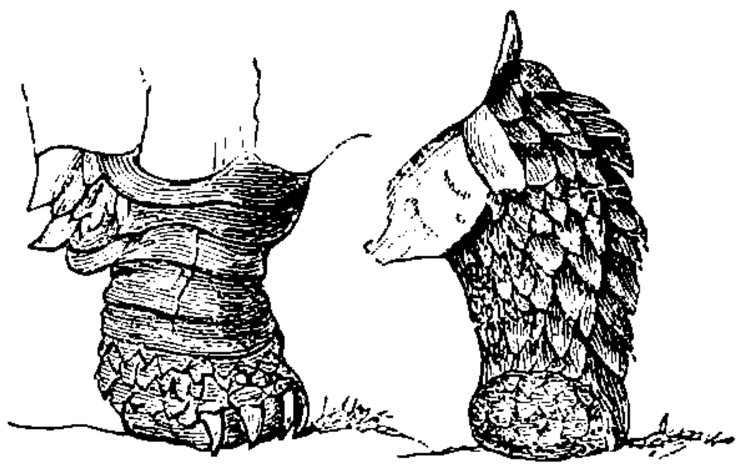
there results, of course, a complete immovability in all these parts, and an immense degree of strength. Their head is generally rather small, and of a flattened form, and the jaws are covered with a hard, sharp, horny beak, the lower portion of which shuts within the upper. This structure supplies the place of teeth, and the portions of food are cut or snapped off on the principle of shears. Though they do not bite very readily, yet, when they do, they bite very severely. There is no possible means of making them let go their hold. Even killing them will not always suffice. They will retain the piece unless the jaws be completely broken. So forcible, indeed, and so violent is their bite, "that I have known," says Mr. Bell, "a stick of half an inch in diameter at once snapped asunder by the jaws of a Snapping Turtle; and a specimen of *Trionyx*, lately in the possession of Mr. Cross of the Surrey Zoological Gardens, snapped off the finger of a sailor when on his voyage to this country." The limbs of tortoises and turtles present a great contrast to that of most other vertebrated animals. They are short and thick, and in all are far removed from the centre of gravity. The form and structure of the feet differ much in the different groups, according to their habits of life. In the Land tortoises they are too short to be able to sustain for a long time the weight of the body, or to elevate it above the level of the ground sufficiently to make locomotion easy. They are clumsy and club-shaped, and these animals therefore only drag themselves slowly along the ground, their plastron or breast-plate almost pressing upon it; and as they move along, their walk is tottering, uncertain, and extremely slow. The marine species, or Turtles, and those which live in rivers, have their feet changed into regular paddles or oars, and endowed with great muscular power. They are thus able to swim well, and their motion through the liquid element, in which they live, is rapid and not without grace. Those species which live in ponds are intermediate between the other two groups, and have the toes webbed and the claws sharp. They are thus able to move along both in the water and on the land; whilst the Land tortoises would perish in the water were they to live in its immediate neighbourhood, and are consequently only found on dry land. The neck in tortoises and turtles is generally cylindrical and capable of great extension, and though the skin is almost always covered with small scales, which are separate and hard, it is the most defenceless part of the animal, and that in which it may most easily be killed. The legs and feet are generally covered with scales also, which serve as a considerable protection to them from accidents or injury; and the texture of this skin is so solid, that the sharpest instruments can with difficulty penetrate it. The senses possessed by these creatures are in general far from being acute. The range of their sensations may be said to be confined to the strictest limits of necessity, or, in other words, merely to what is indispensable for the purposes of self-preservation and reproduction.

LAND TORTOISES (*Testudinidæ*).

The land species are all comprised in one family, *Testudinidæ*, or Tortoises properly so-called; and of all the Chelonia are those which have their shell composed of the thickest and heaviest pieces. In the adult state it is covered with horny, concentrically-grooved shields, which are marked with a permanent areola; and thus the shell is never smooth on the surface, as is the case with marine turtles, &c. The head is in nearly all the species proportionally of the same size; in general it is short, thick, and quadrangular. The eyes are placed laterally and on the same level with the head. The eyelids are cleft obliquely in such a way that the anterior angle is nearly of the same height as the nostrils, whilst the hinder angle is a little higher. The nostrils open at the extremity of the muzzle. The tongue is thick and covered on the upper part with *papillæ*. The horny sheaths which cover the bones of the jaws are very solid and sharp-cutting, or, in some, more or less toothed; and the jaws themselves close like the lid of a box, and can only act in one way, like the blades of scissors. The head and neck can always be withdrawn within the shell. But the most distinctive character of the Land tortoises resides in the structure of the feet. The hinder and fore legs are nearly or quite of the same length; the foot is hard, and of a truncated stump form, like that of the elephant. When they walk, or as it were drag themselves slowly along, this foot is turned obliquely outwards, for it never rests completely on the ground, the claws in fact forming the sup-

port upon which the body rests. All but one genus (*Homopus*) have five claws on the front feet, and four on the hind ones; or if they have five on the latter also, the last is merely rudimentary, and remains concoaled under the skin. They are in some species elongated, nearly straight, and sharp; in others they are short, blunt, and resemble in a slight degree the hoofs of some mammalia. These claws are useful to

Fig. 22.



Fore and hind leg of Testudo actinodes.

the animals, in holding down substances while they tear them with their jaws, and in burrowing or digging holes in which to deposit their eggs, or to take refuge from their enemies or from the cold in situations where they cannot obtain the use of burrows previously made by other animals. The skin which clothes the legs is generally covered with scales—fig. 22. The tail is covered with tubercular scales, and varies very much both in length and form. Sometimes it is very short, scarcely extending beyond the carapace, whilst in other species it reaches nearly to the extremity of the hind feet; and occasionally it terminates in a kind of spur or horny sheath enveloping the last joint. The female tortoise is generally larger than the male. The eggs remain a long time within her body, and are there covered with an external calcareous shell previous to their exclusion. They are all laid nearly at the same time, are of a spherical form, and the shell is pretty solid, not flexible like those of serpents. The newly-hatched young differ considerably in appearance from what they are when adult. Just previous to their birth, they possess at the extremity of their beak a horny point or protuberance, which enables them to break the shell, and thus make their escape from it. Though the Land tortoises never take to the water, yet they are generally found living near it. Their chief places of abode are woods and places well furnished with herbs, and where they can either find or make shallow holes or burrows, into which, when the cold weather comes, they are able to retreat, and in which, in cool climates, they remain during the winter in a kind of torpidity. Their food consists chiefly of slugs and snails, and vegetables. In a state of domesticity, they have been observed to prefer lettuce to any other kind of food. The species appear to be scattered nearly all over the globe, except in Australia, where none have yet been found.

Only two species of Land tortoises are found in Europe:—

THE GREEK TORTOISE, TARTARUGA, OR COMMON LAND TORTOISE (*Testudo græca*)—represented in Plate 6, fig. 1—is the best known. One of the first naturalists who has given a description of this species was our countryman, John Ray. It was well-known, however, to the ancient Greeks; and it is said to be the tortoise which the celebrated Phidias sculptured, and placed at the feet of his statue of Venus, as the symbol of gentleness. The Tartaruga appears to be peculiar to the northern part of the Mediterranean basin, and the opposite coast of Africa. It is extremely common in the Morea, is abundant in Calabria, Sicily, Sardinia, and Corsica, and is found all along the Barbary coast, especially in the neighbourhood of Algiers. It is said also to be found in Spain, in the province of Andalusia, and even to extend eastward to the shores of the Caspian Sea and the foot of the Caucasus. The shell is of an oval figure, a little broader behind than in front, and is swollen or convex. The plates of the carapace are generally smooth, or occasionally striated coneentrically, and are generally of a yellowish-green and black colour, with black triangular spots and rings. The tail is rather long, in the European individuals being terminated by a rather long and pointed claw; and in the African variety (which has been described by some authors as a distinct species, under the name *Testudo Mauritanica*, or the Moorish tortoise) being blunt and clawless. The ordinary size of this animal appears to be from six to eight or ten inches in length. Wherever it is found, it occurs in considerable abundance, and it seems to prefer sandy and woody spots as its places of abode. Its food consists of herbs, roots, worms, and snails, the shells of which it breaks with facility, and swallows the animal. During the cold weather of winter, these tortoises retire into holes, which they dig for themselves in the ground to the depth of two or three feet, and in which they remain in a sort of torpid state till the warmth of the months of April and May revivifies them. Like the generality of reptiles, they delight in warmth, and love to bask in the rays of the sun. In Sicily and Italy these tortoises are sold in the markets as food; but their flesh is less esteemed than the soup made from it. In Paris the soup made from the individuals sent from Algiers, known as *soupe à la tortue* is much esteemed by many people. The habits and disposition of the Tartaruga are very gentle, and it is easily domesticated. It is often kept in gardens, where it is very useful, as it destroys insects, slugs, and snails, which are often so pernicious to the flower-beds. It never does any harm provided it is furnished occasionally with nourishment. Lettuce leaves, according to Messrs. Dumeril and Bibron, are its favourite food, preferring these to any other kind of sustenance. According to some Italian writers, these tortoises breed in the gardens of Italy, where they are often kept. They appear to grow very slowly, and live for a considerable time, individuals having often been kept for upwards of forty years. Who has not read of the "old family tortoise," so exquisitely described by the inimitable author of the "Natural History of Selborne?"

Though the land-tortoise is generally very slow in its movements, at the pairing season it becomes much more active. When several males assemble in one place, they attack each other fiercely, butting with

their heads and biting severely. The female lays her eggs about the middle of summer, depositing them in a little hole, always well exposed to the sun. These eggs are generally from four to twelve in number, spherical in form, white, and about the size of those of a pigeon. The female covers them with earth, and leaves them to be hatched by the warmth of the sun, taking no farther care of either them or the young after being hatched, which generally takes place in autumn.

THE MARGINED TORTOISE (*Testudo marginata*) is the other European species. This animal derives its specific form from its having the hinder edge of the carapace expanded horizontally, so as to form, as it were, a margin all round. The shell is of an oblong, oval form, and the upper part is much swollen, and is nearly as high as it is broad. The plastron or breast-bone is somewhat movable in its hinder part, the animal being able to bring it close to the carapace, without however being able to touch it. The jaws are strong, sharp-edged, and slightly toothed on the sides. The tail is conical, thick, and short, scarcely extending beyond the edge of the shell. The skin of the legs is imbricately covered with thick, flat tubercles. The general colour of the head, neck, tail, legs, and carapace is deep black, the latter having the areolæ of a fine yellow. The under part of the shell is of a dirty yellow. In size this species exceeds considerably the Greek tortoise, being from fourteen to sixteen inches in length, and ten or twelve broad. It is a native of North Africa, being found in Barbary, Algeria, and Egypt. It has lately been found also in Europe, the gentlemen attached to the French expedition into the Morea having discovered it there.

Three species of Land tortoises have been described as natives of India:—

THE BLACK OR INDIAN TORTOISE (*Testudo Indica*), sometimes called the "Elephant Tortoise," is the most remarkable of these. It is a native of the continent of India, of the Isle of France and the Seychelles, and is particularly abundant in the Galapagos islands. It is said to be found also in California. It is not improbable, however, as has been stated, that these tortoises are originally natives of the Galapagos archipelago, and that they have been carried off these islands by the buccaniers, who used to frequent them much, and distributed through various parts of the world. The carapace or shell is about three feet long, compressed in front, and elevating itself above the head at the anterior edge. In old individuals, however, the size here mentioned is far surpassed. A specimen which was for some time kept alive in the Zoological Gardens in London, and mentioned in the Proceedings of the Zoological Society in 1833 as originally from the Seychelles, measured along the curve of the back four feet four inches and a quarter, and was four feet nine inches in breadth. Mr. Darwin, in his "Journal of a Naturalist," gives some very interesting particulars in regard to these natives of the Galapagos, but we must refer our readers to his graphic sketch of them in the above-mentioned work.

There are not fewer than six species of the genus *Testudo*, natives of Africa and the large islands adjoining. Amongst these are—

THE GEOMETRIC TORTOISE (*Testudo geometrica*), one of the most beautiful of the whole family of land tortoises, and—

THE LEOPARD TORTOISE (*Testudo pardalis*), which is found at the Cape of Good Hope. Only two species of land tortoises are found in America, and both of these belong to the genus *Testudo*—

THE GOPHER OR MONGOFA (*Testudo Gopher*) is a native (and the only one) of North America, being found from Florida to the river Savannah.

FRESH-WATER TORTOISES.

Of these there are three families, two of which are numerous in species, living in ponds, marshes, and streams, but coming frequently to land; the third containing fewer species, and which live in rivers and seldom quit the water. The two first families are Pond or Marsh tortoises. They inhabit ponds and marshes, though many live also in moist ground where water fails. They are much more numerous than Land tortoises. The structure of their feet—the toes of which are distinct and movable, furnished with hooked claws, and the phalanges united at the base by means of a flexible skin, which permits them to separate from each other, preserving at the same time their strength and presenting a larger surface—allows these animals to walk upon the ground, to swim either at the surface of or at a considerable depth in the water, and at the same time they are able to cling to and climb up upon the banks of lakes and similar tranquil waters, in which for the most part they make their habitual sojourn. They thus form a natural transition between the truly aquatic species, such as the Soft tortoises (*Trionycidæ*), and Marine turtles (*Cheloniidæ*), and the Land tortoises. The habits and manner of life of the two families of which these marsh tortoises consist, renders them in fact a natural group, but in some parts of their organization they differ considerably. Some, for instance, have a cylindrical neck, covered with a loose skin, which is movable in consequence of the slight adherence of it to the muscles, and acts as a sheath; and this neck they can withdraw entirely within the carapace. The head is nearly conical; the eyes are placed laterally, and upon the sides of the cheeks; and the bones of the *pelvis* or basin are united only to the vertebræ. These are the *Cryptodéres* of Dumeril and Bibron, the Terrapens or *Emydidæ* of Dr. Gray.

Other species, again, have the neck long and broad, and covered with a tight skin closely adhering to the muscles under it, so that it is not retractile within the shell, but admits only of being contracted and bent under the side of the shell, either to the right or the left, when the animal is in a state of repose. The head is broad and much depressed, and the eyes are placed near each other on the upper part of the face, and directed upwards. The bones of the *pelvis* or basin are united not only to the vertebræ, but are also solidly fixed to the plastron or breastplate. These form the *Pleurodéres* of the French authors, the Chelydes or *Chelydidæ* of Dr. Gray.

Of all the families into which the Chelonians are

divided, the two which compose the Pond or Marsh tortoises are the most numerous in species. Specimens are found in both the Old and New Worlds, and Australia. America, which produces only two species of Land tortoises, contains more of these Pond species than all the other parts of the globe united. Thus, out of one hundred and thirteen specimens enumerated by Dr. Gray in 1855 as belonging to these two families, sixty-eight were exclusively American; the remaining forty-five being divided between the various parts of the Old World and Australia. The cause of this is no doubt the configuration of the American continent, with the immense quantity of water, in the form of lakes, marshes, and ponds, which covers a certain portion of its surface, as well as the large rivers and tributary streams which traverse it in all directions.

THE TERRAPENS (*Emydidæ*).

The Terrapens are not only characterized by their being able to retract completely, within the shell, their long, cylindrical neck, with its lax and sheathing skin; they are, moreover, distinguished by their head being nearly as thick as it is broad near the occiput; their eyes being always placed laterally on the sides of the face, and the orbit being so large that this cavity occonpies nearly the fourth part of the total extent of the cranium. The jaws are very strong, with a naked, horny beak; sometimes simply cutting, at others more or less dentated. The tip of the beak of the upper jaw is notched in most of the species, and on each side of the notch there is a pretty strong tooth, and generally the corresponding extremity of the mandible is curved in a sharp point towards the muzzle. In some instances the upper beak resembles very much in form that of certain birds of prey, such as the falcons. The toes are generally webbed nearly to the claws. The bones of the *pelvis* or basin are articulated with the internal face of the carapace by a cartilaginous symphisis corresponding with what is known in other animals as the *os sacrum*, and is quite free on the side of the breastplate. This allows several of these Terrapens to move slightly that part of their long shell.

The great bulk of the species of Terrapens, however, are contained in the genus EMYS, and are chiefly natives of Asia and America.

THE CASPIAN EMYS (*Emys Caspica*), a small tortoise about six or seven inches long, is the only species found in Europe.

THE PAINTED TERRAPEN (*Emys picta*, the *Chrysemis picta* of Gray) is perhaps the most beautiful, as it is certainly one of the most common and best marked species of the genus. It is a native of America, and has a wide range of habitat, for it extends along the Atlantic border from Maine to Georgia. This animal may be readily distinguished, says Mr. Holbrook, from all others of the genus by the beautiful colours and markings of the shell. In general it is of a very dark brown, approaching to a dark olive, with yellow lines, which in old animals are of a fawn colour, but in the young are so bright, especially when seen under water, as to resemble golden bands. The marginal plates are all marked with a bright red spot in the centre, which is surrounded by concentric lines of the same colour, and at times their upper surface appears clouded with red, resembling the mineral called blood-stone. The sternum is entirely yellow, except at the wings, where it is somewhat dusky. The head above and the jaws are dark, almost black, with several small yellow lines running along them. The neck itself above, as well as the throat, are black, marked with longitudinal lines of orange and red. The anterior extremities are black, with one or two red lines in front, while the posterior surface is mottled with orange or red. The posterior extremities are black, both above and below, but the dark colour is relieved by orange lines. The tail is dark above, and mottled at its base with red spots. These colours, however, vary greatly in degree; they are always brightest in the young. This species is not a large one, the shell in an adult specimen being about six and a half inches long, and four and a half broad. It is of a suboval or oblong shape, with a small head, rounded in front. The upper jaw is notched anteriorly, and the lower is slightly hooked or turned upwards in front. The eyes are large and brilliant, the pupil being black and the iris golden, with a black band passing through it horizontally.

The Painted Terrapen frequents ditches, ponds, and pools, and abounds in rivers where the waters are sluggish. It spends almost the whole day, according to Mr. Holbrook, basking in the sun on the banks of rivers, or upon fallen trees or logs. It is very timid, and makes a very rapid retreat when disturbed. It retires early to its winter quarters, and is the first to be seen in spring. It feeds upon insects, tadpoles, young frogs, earthworms, &c. It takes the hook readily, and is on that account very troublesome to anglers. Its flesh is used occasionally as food, but it is not much esteemed.

THE HICOTEE (*Emys decussata*) is a native of the West Indian islands, and is about ten or eleven inches long. The shell is oblong, bluntly keeled, the hinder edge slightly toothed. The shields of the carapace are a little wrinkled, irregularly radiately grooved, and of a uniform pale-brown colour; but the animal itself is green. Dampier mentions this species in his "Voyages." "Two sorts of tortoise or turtle," he says, "are found in the West Indies. One is called by the Spaniards *Hecatee*. Another sort is called the Terrapen. Both these sorts are very good meat. They are in great plenty on the Isle of Pines, near Cuba: these the Spanish hunters, when they meet them in the woods, bring home to their huts and mark them by notching their shells, then let them go. When these hunters return to Cuba, after about a month or six weeks' stay, they carry with them three or four hundred or more of these creatures to sell, for they are very good meat, and every man knows his own by their marks."

THE SALT-WATER TERRAPEN (*Malaclemys concentrica*).—The species of Terrapens we have already mentioned have the head covered with a thin hard skin, and are purely fresh-water tortoises. There is a species, however, that has the head covered with a soft, spongy skin, and the habit of the animal is to live in salt water marshes. This is the Salt-water Terrapen. The shell is seven and a half inches long, and

is of an oval form, rather convex, and slightly tuberculated. The shields are of a pale yellow colour, marked with brown, impressed, concentric rings. The legs, neck, &c., of the animal are gray, with black spots and lines. The head is very large, and the jaws are strong and sharp-edged. The neck and tail are both short and thick. The males are smaller than the females, and the concentric striæ are more deeply impressed. This animal, as has been said above, lives in salt water and salt marshes, and is never met far from them. In their immediate neighbourhood it forms its winter habitation. It is described as a timid animal, easily disturbed, and hiding itself on the least alarm. It swims with great rapidity, and even on land it moves quickly. Mr. Holbrook informs us that this species of Terrapen is widely distributed in America, abounding in marshy places from Rhode Island to Florida. It is found also along the northern shores of the Gulf of Mexico. "This seems," he says, "to be the only Terrapen common to North and South America, and it is not singular when we consider that all others of the tribe live in fresh water—this alone in salt; consequently, it might be driven by currents from island to island, and from one shore of the gulf to the other, like the Chelonia or Sea-tortoises; and yet I have never received them from any of the West India islands, nor have I any evidence of the existence of this species among them. They are very abundant in the salt marshes around Charleston, and are easily taken when the female is about to deposit her eggs, in the spring and early summer months. They are then brought in immense numbers to market; yet, notwithstanding this great destruction, they are so prolific that their number appears undiminished. Their flesh is excellent at all times, but in the northern cities it is most esteemed when the animal has been dug out of the mud in a state of hybernation."

The Box tortoises, including the genera CISTUDO and KINOSTERNON, are remarkable species belonging to this family, and form a natural group distinguished by several important characters, the most peculiar of which consists in the species having their plastron or breastplate separated, as it were, into two (*Cistudo*) or three (*Kinosternon*) divisions, which are movable upon each other.

The genus CISTUDO has an oval plastron with an entire margin, which is divided by a cross suture between the pectoral and abdominal plates. It thus consists of two sections, the hinder of which is the larger. These sections are joined by a hinge formed of a sort of articular cartilage, which allows by its elasticity of their having a degree of motion sufficient to enable the animal to open the shell so as to move its limbs without inconvenience, or, on the other hand, to bring it into close contact with the upper shell, and thus inclose itself within a complete box—hence the name Box tortoise. The genus is represented by—

THE THREE-STREAKED BOX TORTOISE (*Cistudo* or *Cuora trifasciata*)—Plate 6, fig. 4. The carapace, which is of a clear brown colour, is somewhat oblong, and marked with three distinct keels of a black hue, and the toes are strong and widely webbed to the claws. The head is long, narrow, and somewhat depressed, and is of a yellow colour, with two horizontal black or deep-brown streaks on each side, passing from the nostrils across the orbit to the back part of the head, where they unite. The neck is very long, ashy above and yellow beneath. The tail is rather long and slender, and without any horny appendage at the extremity. A live specimen of this species was to be seen a few years ago in the gardens of the Zoological Society in London; but as to its habits in the wild state we have no particular information, except that it is a native of China.

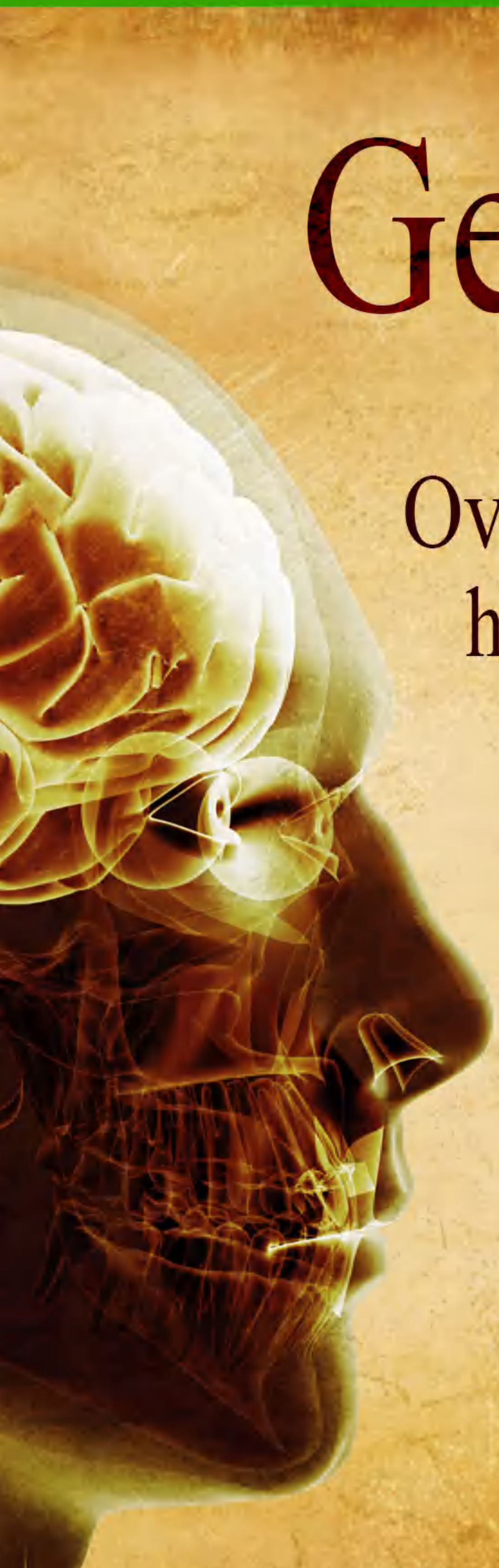
The other genus of Box tortoises, KINOSTERNON, is characterized by the species having the plastron or breastplate formed of three distinct lobes or sections. It is divided by two cross sutures, the central lobe being fixed to the carapace by a bony attachment, and having the anterior and posterior lobes articulated to it by a ligament, and movable. The species are all natives of America. Some of them are odoriferous. There are two, especially, which are found in the same localities, very much resembling each other, and exhaling a strong odour of musk.

THE MUD TERRAPEN (*Kinosternon Pennsylvanicum*) is about four inches long, and inhabits ditches and muddy streams from New Jersey to Florida. It preys upon small fish, according to Le Conte, and other aquatic animals; bites readily at the hook; and is therefore very troublesome to anglers. It takes hold of the bait very gently, and draws it slowly to the bottom of the water, and frequently it allows several minutes to elapse before it seizes it in such a manner as to allow of its being taken.

THE SCENTED KINOSTERNON (*Kinosternon odoratum*), the other species alluded to, is often called the Mud Terrapen also in the Southern states. Its odour appears to be stronger than the preceding, very disagreeable to many people. Mr. Storer, in his Report of the Reptiles of Massachusetts, in the *Boston Journal of Natural History*, says:—"This species has a very disgusting odour, and is hence sometimes called Stinkpot. It is found burying itself in the mud in ditches and small ponds, frequently covered with a thick coat of foreign matter, from which circumstance it has received the common name of *Mud tortoise*." It is a little smaller than the preceding, being about three and a half inches long, and is found in the same localities as it.

THE CHELYDES (*Chelydidæ*).

In addition to the distinguishing characters of this family of Fresh-water Pond tortoises, given at p. 70, we may remark here, that in all the genera but one the nostrils are simple, and open in the upper part, and in a notch of the horny sheath of the upper mandible. In the case of the *Matamata* alone, they are prolonged beyond the muzzle, in the form of a small proboscis. In general the head is naked, and the jaws are never toothed, but are sharp-edged. The neck is always enveloped in a lax and flexible skin, which in some is naked, in others granular, and in others furnished with appendages or plates of floating skin;



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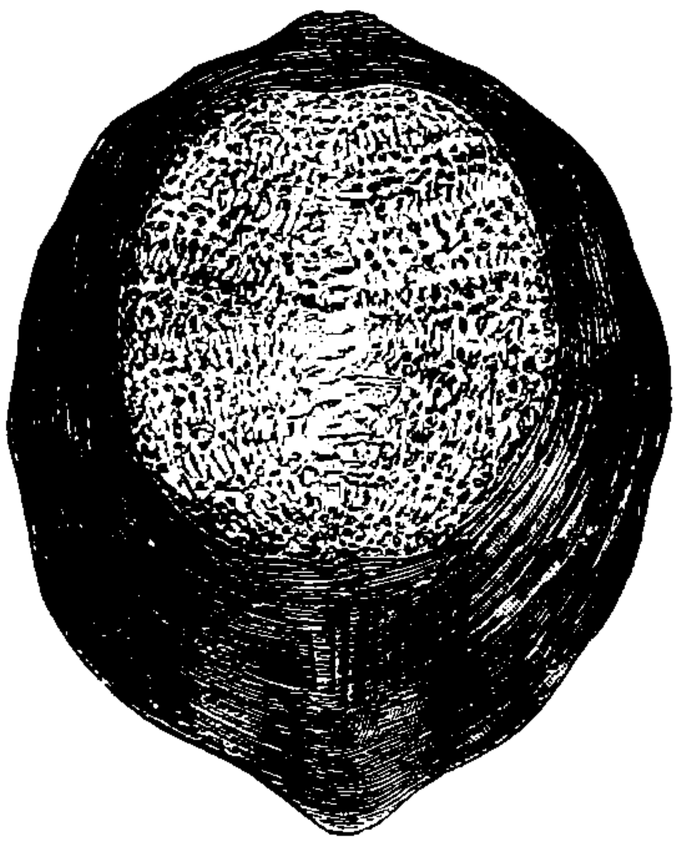
in front and pointed, the bones composing it being nearly naked. The jaws are horny, and covered with a dependent, fleshy fold of skin resembling lips, and which can cover the mouth. The nostrils are prolonged into a thin cylindrical tube, like a small movable proboscis. Their carapace is very broad, and nearly flat—fig. 23. It is soft, destitute of plates, and covered with a flexible and cartilaginous sort of skin, which extends all round the edges of the shell. These

Fig. 23.



Carapace of Trionyx.

edges are soft, and destitute of bones, and the ribs are only united together and to the vertebræ above, whilst they are separate below. The plastron or breastplate is formed of a ring of bones, the centre not being ossified, and covered with a continuous skin. In adult individuals these bones are furnished with rough callosities on the prominent parts. The legs are short and strong, and nearly of equal length behind and before.

None of the species are European, all that have as yet been described being found in the large rivers and deep lakes of the hotter portions of the globe. The Nile and the Niger in Africa; the Euphrates and Ganges in Asia; the Mississippi and Ohio in America, are the principal places of abode of these animals. Some of them attain a very large size. Pennant mentions individuals which weighed seventy pounds, and he had one which lived in his possession for three months that weighed twenty pounds, and was twenty inches long in the shell. The neck measured thirteen and a half inches in length. Individuals of the species known as the Sewteree (*Chitra Indica*), a native of the Ganges and other rivers of India, have been taken, which, according to Dr. Cantor, weighed two hundred and forty pounds.

The River tortoises are in a great measure nocturnal animals. At night, when they consider themselves free from danger, they come forth from the water to stretch themselves out on the rocks in the little islets, or take up a position on the trunks of trees overturned in the rivers, but from which they precipitate themselves again into the water at the least noise or appearance of danger. They are very voracious, and very nimble in pursuit of their prey. This consists of fishes, reptiles, and mollusca, to which they are continually giving chase, and which they pursue while swimming. They in their turn are eagerly sought after by man, for their flesh is much esteemed as an article of food. In order to catch them it is necessary to angle for them, and to bait the hook with live fishes or other small animals, to which motion must be given, for they will not touch carrion or motionless prey. When they seize their prey, or when they are called to defend themselves, they dart their head and long neck forward with the rapidity of an arrow. They bite severely, nor will they let go their hold without taking out the piece seized. Their bite in consequence is much dreaded by the fishermen, who generally cut off their heads as soon as they are caught. The males appear to be less numerous than the females, or at least they are less frequently seen near the shore, the females being obliged to come to land to lay their eggs. These they deposit in large holes which they dig out in the sand, of sufficient size to hold fifty or sixty. They are white, spherical, with a shell which is solid, but only membranous or very slightly calcareous.

THE TYRSE OR SOFT TORTOISE OF THE NILE (*Trionyx Niloticus*)—represented in Plate 6, fig. 7—is a good illustration of the family. The carapace is rather convex in the centre, oval or somewhat orbicular in shape, covered with a skin which is coriaceous, rough to the touch, and of a greenish colour or blackish-brown, dotted with white or yellowish spots. The breastplate is white, the rough callosities bluish. The head is rather long, the jaws very strong, the lips much developed and thick, and the tail is conical, thick, and pointed. The Tyrse (for by that name it is known on the banks of the Nile) sometimes reaches three feet in length. It inhabits the river Nile, but is found in other rivers both of West and North Africa. These animals are said to be very destructive to the young crocodiles, devouring them in great numbers as soon as hatched.

This is the only species of Trionyx that inhabits the Nile. Several other species are found in the rivers in India and America, but we have not space to mention them.

MARINE TORTOISES OR TURTLES (*Cheloniidæ*).

Of all the species of the Tortoise race, the Marine species or Turtles are those which have more especially attracted the attention of mankind from the earliest periods of antiquity. Aristotle distinguishes them from all the others by the term *Thalassios* (θαλασσιος or θαλαττιος), a term derived from the Greek, meaning those animals which "frequent the sea." There are two groups into which they may be divided, according to the structure of the carapace, viz., those which have this part of their shell, as well as their neck and feet, covered with more or less hard and horny scales, and those the carapace of which, and the external parts of their body, are covered with a hard, thick, horny skin. The structure of the limbs is one of the most remarkable characters of this family, and distinguishes them

from the species of all the other families, both land and fresh water. The feet, though the toes are all formed of distinct pieces, expanded at the end and often armed with sharp claws, are changed into flat, depressed fins, which are not fitted for any movement but that of swimming, an act which these animals perform with great vigour and celerity. The fore legs are very much longer and larger than the hinder ones, and this forms a very characteristic feature of the species. They are not retractile within the shell. The whole structure of the Marine tortoises shows an exact correspondence with their manner of living, which is essentially aquatic. Their carapace, as well as their legs, is exceedingly flattened, a form well adapted to admit of rapid movement through the water. It is almost always heart-shaped, and has a defined bony margin. The Land and Fresh-water tortoises have no voice except a sort of hissing noise when irritated or suddenly laid hold of; the marine species, on the contrary, some of them more especially, as the one well known by the name of Luth (*Sphargis*), have a remarkable cry, and when caught in the net or severely wounded, utter a loud roaring sound, from which, indeed, the generic name (*Sphargis*) is taken—a name derived from the Greek word *sphargizo* (σφαργιζω), which means "to utter a sound with a distended throat."

The principal food of the Marine tortoises consists of marine vegetables, which the structure of the jaws just described enables them to cut and masticate with facility. Some few, however, especially such as the Hawksbill and Loggerhead, which exhale an odour of musk, feed also upon certain crustacea and mollusca, more particularly cuttle-fishes. They scarcely ever appear to leave the water, except at the time of laying eggs. Some of the species, however, it is said, come out at night, and creep up on the shores of deserted islets, where they clamber up the rocks to browse upon the marine plants which form their food. In calm latitudes, even seven or eight hundred leagues from any land, these animals are often met with lying stretched out on the surface of the sea, and in a state of absolute immobility, as if they were dead. It is believed that they assume that position in order to give themselves up to sleep. They have, all of them, the faculty of swimming under water for a length of time, owing to the fact of their possessing very extensive lungs. This family of Marine tortoises contains some of the largest species of the order to which they belong. As we shall see when we come to mention the species in detail, some individuals of the Coriaceous turtle or Luth have been found to weigh from fifteen hundred to sixteen hundred pounds, and others of the true turtles to weigh from eight hundred to nine hundred pounds, with a shell fifteen feet in circumference, and nearly seven feet long. They live long, and are slow in growth. The males in general are smaller than the females. The time during which the sexes remain united together lasts a fortnight, or, according to some observers, nearly double that time; and the act of reproduction always takes place in the water. When the time arrives for depositing her eggs, the female has often to traverse spaces of sea more than fifty leagues in extent, the male accompanying her or following after. By a peculiar kind of instinct, almost all the females of the same latitudes, from all parts and at nearly fixed periods, repair to the sandy shore of some desert island for this purpose.

The Marine tortoises or turtles are found in the seas of all hot climates, but chiefly towards the torrid zone. In the equinoctial ocean they abound on the shores of the West Indian islands, as Cuba, Jamaica, the Caimans or Alligator Islands, St. Domingo, and the Gulf of Mexico; in the Atlantic Ocean they are found in equal abundance at the Cape Verde isles and Ascension; in the Indian Ocean they frequent the shores of the Isle of France, Madagascar, the Seychelles, and Rodriguez; in the Pacific Ocean they are found at the Sandwich Isles and the Galapagos.

Amongst all the species of the class *Reptilia*, the Marine tortoises are those which are the most useful and advantageous to man. In consequence of this, in climates where they abound their capture becomes an object of great importance; some for their carapace or shell, and others for their flesh as an article of food, their fat, and their eggs.

In those countries where turtles abound, and where they attain a large size, the natives use the carapace as canoes or boats to creep along the coast in. This is mentioned by Pliny and Diodorus Siculus, who speak of a tribe of Ethiopians on the shores of the Red Sea, called from their living so much upon the flesh of these Chelonians, "Chelonophagi," or Turtle-eaters. And that this is not a mere invention of these ancient authors seems to be proved, and the statement corroborated, by a fact mentioned by Dampier:—"I heard," he says, "of a monstrous Green Turtle once taken at Port-Royal in the Bay of Campeachy, that was four feet deep from the back to the belly, and the belly six feet broad. Captain Rock's son of about nine or ten years of age, went in it as in a boat, on board his father's ship, about a quarter of a mile from the shore." These shells are made use of also in some parts by the natives as a covering for their huts, as troughs for the domestic cattle to drink out of, and as baths for their children. "In the Gulf of Manaar," says Sir J. Emerson Tennent in his account of Ceylon, "turtle is frequently found of such a size as to measure between four and five feet in length; and on one occasion, in riding along the sea-shore north of Puttam, I saw a man in charge of some sheep resting under the shade of a turtle-shell, which he had erected on sticks to protect him from the sun—almost verifying the statement of Ælian, that in the seas of Ceylon there are tortoises so large that several persons may find ample shelter beneath a single shell." As a delicious article of food the flesh of the Turtle is well known. At first it was made use of by our navigators, who found it a healthy, agreeable, and nourishing food after their long sea-voyages, and an excellent remedy against the ravages of scurvy. It came afterwards, however, to be used at better tables, and, as is well known, is now and long has been an especial article of luxury in this country at the banquets of the wealthy. In Jamaica and elsewhere *preserves* have been established where turtle are kept, and from whence they are distributed to other countries as

an article of commerce. The introduction of turtle as an article of luxury into this country dates more than one hundred years back. The fat of certain species, when fresh, is used instead of butter or oil in cooking; and that of those species which smell of musk is employed in preparing leather and giving it suppleness, as well as for burning in lamps. This fatty or oily matter is so abundant in these animals, that frequently thirty pints of it have been extracted from one individual.

The eggs of the greater number of species are very much sought after as affording an excellent article of food. The white part or albumen does not coagulate by heat, but the yolk is much esteemed. Even in the musky species the eggs are of excellent flavour. Mr. Holbrook informs us, that in the Tortugas Islands (four or five uninhabited sandbanks in the Caribæan Sea, visited only by turtles and wreckers, but which are a favourite haunt of the Green Turtle), the eggs of this species are taken wholesale. "The 'egger,'" he says "uses a small stiff rod, with which he 'probes' the sand in those places where Turtles usually deposit their eggs; and in this way myriads are collected, as may be supposed, when it is recollected that many hundreds of turtles lay their eggs on a small space of sandbank. The 'eggers,' however, do not confine their depredations to the nests of the Green Turtles, but they seize upon those of all other species, as well as upon the eggs of thousands of sea-birds that seek the same localities during the breeding season."

The horny laminæ or plates which cover the carapace and breastplate of the Marine tortoises can very readily be detached. In the greater number of species they are too thin to be employed with advantage in the arts or manufactures; but those of the Hawk's-bill Turtle (*Chelonia imbricata*) are thicker, stronger, and more transparent than those of any other species, and are accordingly much esteemed and made great use of for ornamental purposes, under the name of "Tortoise-shell." This substance appears to differ essentially from horn, because, as Messrs. Dumeril and Bibron remark, it is not formed of parallel fibres, and because it appears rather an exudation of solidified, muco-albuminous matter, the tissue of which is homogeneens, but which can be cut and polished in every way like horn. Besides, they add, it is susceptible of being softened by the application of heat, and then can be made to assume various forms, which it preserves after cooling. Thus, though in the rough state these plates are fragile and brittle, when properly treated, from the fineness of its tissue, its compactness, the admirable polish and impressions it can receive, its ductility, the facility with which it can be moulded, and its fragments soldered together and amalgamated by means of their own substance reduced to powder, tortoise-shell is in great demand in the manufacture of ornamental objects of furniture, and has become an article of considerable commerce. In order to obtain the plates from the carapace of this animal, it is only necessary to subject the shell to the action of heat. According to Dumeril and Bibron's account of this process, the convex part of the carapace is submitted to the effect of a strong fire, by which means the plates start up and are then detached with great facility. In his account of Ceylon, Sir J. Emerson Tennent says, that as the shell becomes clouded and milky after the animal's death, the natives of that island, in order to take it freshly coloured, catch the turtles as they come to deposit their eggs, and "suspend them over fires, till the heat makes the plates on their dorsal shield start from the bone of the carapace; after which the creature is permitted to escape to the water." In the rough state these plates vary much in colour. Some are transparent, and are called "white, or spotless;" others are marked with a reddish-brown colour, more or less deep, which is disposed in round, irregular spots, or in streaks, and are called "speckled;" others, again, are quite brown or black. The ancients appear to have been exceedingly fond of the use of this beautiful substance in the decoration of their houses, apartments, &c. This luxury was carried to an excessive degree by the Romans in the time of Augustus. Bruce, in his Travels, informs us that "the Egyptians dealt largely with Rome in this article of commerce. Pliny tells us that the cutting of them for veneering or inlaying was first practised by Carvilius Pollio, from which we would presume that the Romans were ignorant of the Arabian and Egyptian art of separating the lamina by fire placed in the inside of the shell when the meat is taken out. Martial says that beds were inlaid with it. Juvenal, and Apuleius in his tenth book, mentions that the Indian bed was all over shining with tortoise shell on the outside, and swelling with stuffing of down within. The immense use made of it in Rome may be guessed by what we learn from Velleius Paterculus, who says, that when Alexandria was taken by Julius Cæsar, the magazines or warehouses were so full of this article, that he proposed to have made it the principal ornament of his triumph, as he did ivory afterwards, when triumphing for having happily finished the African war. This, too, in more modern times, was a great article in the trade to China, and I have always been exceedingly surprised, since nearly the whole of the Arabian Gulf is comprehended in the charter of the East India Company, that they do not make an experiment of fishing both pearls and tortoises."

Such being the value of Marine tortoises, no wonder that their capture is a business of great importance, and that many methods are employed for that purpose. On some coasts advantage is taken of the usual time when the females land upon the desert islands to deposit their eggs. Their time for doing this, as has been already mentioned, is the night. The turtlers, who frequent these places, wait in perfect silence till they have left the water; they then intercept them, and with their hands, or with a lever when they are too heavy, turn them on their back. As they cannot turn or "right themselves" when once placed in that position, they remain there till morning, when the men return and carry them off to their boats. They are often left in this same position, on the deck of the vessels on board which they are taken, for twenty days; the only precaution adopted being to wet them with sea-water several times a day. They are then deposited in the preserves or pens, or, as they are called in America, *crawls*, made for the purpose of keeping them; and

which are so constructed as to be filled at every flood tide. Here they are kept till taken to market or sold. In the South Seas, skilful and practised divers take advantage of the moment when they find these turtles asleep on the surface of the ocean; they dexterously swim right under them, so that on coming up they may seize hold of them and retain them there till both are hauled on board the boat. Mr. Darwin mentions the same process at the Keeling Islands, and thus describes the capture of these animals:—"The water was so clear and shallow, that although at first a turtle quickly dives out of sight, yet in a canoe or boat under sail, the pursuers, after no very long chase, come up to it. A man standing ready in the bow at this moment dashes through the water upon the turtle's back; then clinging with both hands by the shell of its neck, he is carried away till the animal becomes exhausted and is secured. It was quite an interesting chase to see the two boats thus doubling about, and the men dashing head foremost into the water trying to seize their prey." These animals are also taken by means of harpoons. In the open sea, when they come to the surface to breathe or to sleep, they offer a fair mark to the fisherman. The point of this instrument is sharp and arrow-shaped, and to the extremity is attached a ring to which a long cord is fastened. The animal when wounded dives and carries with it the harpoon and cord, but is soon hauled up and dragged alongside the boat. At the Bahama islands the natives are, according to Catesby, very dexterous in taking these animals by means of an instrument called a *peg*; and Holbrook tells us that the very same instrument is used in the Tortuga islands at the present day. He quotes Audubon, who says that he saw a man who with his *peg* had been known to secure eight hundred grown turtles in one year! But the most singular method used for catching turtle is one practised in the Indian and China seas, and on the coast of Mozambique. This consists in the use of the sucking-fish (*Echeneis remora*), which, as Dumeril and Bibron say, are "taught this manœuvre, like our hunting dogs, and are called in consequence, *hunting-fish*." The fact was known to Columbus, was verified by Commerson many years afterwards, and has since more recently been confirmed by Mr. Salt. The sucking-fish is thus employed: The fishermen have in their boats buckets which contain several of these animals, with a ring through their tails, to which a long slender cord is attached. As soon as they perceive at a distance, several turtles asleep on the surface, but which they know a slight noise might awaken, they throw one of the sucking-fishes overboard, giving it a long play of rope. As soon as the fish sees the turtle floating, it approaches it, darts upon it, and fastens itself by its sucker to the under surface of its carapace. To this it adheres with such force, that in withdrawing the rope, both fish and turtle are hauled in together. Mr. Salt, when in the Mozambique, had a specimen of a sucking-fish given to him as a present. "All the Portuguese gentlemen whom I conversed with," he says, "on this subject, agree in assuring me that fish of this kind were employed on the coast in catching turtle."

THE CAREY (*Chelonia virgata*) forms our illustration of this family—see Plate 6, fig. 3. This turtle has a great range of habitat, as it is a native of the coasts of South America, the Cape of Good Hope, and the Indian Ocean. It has also been found off Teneriffe, at New York, and in the Red Sea. The shell of the Carey is about two feet nine inches in length. and the carapace is proportionally shorter than that of any other species of the family. It is truncated, as it were, in front, forms an obtuse angle behind, and is very much arched on the sides. The colour of the carapace, head, and fins, is a deep chestnut, rayed with brown mixed with yellow; and the breastplate is gamboge or greenish-yellow.

THE GREEN TURTLE (*Chelonia viridis*) is the species which excels all the others in the delicacy and excellent flavour of its flesh. It is *the Turtle* par excellence, so well known in this country to all "bons vivants." What would the Lord Mayor's dinners at the Mansion-house of London be without the Turtle!

The Green Turtle surpasses all the other species (except the Coriaceous Turtle) in size and weight. The ordinary length of adult specimens may be about four feet; but individuals not unfrequently occur which measure six or seven feet in length, and weigh upwards of eight hundred pounds. Le Maine, in his "Voyage to the Canary Islands," informs us, that near Cape Blanco turtles are found of the enormous size of fifteen feet in circumference, and that the flesh of one of them would be a sufficient meal for thirty men!

The carapace is oval, somewhat heart-shaped, and slightly convex. The head is rounded, and, comparatively speaking, rather smaller than in most other marine tortoises. The lower jaw is strongly toothed and hooked in front, and the upper jaw is notched in front and serrated on the sides.

The Green Turtle is very common upon low, sandy coasts in both continents, but principally within the torrid zone. Its chief food consists of marine plants, and more especially the *Zostera marina*, which in consequence is known by the name of "Turtle-grass." According to Mr. Audubon, it cuts this near the roots, in order to procure the most tender and sucenlent parts, which alone are eaten, while the rest of the plant floats to the surface and collects there in large fields. This, when seen, is a sure indication that the feeding ground of the Green Turtle is near.

THE HAWK'S-BILL TURTLE or CARET (*Caretta imbricata*).—If the Green Turtle excels all others as an article of food, the Hawk's-bill Turtle is the most valuable as producing a substance of great importance in the arts and manufactures. It is smaller than the Green Turtle, for it is rare to find one from three hundred to four hundred pounds weight. The shell is depressed, oval, or somewhat heart-shaped, and covered with plates, which are laid one above the other like the tiles of a house—hence its specific name *imbricata*, or imbricated. The breastplate is large, full and entire in front and behind, but hollow and depressed in the centre. The head is oval, elongate, and compressed at the sides. The upper jaw is greatly prolonged, and hooked in front like the beak of a hawk, from which circumstance the common English name

of the animal—the Hawk's-bill—is derived. The edges of their jaws are entire and without teeth or serræ. The Hawk's-bill Turtle is a native of the Indian ocean and the American seas. It is taken at Ceylon, Amboyna, the coast of New Guinea, and North Australia, the Seychelles, the coast of Cuba, and other West Indian islands, the Red Sea, &c.; and individuals have even strayed as far north as the coast of Great Britain. As we have said before, however, it is the substance known by the name of *Tortoise-shell*, which is the produce of this animal, that makes the Hawk's-bill valuable. Other species have the same kind of plates that cover the carapace; but in no other are these plates sufficiently thick to be of any value in the arts. Tortoise-shell is not considered of the best quality unless the animal has reached to a certain size, weighing about one hundred and sixty pounds; before that state it is too thin. The quantity obtained from a single individual varies much. It is stated by some authors that eight pounds may be gained from a large turtle. Mr. Holbrook says that fifteen pounds is the largest quantity that is ever obtained, but that only from animals of the largest size. M'Culloch, in his "Dictionary of Commerce," says that the best tortoise-shell is that of the Indian archipelago; and that the finest of that quarter is obtained from the Spice Islands and New Guinea.

Of the second group of Marine tortoises, or those which have the carapace and the external parts of their body covered with a leathery skin, only one species is at present known.

THE CORIACEOUS TURTLE, or LUTH, as the French authors call it (*Sphargis coriacea*), is undoubtedly the largest of all the family, individuals having been occasionally found weighing twelve hundred pounds, and measuring eight feet in length. Though not a common species, it seems to have a wide range, as specimens have been taken in the Mediterranean; in the Atlantic, as in Chesapeake Bay on the coast of North America, and the Tortugas or Turtle islands of Florida; at the Cape of Good Hope; on the coast of Chili; and in Japan, where it is known by the name of *Jalafa*. It has also been occasionally taken off the coasts of France and England. Borlase, in his "History of Cornwall," tells us that two individuals of a large size were caught off that coast in the mackerel nets, in the summer of 1756; and Pennant informs us of another specimen having been caught on the coast of Dorsetshire, and which is now in the British Museum. In August, 1729, a specimen was captured off the mouth of the Loire, about thirteen leagues from Nantes, which was upwards of seven feet long.

The carapace of this species of turtle is somewhat heart-shaped, narrow, and pointed behind, and is marked on the back with seven longitudinal keels. The breastplate is large, very full in front, and perfectly flat, without any prominence or tubercle whatever. The head is very large, and the jaws of great strength and very sharp on their edges. The upper one has three remarkable notches, one in the centre which is angular, and one on each side at a short distance from the former, which are rounded. The lower jaw is very acute at the point, and somewhat hooked, corresponding with the central notch of the upper. The neck is very short, very thick, and covered with a coriaceous skin. The fore legs are large and well developed—twice the length of the hinder. Both are covered with a coriaceous skin. The tail is short, acute, and scarcely extends beyond the carapace. The whole surface of the animal is covered with a smooth, leathery skin, quite destitute of horny plates or scales. It is of a very dark-brown colour, with the exception of the ridges or keels on the back, which are tinged in different places with obscure dirty white. Mr. Audubon states that the Coriaceous Turtle, in resorting to the Tortugas or Turtle islands of Florida for the purpose of depositing its eggs, is later than the other species in arriving there. The average number of eggs laid by it, he says, may be three hundred and fifty, in two sets. It appears also to be less cautious than the Green Turtle or Hawk's-bill in choosing the places for this important operation. Its food consists of mollusca, fish, crustacea, sea-urchins, and various marine plants. Pennant says that it becomes extremely fat, but that the flesh is coarse and bad. The ancient Greeks, it is said, were well acquainted with this species of marine tortoise; and it has been often confidently asserted, though we think without sufficient proof, that it was from the shell of the Coriaceous Turtle that the first lyre was fabricated.

ORDER II.—CROCODILES AND ALLIGATORS (EMYDOSAURIA).*

OF all the families of which the class of reptiles is composed, that of the Crocodiles contains the bulkiest and strongest species. In general appearance they resemble gigantic lizards, but they differ from the order *Sauria*, or Saurian reptiles to which the lizards belong, in having the body covered with square, keeled, bony plates, imbedded in the skin, and placed in longitudinal lines; in the solidity and formation of their skull; and in the vent being longitudinal. In size they vary from ten or twelve feet to fifteen or twenty, and some even attain the length, it is said, of twenty-five or thirty. Distinguished as they are by their great magnitude, they have also the character of great ferocity. "Inhabiting the margins of the mighty streams of tropical climates, they are the terror of all who

* From the Greek words, *emus* (εμυς) tortoise, and *sauros* (σαυρος) lizard.

approach them; they prey upon every animal which comes within their reach, and man himself is not free from their attacks, for instances are by no means rare, both in ancient and modern times, of their suddenly seizing upon human beings, and carrying them off to their watery haunts." They are often called the tyrants of the fresh waters, and their capacious mouth and numerous strong and conical teeth fit them well for a rapacious life. James Montgomery happily describes the family in a few words:—

> "The crocodile, the dragon of the waters,
> In iron panoply, fell as the plague,
> And merciless as famine, cranched his prey,
> While from his jaws, with dreadful fangs all serried,
> The life-blood dyed the waves with deadly streams."

In general form the body of the Crocodiles is depressed; and the tail is long, tapering, thick at the base, and compressed at the sides, so as to form a sort of paddle or oar. The legs are so very short, that they appear as if they could never support the weight of the body. They have no clavicle or collar bone. The fore feet have five toes, the two outer of which are destitute of claws. The toes in the hind feet are only four in number, the outermost of which alone wants a claw. These latter are connected together by a membrane or web, while those of the fore feet are free. The partially webbed feet, the flat compressed tail, and the position of the nostrils at the tip of the muzzle, all sufficiently show the aquatic nature of the Crocodiles.

The female deposits her eggs in the sand. In some species she makes a sort of nest in which she lays them, then covers them with leaves and debris of plants, and thus leaves them to be hatched by the heat generated there from the fermentation of the vegetable matters. Some of the Crocodiles are said to lay three times after short intervals; and about from twenty to thirty each time. The eggs are covered with a hard white shell, are about the size of those of a goose, and are said to be good eating. The young are hatched in about twenty or thirty days, and the moment they quit the shell, they make with all speed to the water. A great many of these eggs are destroyed by the ichneumon and tupinambis; and vast numbers of the young are devoured by the fresh-water tortoises, voracious fishes, various amphibious animals, and even, it is said, by the old Crocodiles themselves, when pressed by hunger. In all probability these animals live to a considerable age, perhaps at least that of man; and their growth appears to be slow. They are able, like other reptiles, to sustain long fasts, and some of the species, where the heat is not so very great, bury themselves during the winter in the mud. Their principal places of abode are the banks of large rivers and marshy lakes; and they are often found living in society together in large troops. Their chief food consists of fish, frogs, water-birds, and any other animals they can secure. Even dogs, swine, and oxen, it is said, cannot always escape their voracity. Man, himself, sometimes falls a victim. In order to obtain their food they often have recourse to artifice; swelling out their lungs with air, so as to make their bodies specifically lighter than water, they allow themselves to float immovable on the surface of the river, where they look exactly like a branch of a tree, and thus their unsuspecting prey come around them.

The Crocodiles are all strangers to Europe, and with the exception, perhaps, of one or two, are equally so to Australia. In the three other parts of the world, however, they are found, and often in great numbers. In Dr. Gray's arrangement of this order, these animals are divided into two families, the true *Crocodiles* and the *Alligators*. The latter are peculiar to America, while the former are common to both worlds.

FAMILY OF CROCODILES (*Crocodilidæ*).

The species of this family are chiefly characterized, and distinguished scientifically, by the teeth. The lower canines fit into a notch in the edge of the upper jaw when the mouth is closed. At the same time they are known by the muzzle behind the nostrils being much narrowed by the hind legs having a fringe of compressed scales behind, and by the toes being webbed to the tip.

The family contains three genera, and about fourteen species.

THE EGYPTIAN CROCODILE or the CROCODILE OF THE NILE (*Crocodilus vulgaris*) is the species which forms our illustration of the genus *Crocodilus*—Plate 7, fig. 2; and Plate 8, fig. 5 (teeth). This huge creature, which often reaches the length of from twenty-five to thirty feet, is a native of the Nile, the Senegal, Niger, Gambia, and probably most of the rivers of Northern and Western Africa. It appears to have been well known from the earliest periods, and it even seems to have been worshipped in Egypt previous to our historic records of that country. At Memphis it was reared with the greatest care by certain priests who had charge of it, and who nourished it with abundant food. Sacrifices and offerings were presented to it, it was adorned with trinkets and jewels, and lodged in a lake or basin in the midst of the temple. Treated in this manner, the Crocodile lost its ferocity, and became so tame as to be led about in religious processions and ceremonies. When the celebrated Greek historian Herodotus visited Egypt, which was about 400 years before the birth of Christ, the habits of this animal were well known. His object was, in a great measure, to investigate the religious history of that people, and therefore he was insensibly led to the study of an animal which was so mixed up with their sacred rites as the Crocodile. At that time he informs us that the inhabitants of the Thebais and the shores of the lake Mœris regarded these creatures with the highest reverence. Each person in that district reared a Crocodile which they trained up, suspending gold and jewels from its earlids, and adorning its fore feet with rings of gold. They fed it carefully and with delicacies, and when it died it was embalmed and placed in some consecrated repository. Numerous mummies of young Crocodiles in the British Museum, obtained from their primitive repositories after a lapse of more than two thousand years since their embalmment, and still in perfect preservation, attest the truth of that statement. The description given us of the Crocodile

of the Nile by this distinguished historian is declared by M. Geoffroy St. Hilaire, who, during the invasion of Egypt by the French under Napoleon I., had great opportunities of studying and observing the habits of the creature, to be true in most respects as we find it at the present day. It would appear that at the time he wrote, the Crocodile was found in Lower Egypt, but now it is only found in Upper Egypt, and is never seen below Thebes. In such situations the temperature is very high, and accordingly it is never found in a lethargic state, as is the case with the species found in America and elsewhere. It is nocturnal in its habits. During the day it comes ashore, taking up its abode in some quiet retreat for the purpose of sleeping; but when evening comes on it resumes its activity and returns to the water, where alone it is able to successfully secure its prey. Their principal place of abode is a series of small islands in the river, and there they live in society. Mr. St. John, in his "Travels in the Valley of the Nile," tells us that he saw numbers of them during his passage up the river. "These islands (sand-banks at Pharos) are the usual haunts of the Crocodile; but as they love to bask in the warm sun, and have an aversion to cold, there is little danger of encountering them early in the morning, or when the wind blows. In fact they seem never to rise out of the water but when the surface of the Nile resembles that of a pond, and the whole sandy shore is glittering in the sun, when you see them lying in troops along the edge of the stream." The different individuals of the troop select and keep their own particular spot. These are flat shores where spurs of fine sand stretch a considerable distance, and conduct to the water's edge by a gentle declivity. Each troop or society remains faithfully attached to the localities where they were born, and never go far from them except when in search of prey. This occupation fulfilled, they return at particular hours to their resting-places on the sandy shore, which had been previously selected by the foresight of the old chiefs of the family; and placing a sentinel to give the alarm in case of danger, they there abandon themselves securely to sleep. The sentinel, placing his ear partly on the ground, listens for the least noise, and if disturbed, the troop make direct to the water. M. G. St. Hilaire says he has watched them at such times, and has seen them turn themselves slowly, and march at first apparently carefully and with measured steps, but after a certain distance they would leap briskly into the water, clearing at a bound a considerable distance. The egg of the Crocodile is white, and of a spheroidal form. It is not much larger than that of a goose, and the young Crocodile at its birth is only two and a half decimetres in length.

The very name of Crocodile excites the idea of an animal alike formidable for its size and ferocity; of an animal unequalled in its own orders, and which is the tyrant of the fresh waters. The story of the little bird called *Trochilos* by Herodotus, which, according to his account, frees the mouth of the Crocodile from the leeches which infest it—or, as Pliny asserts, picks or cleans the huge reptile's teeth—is probably familiar to every one. We will allow Mr. St. John to tell the tale:—"We shot and ate a *siksak*, the *Trochilos* of Herodotus, a sort of gentleman in waiting on the Crocodile, about which history and tradition tell strange stories. What they say is this, that the Crocodile being too much addicted to live in water with his jaws open, allows a number of leeches to creep down his throat, where, vigorously sucking his blood, they prove extremely troublesome. Against these enemies, however, he finds a faithful ally in the siksak, which, as soon as he perceives, he opens his delicate mouth, and the bird, rendered bold by instinct, leaps like another Curtius into the gulf, not to be swallowed up however, but to swallow. He kills and devours the leeches, and then hopping out, receives the thanks of the Crocodile. Sometimes this lumbering animal, getting sleepy during the process, mechanically closes his jaws, so as to deprive his little friend of air; upon which, extending his wings, furnished with sharp spikes on the tips of the shoulders, he wounds the Crocodile's throat, and reminds him that it is his business to be civil. "For the truth of the story," he adds, "I will not answer; but certain it is that I seldom, perhaps never, saw a Crocodile without a siksak standing close beside him on the sand, evidently within his reach, but without his exhibiting the slightest desire to molest or injure it." Herodotus was the first author that mentions this curious tale; and M. Geoffroy thinks, that if we use the word generally translated leeches, to mean merely anything that sucks blood, the story is not at all destitute of reality. There are thousands of gnats and musquitos in these localities he says, which suck blood; and he asserts that as the Crocodile has no movable tongue to sweep them away, its mouth is infested with these troublesome insects to a great degree. Moreover, he affirms that there is a small bird called *siksak* by the natives, which he has frequently observed hopping about in all directions round the Crocodile, and even going into the mouth of the reptile as it lay asleep, or was feigning to be so. Attracted by these insects, upon which it feeds, he has no hesitation in saying the bird does enter the reptile's mouth when wide open, and there picks up the insects which it finds in abundance. This bird is recognized at once as a species described by Hasslequist, under the name of the Egyptian plover (*Charadrius Ægyptius*); and as to this apparent cordiality between two such animals, there is nothing very extraordinary in it, as similar affections arising from mutual good offices, are exemplified in other cases in the animal kingdom.

If the Crocodile has a good friend in the little siksak, it finds powerful enemies in one or two other small animals. The ichneumon, a small animal about eighteen inches long, belonging to the *Viverridæ* or Civets, is particularly destructive. It is very fond of eggs, and in Upper Egypt searches with great avidity for the eggs of the Crocodile in the sand. It devours great numbers, and it was thought to check so much the increase of these large reptiles, that it is one of the animals which were formerly held sacred by the natives; divine honours having been paid to it in the ancient city of Heraclea. The tupinambis too, a large lizard, is a powerful enemy, for, as it swims well, besides eating the eggs, it destroys a great number of the young after they have reached the water. Though,

them, shot it in the mouth; but not wounding it mortally it escaped into the river. The day after he again saw another band lying on the banks of the river, and succeeded in shooting two of them.

FAMILY OF ALLIGATORS (*Alligatoridæ*).

The Alligators are distinguished from the crocodiles by having the canine teeth of the lower jaw fitting into a pit, instead of a notch, in the edge of the upper, when the mouth is closed. The hind legs are destitute of the fringe of scales on the hinder part, and their toes are scarcely webbed. The species are not numerous, and they are peculiar to the New World. Nine or ten only have been described, and they are arranged in three distinct genera, *Alligator*, *Jacare*, and *Cayman*. The genus ALLIGATOR has the jaws of an oblong figure, depressed, and is more particularly distinguished by having a small longitudinal rib between the orbits. The hind feet are webbed; and the nostrils are separated by a bony septum.

THE ALLIGATOR, par excellence, THE PIKE-MUZZLED CAYMAN of some authors (*Alligator Mississippiensis*)—Plate 8, figs. 7, 7*a* (skeleton and skull)—is one of the best known. The head is elongated, suboval, rounded in front, truncated behind; having the general form of that of the well-known fish called the pike. The superior surface of the snout is elevated for the nostrils, and the forehead is subdivided by a short sharp keel into two halves. This ridge is peculiar to the Alligator. The nostrils open on the upper part near the snout, and are (even in their early youth) separated from each other by a bony plate or partition —a formation found in no other species of the order. The eyes are large and prominent; and there are three eyelids, the upper one of which is covered with two large plates, and several smaller ones. The jaws are slightly curved, and armed with forty teeth above and below, of which the fourth inferior pair is the longest of all, and received in sockets of the upper jaw when the mouth is closed. The body is elongated, rounded above, full at the flanks, and flat below. The chest and belly are protected by broad, smooth, quadrilateral plates. The tail is large, long, compressed and thick below, and surmounted above with a double, strongly serrated crest on its anterior, and by a single crest on its posterior half. The fore legs are large and strong, but the hind are nearly twice the size. The body of the Alligator, in the old animal, is of a dusky colour above, the throat yellowish-white. The common size is between nine and ten feet, but they often grow much larger. Holbrook says he has seen one in Carolina thirteen and a half feet long; Catesby has seen them fourteen feet; and Bartram tells us that he has seen them twenty feet in length, and that some are supposed to grow to even twenty-two or twenty-three feet. Waterton asserts that he himself "once saw an alligator in the Oronoque thirty feet in length, and another of the same size in the Essequibo." Bartram's description of this huge creature is very graphic:—"When full grown," he says, "it is a very large and terrible creature, and of prodigious strength, activity, and swiftness in the water. Their body is as large as that of a horse; their shape exactly resembles that of a lizard, except their tail, which is flat or cuneiform, being compressed on each side, and gradually diminishing from the abdomen to the extremity, which with the whole body is covered with horny plates or squamæ, impenetrable when on the body of the lire animal even to a rifle ball, except about their head and just behind their fore legs or arms, where it is said they are only vulnerable. The head of a full-grown one is about three feet, and the mouth opens nearly the same length; their eyes are small in proportion, and seem sunk deep in the head, by means of the prominence of their brows. The nostrils are large, inflated, and prominent on the top, so that the head in the water resembles at a distance a chunk of wood floating about. In the forepart of the upper jaw on each side, just under the nostrils, are two very large, thick, strong teeth or tusks, not very sharp, but rather the shape of a cone. These are as white as the finest polished ivory, and are not covered by any skin or lips, and always in sight, which gives the creature a frightful appearance. In the lower jaw are holes opposite to these teeth to receive them. When they clap their jaws together, it causes a surprising noise, like that which is made by forcing a heavy plank with violence upon the ground, and may be heard at a great distance."

The Alligator is a native of North America. It is first observed on the Atlantic border of the United States, in North Carolina. From this point, they abound near the mouths of all the creeks and rivers that empty into the Atlantic Ocean, or into the Gulf of Mexico, as far as New Orleans, ascending up the Mississippi as high as the entrance of Red River, a distance of six hundred miles. Their chief places of abode are the low stagnant ponds and deep morasses of the Southern States, where hundreds of them can be seen at a time, either on the flat marshy banks of creeks and rivers, or on sandy or muddy shores left dry by the ebb of the tide. Here they remain motionless for hours, apparently asleep, and are often mistaken for logs of dead and decaying wood, as well from their colour as from their perfect immobility; but, when disturbed by the approach of enemies, they suddenly retreat to the water. At other times, they may be observed floating on the surface of the water, and only directed by its current; suddenly they skim along with the greatest velocity, either in search of food or their mate. In his native state, the Alligator is exceedingly voracious, and feeds on any animal substance that falls in his way. As Catesby says, he springs upon domestic animals, such as pigs, sheep, or oxen, that are imprudent enough to penetrate into their solitudes; but he seems in general to be mostly attracted by fish and other animals in motion, as minks, musk-rats, dogs, &c., so as to render it almost impossible for them to cross even small streams without danger at certain seasons of the year. Holbrook tells us that Alligators are said to lie in wait for their prey on the banks of creeks and rivers, and when it approaches they sweep it into the water with their tail; "and it is certain," he adds, "that the animal uses the tail in defence, striking with it the enemy, and turning the head to the same side, at the same instant, so as to represent nearly a circle. There seems to be some difference of opinion amongst authors

as to the ferocity of the Alligator and his motions on land. Mr. Holbrook says that this animal is much more timid than is commonly supposed, and he believes that there is no well authenticated instance in Carolina of their having preyed on man. It moves but slowly and with difficulty, he says, on land, in consequence of the shortness of the extremities compared with the great length of the body. "He raises himself on his legs, advances for a short distance, dragging along the thick heavy tail; now he falls upon the belly, apparently to rest for a time, before he proceeds on his journey." Waterton, however, asserts that in Guiana this creature is bold and ferocious, and by no means slow-paced on land.

Bartram's testimony as to the ferocity of this species corresponds with this account given by Waterton. The stories given by this traveller of his different enconnters with Alligators in Florida are most amusing, whilst at the same time his description of its habits is so correct in many particulars, that, romance as it may appear, we cannot refuse credit to his statements. He travelled in Carolina, Georgia, and through East and West Florida between the years 1773 and 1788; and, as Holbrook remarks, though his description appears, with our knowledge of these animals at the present day to be one that should be received with caution, yet it is very possible that the encroachments of man upon their dwelling-places, since Bartram saw them, may have rendered them more timid and distrustful. We have already made a similar remark when describing the rattlesnake—see p. 44.

In the spring of the year and early summer months, and during the period of incubation, and specially in cloudy days or in the evening, Alligators make a great noise. Their croak, according to Holbrook, is not unlike that of the bull-frog, but louder and less prolonged. The females construct peculiar nests in which to deposit their eggs. Mr. Holbrook informs us that they mount small sandy hillocks, or construct small mounds with mud and vegetable substances, for this purpose. The eggs are hatched by the heat of the sun in about thirty days; and for some time after they are born, the young appear to live only upon the larvæ of insects and very small fishes. The Alligator, like other reptiles, can remain a long time without eating; and on the approach of winter they seek out holes in the earth, where they remain torpid till spring or the warmth of the weather excites them again to life and activity. In the Southern States many are dug out of these retreats, in this state of hybernation, by the slaves, who esteem the tail as an article of food, and which is even declared by Holbrook to be "tolerable." The eggs are also used as food. According to Waterton they are about the size of a turkey's, and the outside is rough and of a dirty-white colour.

The name of *Alligator* is most probably derived from the Spanish word *lagarta*, a lizard. Waterton says that the British having seized on the settlements in America formed by the Spaniards, soon became acquainted with this reptile, and on hearing the Spaniards exclaim "una lagarta" when the animal made its appearance, they, in their turn, called it "an alligator;" for so the two Spanish words, "una lagarta," sounded in the English ears.

The genus JACARE differs from *Alligator*, in having a ridge across the face between the eyes, and the nostrils being separated by a cartilaginous septum. The jaws are oblong, depressed; the hind feet are scarcely webbed; and the eyelids are fleshy.

THE SPECTACLED YACARE (*Jacare sclerops*).—The species represented in Plate 7, fig. 3, is a native of Brazil, and derives its name from the native appellation of this reptile, the Gnarauis calling it the *Yacare*. Azara who tells us this, informs us also that it is common in all the rivers, lagoons, and estuaries in Paraguay, where it may be seen in the mornings and evenings lying under the water, showing only its eyes above the surface. About mid-day, however, it leaves the water and comes ashore to sleep on the sandy banks and bask in the sun. There it sleeps profoundly, returning precipitately to the water the moment a man or dog approaches. This Yacare grows to a considerable size, eight feet being an ordinary length, though it often reaches to still larger. Azara, in his "Travels in South America," gives a very good description of the Yacare. The head, he says, is flat above, is long, and the muzzle so deeply cleft, that from its tip to the angle of the throat is fourteen inches. Its tail constitutes nearly half its total length, and is rather singular in form. Its posterior part is triangular and prismatic, and there extends all along it a series of scales in form of a crest. The upper part of its body is covered with a skin of a dark colour, underneath which it has scales impenetrable to the balls of a musket. It has them also underneath, so that they can only be killed by striking them in the eyes, which are small, or at the flanks. This reptile has no incisives, and the rest of the teeth are so disposed that we may at once infer that the animal can make no use of them to cut with, not even to tear their prey, but that it is obliged to swallow the fishes which it seizes without masticating them. In Paraguay the natives do not appear to fear the Yacares, and do not hesitate to bathe and swim in the rivers frequented by them. Sometimes, however, they seize dogs traversing the stream, pull them under water and drown them. The female lays about sixty eggs, which are about the size of those of a goose, and are white. She buries them in the sand, covering them over with herbage, and leaves them to be hatched by the heat of the sun. These eggs are much sought after by the Indians, who esteem them as an article of food; and they eat the flesh of the animal also, which is white and well tasted, though dry.

The third genus, CAIMAN, differs from the two others, principally by the eyebrows being defended with three bony plates. There are three species described—one, the native habitat of which is not well known, further than it is from South America, *Caiman trigonotus;* another a native of Brazil, the Eye-browed Cayman, *C. palpebrosus;* and the third, an inhabitant of Tropical America, the Swollen-headed Cayman, *C. gibbiceps*. Very little is known of their habits, and the specimens are very rare in European museums. The toes are scarcely webbed, which might lead us to suppose that these animals were more terrestrial in their habits than the Alligators and Yacaris.

ORDER III.—DOUBLE WALKERS, OR AMPHISBÆNIANS (AMPHISBÆNIA).*

THIS last order of Reptiles, the Amphisbænians, are peculiar-looking animals, and are not of much general interest. In some systematic arrangements they take their place along with Serpents, and in others they are placed amongst the Lizards. In the system we have adopted in this work they form an order by themselves, and are placed at the end of the whole class of Reptiles. In many of their characters they differ from all the other orders we have been describing. The body of the various animals which compose the order, is elongate, of a cylindrical form, and naked, but surrounded with rings of square scales or plates, placed crosswise, and divided into two sets, in all but the *Lepidosternons*, by a slight longitudinal groove on each side. The appearance of these square plates has been compared to that of a piece of mosaic work. The tail is short, continuous with the body, and about the same dimensions. It is blunt, and generally of a conical form. The head is the only part of the body which possesses scales or plates similar to those of lizards or serpents. The eyes are very small, and in general appear like two simple black points, shining through the skin by which they are covered. The ears are hidden under the skin, and no external auditory holes are visible. The mouth is small and the jaws are not extensile, the upper being fixed to the skull and intermaxillary bones. The tongue is not sheathed and extensile like that of serpents, neither is it forked, but only notched at the end, and terminates in two smooth threads. It is flat, short, and broad, and the greater portion is covered with large flat papillæ or scales. The nostrils are small and placed on the side of the muzzle. With the exception of the genus *Chirotes*, they are totally destitute of limbs; and even that species which has them, possesses only the two front members. With the exception of about two species, they are all natives of the New World.

The Amphisbænians in the catalogue of the Reptiles in the British Museum consist of about fifteen species, which are distributed in four families.

FAMILY—AMPHISBÆNIDÆ.

This family, that of the true Amphisbænas, have the teeth fixed on the internal edge of the jaws. They are placed in a single row, are conical, slightly curved, simple, pointed, unequal, and distinct from each other. The square scales or plates with which the body is covered, are all of the same size and shape throughout. The scales of the head, however, are variable in form. There are no traces of limbs. The tail is short. The species are chiefly found in America and the West Indies. They live in the nests of the white ants, or *termites*, and feed upon the larvæ of these animals. A number of fables have been related of these animals by some of our earlier writers. It was said for instance, and even believed, that if an Amphisbæna were cut in two across the middle, the two heads would mutually seek each other; and that when they met, the cut extremities united again, the blood serving as a sort of cement for making them adhere. It was also believed that if cut into three pieces, each head sought the side to which it belonged, and that when the fragments were united the animal was as whole as ever. This reptile was also said to be difficult of being killed. The only means of doing so was by cutting off the two heads with a small part of the body, and suspending them to a tree by a cord; but that this was not to be depended upon: for if the birds of prey did not eat them, and if the cord rotted and allowed the dried portions to fall to the ground, these parts became revivified by the first rain which fell and moistened them, and coming together, united again into a perfect animal. Such belief is attributed to the natives of Brazil at the present day; and Stedman in his "Voyage to Surinam" says, that "the flesh of the *Amphisbæna*, dried and reduced to a fine powder, is confidently administered as a sovereign and infallible remedy in all cases of dislocation and broken bones—it being very naturally inferred that an animal which has the power of healing an entire amputation in his own case, should at least be able to cure a simple fracture in the case of another."

THE WHITE AMPHISBÆNA (*Amphisbæna alba*) is the species selected for illustration—see Plate 3, fig. 3; and Plate 8, fig. 9 (skull). This animal is a native of Brazil, and, we are told, is known in that country by the name of *Ibriaram*, which signifies "Lord of the earth." It is of a white colour, often spotless, and the body possesses two hundred and twenty-three rings of scales, and the tail from fifteen to twenty more. Azara met with it in his travels in South America, and says that it is common in Paraguay, but that he never saw it beyond the thirtieth degree of south latitude. Margraave, an early writer on America, was the first to describe this Amphisbæna, but his description is not to be relied upon. He relates, for instance, that the "serpent," as he considers it, wounds with its tail as well as its head, and that the bite is extremely venomous—both assertions equally erroneous. He says, moreover, that it lives underground, and that it attacks ant-bills, so as to drive out the ants in large flocks as soon as they have got their wings. In all probability, like the following species, it feeds upon ants, and this may have given rise to Margraave's story.

THE SOOTY AMPHISBÆNA (*Amphisbæna fuliginosa*) is a much larger species than the preceding, being from one and a half to two, and even, according to Stedman, three feet in length. It is of a very dark colour varied with white, and has two hundred and twenty-two rings on its body, and twenty-eight on the tail. It is a native of Brazil, Cayenne, and some of the West Indian islands; and its habits and manner of life are very similar to those of the preceding species. It burrows

* From the Greek word *amphisbæino* (αμφισβαινω), to walk in two ways.

under ground, feeds upon earth-worms, slugs, insects, &c., and it is said to make especial war upon ants' nests.

FAMILY—LEPIDOSTERNIDÆ.

The second family, that of the Lepidosternons, differ chiefly from the true Amphisbænas, in having their chests covered with shields of a larger size and a different shape from those of the rest of the body, and by the body having three lines which divide the rings of scales into three sets. There are only three species described, all natives of Brazil.

FAMILY—CHIROTIDÆ.

The third family, that of the Chirotes, differ from the two preceding families by the possession of two legs. These are the front members, and are placed near the head. They are, however, very short and weak, but are furnished with five toes, four of which possess a claw.

THE MEXICAN CHIROTES (*Chirotes lumbricoides*) —represented in Plate 3, fig. 4—is the only species known. This curious-looking animal is about eight or ten inches long, and is a native of Mexico. The structure of its teeth, and the rings of scales with which its body is covered, connect it with the Amphisbænas, otherwise its shape and short legs would lead one to place it amongst the lizards, close to the *Chalcides*. The scales of the body are nearly square, and, like the true Amphisbænas, are divided into two sets by a lateral line on each side. The tail is short, cylindrical, rounded at the extremity, nearly of the same size as the head and body; and the rings are entire, not divided by the line which runs along the sides of the body, but which terminates at the vent. The number of rings upon the body amounts to one hundred and fifty, and those of the tail to about thirty-one. The head of the Chirotes is rounded in front, and scarcely distinguishable from the body; and the eyes are almost imperceptible, covered with a transparent skin, and destitute of eyelids. The feet are only about four or five lines long, and are covered with rings of scales similar to those of the body. Little or nothing is known of its habits.

CLASS—AMPHIBIA.—FROGS, TOADS, SALAMANDERS, &C.

THE term *Amphibia*, amphibious animals, is derived from the Greek word *amphibios* (αμφιβιος), which signifies "having a double life." The denomination is, in general language, applied very loosely, to mean any animal that is so organized as to resort habitually to, and seek its food in the water as well as on land; to any animal, in short, such as the walrus, the otter, water rat, &c., whose habits are aquatic as well as terrestrial. Strictly speaking, however, the term *Amphibious* applies only to such animals as have both internal lungs to fit them for breathing atmospheric air, and gills, such as fishes have, to enable them to breathe in the water. The number of animals so organized, when they have arrived at an adult state, is very small; but there are many which at an early stage of their existence are so organized, and at different periods of their life possess both lungs and gills. Both of these groups of animals belong to the present class, and the general name of *Amphibia* has been retained by systematic naturalists for them exclusively. In those which at an early age are furnished with gills, and like fishes, respire water, those organs in due time become obliterated, and the lungs then develope. These are the frogs, toads, newts, &c., and are called *Caducibranchiate amphibia*, or "amphibious animals with perishable gills." In the other group, the gills are permanent organs, remaining after the owners have acquired lungs, and thus the animal can live indifferently either in the water, respiring like fishes, or on land, breathing like mammalia. These are the Axolotl, Lepidosiren, Proteus, and Siren, and are called *Perennibranchiate amphibia*, or "amphibious animals with persisting gills." By many naturalists, the *Amphibia*, instead of forming a class by themselves, constitute only an order of the great class, *Reptiles*. They differ, however, so much in many essential characters from all the other orders of that class, that they are fairly entitled to the rank of a distinct class of animals by themselves. Instead of being covered with scales, plates, or shields, the skin is naked, smooth, and often moist, and lubricated with a fluid secretion, and aids the lungs by affording a surface for the aeration of the blood. The lungs are equal in size on both sides, and of a cellular structure; and the young are subject to a metamorphosis. The body of amphibious animals is either depressed, and squat, as the toad, &c.; elongated, like the salamanders and newts, &c.; or rounded, as the cæcilias. The head is depressed and joined to the body without any distinct neck or division. They have all a distinct and well-developed sternum, but the ribs are either only rudimentary or are altogether wanting. The vertebræ or bones of the spine, in the back, are variable and not easily distinguishable from each other—in the tailless species, as the frog, being only ten, and in the sirens, being ninety in number. In many of the species the body is destitute of a tail; while in the others, this organ is well developed. The limbs vary in form and number; in some being well developed, in others being very incomplete, and in several altogether wanting. The toes are destitute of nails or claws, or, at the most, are only provided with small horny sheaths. They are in general, however, well adapted for receiving the impressions of touch. The sensorial functions are blunt. Though the nerves

are very distinct and robust, the cavity of the cranium is very small, and even that is by no means filled with brain. The eye in general is contained in a large orbit, in most of them is protected by three lids, and in some is moistened by a fluid analogous to tears. The pupil, except in the tailless species, whose habits are nocturnal, and in which it is angular or linear, is round and very dilatable. There is considerable difference in the structure of the organ of hearing; in some the auditory canal is visible externally, and in others is not apparent. The nostrils in the great majority of the Amphibia are inclosed in a bony case; and the internal nostrils open into the middle of the palate, as in the frogs, &c.; but in some there is no bony case, and the internal nostrils open between the lips and bones of the palate. The tongue is in general of a good size, is very soft and fleshy throughout, and in most is armed with a tenacious, viscous secretion. The mouth is very wide and without movable lips. In a few species the teeth are wanting; but in most of them they are present, and are implanted in the jaws. Generally they are numerous, simple, of small but equal size, and close set, either in a single row, or aggregated like the teeth of a rasp. The heart consists of a single ventricle and two auricles in the adult. The circulation is simple, part of the blood passing through the lungs or gills, and then returning into the general current. The blood is cold, and has large and elliptical globules. They all have lungs, which are formed of large cells, and float in the cavity of the belly. In general they are two, but in some, as in the salamanders, there is only one, which resembles a bladder. In early life they are furnished with gills, analogous to those of fishes, which are supported by cartilaginous arches resulting from the prolongation of the bone of the tongue, the *os hyoides*. When in a perfect state, the greater number lose this gill apparatus, whilst others preserve them during life. The act of respiration is carried on by the muscles of the throat, and is somewhat similar to that of deglutition or swallowing, it being necessary for inspiring air that the mouth should be closed. Most of the Amphibia are oviparous; some, however, being ovoviviparous. In the males there are no external genital organs visible, and the act of reproduction consists in a simple contact, which endures for several days. The eggs have a membranous envelope, are most frequently laid before fecundation takes place, and increase in size after they are laid. The young undergo a variety of transformations. At first they do not possess limbs, but are furnished with a tail; and when they become nearly adult, they assume four members, and the greater proportion of them lose their tail.

The Amphibia almost all live in the water or in moist places. In early life they are herbivorous, but they become carnivorous as they pass into the perfect state. They never, however, feed on the dead carcasses of animals.

The Amphibia have been arranged in different ways by different naturalists. Some take the absence or presence of a tail in the adult state as a means of division into two great groups—the Tailless and the Tailed. Others consider the character of the gills, whether caducous or persisting, as a better method of arrangement—the Caducibranchiate and the Perennibranchiate. "The division adopted by many zoologists of the present day," says Professor Bell, "according to the mere presence or absence of the tail in the perfect state, is not only liable to the objections which belong to all merely dichotomous arrangements, but appears to be far less natural, and far less consistent with the physiological characters of the groups, than that which is derived from the absence or presence and the duration of the branchiæ." In the arrangement of the animals of this class adopted by Dr. Gray in his catalogue of the Amphibia in the British Museum, and which we prepose following in these pages, the structure of the nostrils, with the condition and duration of the gills, are the principal characters relied upon.

The greater proportion, as we have before observed, have the nostrils inclosed in a bony case, and open internally on the sides of the middle of the palate. These form the group TRITONES. The others, which have no bony case to include the nostrils, and have them opening internally between the lips and the bones of the palate, form the group SIRENES.

The first group, TRITONES, is divided into three Orders :—

I. BATRACHIA, containing the Frogs, Toads, and Salamanders, and distinguished by the well-developed gill of the young animals disappearing when they reach the mature form, and being then provided with well-developed lungs and four limbs.

II. PSEUDOSAURIA, containing the curious and singular animals called the Hell-bender (*Protonopsis*), and the Congo snake (*Amphiuma*); and distinguished by their having the gill rudimentary or internal, with the gill apertures permanent throughout life. The limbs, which are four in number, are either short or almost rudimentary.

III. PSEUDOPHIDIA, containing the anomalous-looking animals called the Cæciliæ; and distinguished by having a rudimentary or internal gill like the preceding order, but with the gill apertures, which are on the side of the neck, becoming closed in the adults.

The second group, SIRENES, contains but few species, and is divided into two Orders :—

I. MEANTIA, containing the well-known animals the Proteus and Siren; and characterized by their having well-developed gills which remain throughout the whole life of the animal, rendering them, as they possess lungs also, truly amphibious. The limbs in some are four in number, in others only two, but they are only weak and rudimentary organs.

II. PSEUDOICHTHYAS, containing the very interesting but disputed animal called the Mud-fish (*Lepidosiren*); and characterized by having both an external and an internal gill and four very rudimentary and elongate, narrow limbs resembling the fins of fishes.

The animals contained in this order appear to connect the Reptilian Class with that of the Fishes, and by Professor Owen, Sir John Richardson, and some others, are placed amongst these latter animals. As Sir John Richardson is engaged on the article FISHES for this work, we will leave the further notice of these curious creatures to him.

ORDER OF BATRACHIANS (BATRACHIA).

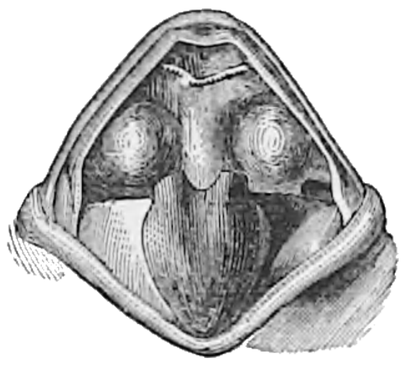
IN all the Batrachia the skin is soft and smooth, and generally more or less moist. It possesses the power of secreting fluid, and thus materially assists in effecting those changes in the blood which in other animals are performed by the lungs or gills. All the Batrachians, the history of which we are well acquainted with, undergo a series of transformations or metamorphoses while advancing from youth to maturity. The young enter life under an entirely different form from that which they are afterwards to assume. At first emerging from the egg, and for some considerable time afterwards, their form and structure are essentially similar to those of fishes. They have an elongated body, no feet, a laterally compressed tail, and external gills. The mouth, which is small, is furnished with horny hooks or teeth for the separation of vegetable matter, and they have a small tube on the lower lip for attaching themselves to aquatic plants. In this state they are known by the name of *tadpoles*. At a certain period of their growth a gradual change takes place. In some the external gills disappear, and become covered with a membrane, being placed in a sac under the throat. The creature now breathes as a fish. Soon the hinder limbs begin to make their appearance, showing themselves near the origin of the tail; the anterior limbs are then put forth. The lungs, which hitherto have been rudimentary, now begin to be developed; the gills are removed by absorption, and the animals respire like perfect reptiles.

All the Batrachians, in their first state especially, swim well, and the greater number can also, at least in the adult state, walk upon the earth, and can climb and even leap with great facility. The form of their body indicates as it were beforehand the nature of their movements. Thus, for example, all those which preserve the tail in their adult state walk only slowly; they can merely drag their bodies along the ground, and usually live in the water, as the Salamanders. Those, on the contrary, which lose this member, as the Frogs, walk on the ground, climb trees, and leap with great agility. Taking these their habits into consideration, as well as their form when in the adult stage of existence, naturalists have in consequence divided the whole Order of Batrachians into two sub-orders or large groups. The first is the sub-order SALIENTIA or Leaping Batrachians, by many authors called ANOURA, or Tailless Batrachians; and contains the Frogs and Toads. The second sub-order is that of the GRADIENTIA, or Walking Batrachians, called by many authors URODELA, or Tailed Batrachians; and contains the Salamanders, and Tritons or Newts, &c.

SUB-ORDER I.—BATRACHIA SALIENTIA, OR ANOURA (TAILLESS BATRACHIANS).

IN the catalogue of the species of the *Batrachia Salientia* in the British Museum, compiled by Dr. Günther, and which amount to the number of two hundred and eighty, this suborder of Batrachians is divided into three groups, according to the presence or absence and form of the tongue. The greater number have their tongue, which is fleshy and somewhat bifurcated at the tip, adhering to the jaw in front, whilst it is more or less free behind—forming the group called *Opisthoglossa*, or Front-tied tongues—fig. 23. A few have this member free in front, and form the group *Proteroglossa;* whilst there is a small number again which have no tongue at all. These are called *Aglossa*.

Fig. 23.



Mouth of Polypedates Schlegelii—to show form and structure of tongue of the Opisthoglossa.

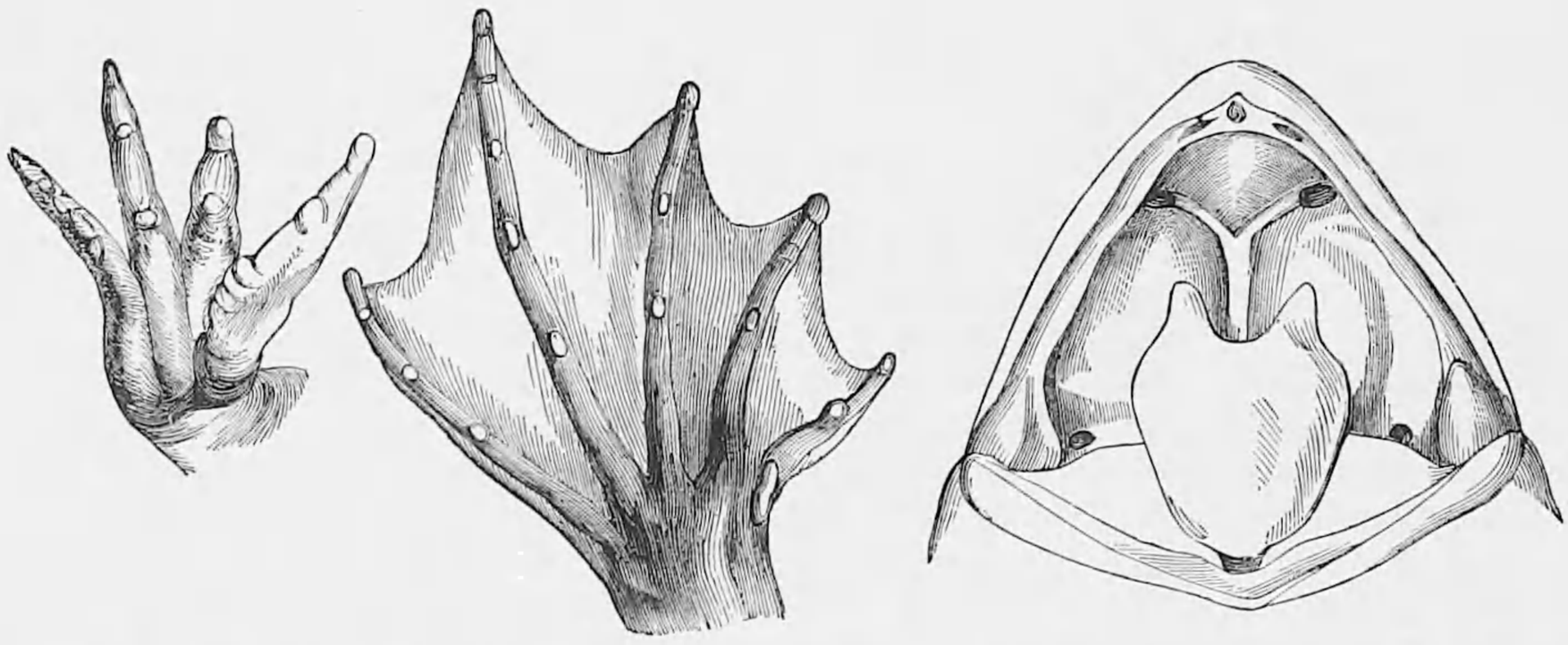
The first group, the Front-tied tongues (*Opisthoglossa*), contains more than seven-eighths of the whole number of species, and is divided into sections according to the structure of their toes; one set having the toes sharp at their extremities (*Oxydactyla*), while another has the tips of the toes dilated into small pads (*Platydactyla*). The sharp-toed section is composed of the true frogs and toads, *Ranina* and *Bufonina*, while the flat-toed section contains the tree-frogs, *Hylina*:—

RANINA, OR FROGS.

The Frogs are in general of a slight, thin form, with the hind legs much longer than those in front. When in a state of repose on the ground, they carry their head very high, and their hind legs are then doubly folded on themselves, forming an angle of 45° with the length of the body. The muscular system is well developed, and the muscles of the thigh and leg particularly so, presenting a great analogy with those of man. They possess a great degree of elasticity, and in consequence of this, the leaps which these animals take when suddenly roused or alarmed, are very great, extending sometimes, it is said, over a space more than fifty times the length of its body. Frogs generally feed upon the larvæ of aquatic insects, worms, small mollusca, &c.; and they are sure to select for their prey an animal which is alive and in motion. They always reject dead animal matter. To obtain

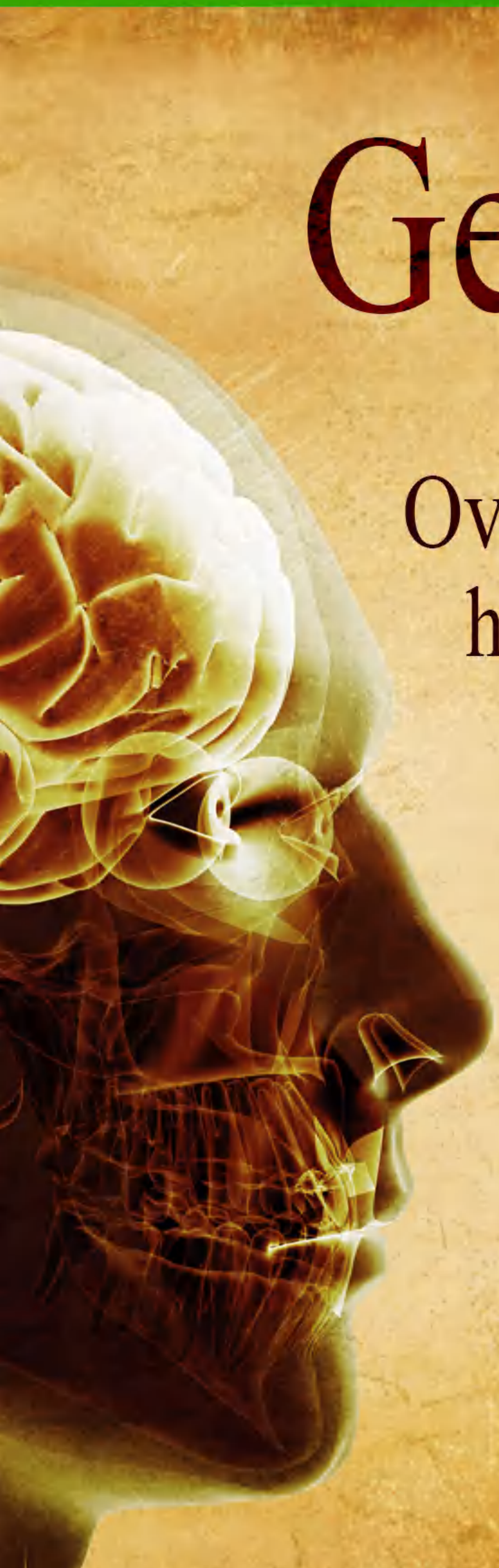
this prey they watch with great patience till it comes within their reach. They then dart upon it with great velocity, shooting out the tongue in order to catch it by means of the viscid secretion by which it is covered. This fluid appears to retain the object seized, while the two points of the bifurcation seem to twist round it. The prey once seized, it is speedily swallowed, the animals pushing it into the œsophagus with the thumbs of their fore feet. In consequence of their feeding on worms and mollusca, frogs are useful animals in gardens, as they destroy great numbers of slugs and worms, which are so hurtful in these places. Frogs, having the toes of the hinder feet webbed, swim remarkably well in the water; and on land their mode of progression is by a series of successive short leaps—fig. 24. These animals are generally found in moist

Fig. 24.



Mouth and fore and hind feet of Rana Occipitalis—to show structure of toes and tongue of the group Ranina, or Frogs.

places, in the grass of meadows, and on the banks of streamlets, into which they continually leap and dive. In summer, during or after warm rain, they make their appearance in our meadows in such vast quantities, that many people have imagined that it had rained frogs. This is an ancient belief, and is still in full credit in the provincial parts of many countries of Europe. Several of the old authors have mentioned this sudden appearance of these creatures; and Aristotle, in noticing the phenomenon, calls the frogs so suddenly called as it were into existence, *diopetes* (*δίωπετης*), or "sent from Jove." The males of some species, especially the Edible or Green frog, have two sacs called vocal pouches, on each side of the throat, which in general are only manifested externally by the swelling which is produced in them when filled with air. These animals have a peculiar and sonorous cry, louder and stronger in the species with the vocal sacs, which is known in this country by the name of croaking. It is chiefly during rain in warm weather, and in the morning and evening, that we hear this noise, which must be familiar to every one. In autumn, when the summer heats are over, these animals appear to lose their voracity, and cease to take food; and when the cold becomes more considerable, they protect themselves from its rigour by sinking into the mud of deep waters, or by taking up their abode in holes on the banks of streams and ditches. They sometimes assemble in one place in such quantities as to cover the soil to the depth of a foot, and thousands may thus be taken in a few minutes. In this country they revive upon the return of spring, and emerge from their winter retreats to recommence a life of activity and obey the grand law of nature—the reproduction of their species. The arrival of the season for this important function is shown in the male by the appearance of a black wart on the fore feet, and the belly swelling. The male frog leaps on the back of the female, to whom he clings by the aid of these warts on his fore feet. During the cohesion of the two sexes, which lasts for a considerable period, sometimes for fifteen or even twenty days, the female commences depositing her eggs, which are fecundated during their passage by the seminal fluid of the male. When first expelled these eggs are globular, black on one side, and whitish on the other. They are enveloped in a glairy or glutinous transparent mass, which serves for the nutriment of the embryo, and swell greatly in the water after they are laid. They are, in the case of the common frog of this country, deposited at the bottom of the water, and then float on to the surface, and are left there to hatch by the ordinary temperature of the atmosphere. The number deposited at each laying is very great, as many it is said as from six hundred to twelve hundred annually. Swammerdam once counted eleven hundred, and Montbeillard thirteen hundred, from one female. The development of the young is more or less rapid according to the temperature of the atmosphere. In a few hours after its expulsion the egg begins to show a slight change. At the end of about fifty hours, when the temperature is high, the embryo may be seen within the egg, with the head well marked, the tail somewhat elongated, and even the rudiment of the membrane or web which is destined to form its fin is visible. The development then goes on gradually, till, according to Professor Bell, in the ordinary temperature of this country, at the end of a month the young creature bursts its shell and comes forth in the well-known state of a tadpole. At this stage of its existence it is blind and destitute of feet. It has a large head, a globular belly, a long tail, and external gills by which it respires. It feeds solely on vegetable substances,



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viridis)—Plate 1, fig. 1—is rather larger than our Common frog. It varies very much in colour, according to the locality in which it is found. In general the upper parts of the body are of a beautiful green tint, irregularly marked with brown or blackish spots or patches of nearly equal size, the limbs being marked transversely with bands of the same colour. It differs from the preceding species in wanting the dark mark extending from the back of the eye to the shoulder, and in having three distinct narrow bands, of a fine golden yellow, running down along the back. The male is distinguished by having a vocal sac on each side, behind the angle of the mouth. When filled with air in the act of croaking, they become large and globular, standing out, one on each side of the head. The Edible frog is essentially aquatic in its habits. It is found in running streams as well as in stagnant waters; in rivers as well as in ponds; in marshes, ditches, and even the smaller pools of standing water. It seldom comes to land, and never remains far from the banks of streams or ponds, but throws itself precipitately into the water the moment it hears any noise, nor does it expose itself again until certain that all danger is past. In general it is in muddy places where reeds and other aquatic plants grow, that this frog is found; and there either lying motionless on the surface of the water, or perched on some aquatic plant, as water lilies, &c., it pours forth during most of the summer season the most intolerable croakings. The female, which wants the vocal sacs, produces more of a groaning kind of noise, but the croak of the male is exceedingly powerful, from the air which it forces into these sacs causing a great vibration in them; and they croak by day as well as by night. As the name imports, it is this species which is eaten on the Continent. In France it is the Common frog; and there, and in other parts of Europe, a considerable consumption takes place annually. In Vienna, it is said, they are fattened up for sale, and kept in preserves called *Froggeries* (Grenouilliéres), constructed for the express purpose. The food of this species, like that of the preceding, consists of insects, small aquatic mollusca, and worms, provided they be alive and in motion. They are voracious creatures, and may be taken during the heats of summer by a line baited with a piece of scarlet cloth, which is kept in motion so as to give it the appearance of a living creature. They are also captured by a line having a round ball of bread or dough attached to it and put in motion. Being suddenly swallowed, before the animal has time to open its mouth to permit the bait to be rejected, a sudden jerk of the line lands it on the bank. The Edible frog has a wide range; it is found throughout the greater part of Europe; in Northern Africa, in Persia, China, and Japan. Its existence as a British species, however, has only been very lately recorded. It was first, we believe, made known as a denizen of our isle by Mr. F. Bond, who published a short notice of its capture in Cambridgeshire in the *Zoologist*, in 1843. It was found by a friend of his in Foulmire Fen, and was then thought to be very rare. Subsequently, however, Mr. Bond found them in considerable abundance, and describes the male as having, when croaking, "two large bladders, one on each side of the mouth, which give it a very curious appearance." He expresses his surprise that they were never seen before, their croaking being so very different from that of the Common frog; "the sound," he says, "is more of a loud snore, exactly like

Fig. 25.

Bull Frog (Rana mugiens).

that of the barn owl (*Strix flammea*). The whole fen was quite in a charm with their song!" He further remarks that it is a very timid animal, disappears on the least alarm, and is not very easy to catch. Professor Bell, in the same work (*Zoologist*), says, the croaking of this frog is so loud and shrill as to have obtained for them the name of "Cambridgeshire Nightingales," and "Whaddon organs!" In a later number of this journal (1849), Mr. Doubleday of Epping is said to have turned out some specimens of this

species, received from Cambridgeshire, into a pond near his own residence, and that they soon migrated to another pond, and there made themselves perfectly at home.

THE BULL-FROG (*Rana mugiens*, or *pipiens*)—fig. 25—a North American species, is of a large size, reaching even to the length of twenty-one inches, the body alone measuring seven lengthwise, four or five across, and weighing about two pounds. The head of this species is very large, broader than long. It has a very large mouth, great prominent eyes, and the vocal sacs are internal. The body is thick and massy, smooth above, and in front it is of a green colour; dusky, with only a greenish tinge behind, and marked with irregular blotches of dark-brown. On the sides and belly it is of a yellowish tint, fading almost to a dusky-white. Bull-frogs are found in almost every marsh and pond of North America, and in general are solitary in their habits, only collecting together in the breeding season, at which time hundreds may be seen in one small pond, and then, says Mr. Holbrook, "the croak uttered by the males is so loud as to resemble the distant roaring of a bull, and can be heard on still evenings at the distance of half a mile. During the day they are generally quiet, and only begin their noise at the approach of twilight or in dark cloudy weather."

There are some species of frogs in South America which are distinguished from all others by having the edge of the upper eyelid more or less produced into a point, so as to form a long horn. Azara tells us that in Paraguay the residents do not distinguish frogs from toads, but call all the animals of this order by the general name of toad. At Chaco, he says, "there are some toads which weigh several pounds, and there are others very large, which are seen leaping in all the low grounds when there is moisture. They are neither very ugly nor very swollen, and one would say that they had ears straight like horns."

These frogs constitute the genus CERATOPHRYS, of which four species have been described.

THE HORNED FROG (*Ceratophrys cornuta*), which is found in Cayenne and Brazil, is the best known. It is a large species, equal in size to the bull-frog of North America. The head is very depressed in form, and very broad behind, and the mouth is enormously large. The skin is covered nearly all over with tubercles, and is of a cinereous yellow colour, striped with lines of obscure grayish-brown. "It is difficult to find an animal," says Shaw, "of a more singular appearance than the present, not so much from the general shape of the animal as from the extraordinary structure of the upper eyelids, which are so formed as to resemble a pair of short sharp-pointed horns; while the width of the mouth is such as to exceed that of any other species, and even to equal half the length of the body itself." The Prince of Wied informs us that it lives in the large, obscure, and moist woods, and particularly in the marshes of Brazil, although it is also met with in cultivated and even dry places. It leaps well, and towards evening may be heard uttering a monotonous croaking. Its food consists of small mice, birds, and small frogs, molluscs, and other diminutive animals.

All our readers are familiar with the plague of frogs brought as a punishment upon Pharaoh for refusing liberty to the Hebrews. Though this was a miraculous visitation, ordered by God for a special purpose, it was not contrary to nature. The plague consisted in its unexampled intensity and magnitude, indicated by the fact that the immense heaps of the carcasses of these animals ultimately corrupted the land; "and still more," as Dr. Kitto observes, "by the fact that their numbers were such as to force them when alive to forego their natural habits, and, instead of confining themselves to the waters and moist soils, to spread over the country, intruding even into the most frequented and driest places—the most private chambers, the beds, nor even the ovens being exempt from the visitation." The frog was one of the sacred animals of the Egyptians; and in this instance the object of their superstition became the instrument of their punishment. Frogs are still very abundant in the Nile,—

THE DOTTED FROG (*Rana—Pelodytes—punctata*), which is of an ash-colour, dotted above with dark spots, being the common species of the country. It is said to change colour when alarmed, and is also found in Europe.

BUFONINA, or TOADS.

The Toads are distinguished from the Ranina or Frogs by their having no teeth in the jaw, and by their having a well-developed ear. In general the tongue is not notched at the tip, but is entire, and longer than in the frogs. Many of them have a smooth skin, but the true toads, species of the genus *Bufo*, have it covered more or less all over with warty tubercles. The head varies very much in size and form, being sometimes very small, at others very large; and the shape of the body is equally various. In all of them the processes of the sacral vertebræ are dilated, and the greater number possess those glands known by the name of parotids. The extremities vary much in length, but in many of the species the hinder ones are much shorter than in the frogs. The fingers are four in number, all free, and the toes are five, more or less webbed; while on the plantar surface, in the greater number, there is a tubercle, sometimes greatly developed, which from its position resembles a sixth toe. The males have either one only or two vocal sacs, which are in all of them internal. In the toads as in the frogs we find a number of small glands scattered over the skin, which secrete a viscid fluid. It is said these animals have the power of increasing at will this secretion, and cause it to run out like a dew at all points. This humour was at one time considered to be poisonous, and though this notion is now rejected by naturalists, and the liquid proved to be innocuous, it is yet perhaps possessed of some use as a means of defence. It is somewhat fetid and of an acrid quality; is neither acid nor alkaline, but when evaporated yields a transparent residue, which acts on the tongue like extract of aconite. The use, according to Dr. Davy, may be to defend the reptile against the attacks of carnivorous animals, and may serve, also, he thinks, as an auxiliary to the function of the lungs. This poisonous reputation of toads, however, is still a common

belief among the vulgar, and will perhaps continue to exist as long as Shakspeare is read. The poor reptiles will still be held up as moral beacons, and bad men will still be

> "Marked by the destinies, to be avoided
> As *venom toads*, or lizard's dreadful stings!"
>
> —*Henry VI., Part* 3.

Shakspeare's belief in the poisonous nature of toads seems very strong, so often does he introduce the image. In Richard the Third, for instance, the Lady Anne, in that "keen encounter of their wits," seems to come to a crisis in her passion, when she tells the "hunchback" as she spits upon him, that—

> "Never hung poison on a fouler toad.
> Out of my sight! thou dost infect mine eyes."

and Queen Margaret can find no fitter name for him than

> "That poisonous hunch-backed toad."
>
> —*Richard III.*

The negroes of Africa, however, have no such superstition. Knowing from experience that the skin of the toads is cool, from the great amount of evaporation which takes place from the skin, they, as Adanson informs us, "in traversing the burning sands of Senegal, are in the habit of applying one of them alive to the forehead for the purpose of cooling it." The reproduction of toads, and the metamorphoses of the young, are in all essential points similar to those of the frogs. The ova, however, instead of being expelled in a mass, are arranged in a double series, placed alternately and perfectly regular. The jelly-like mass in which the embryos are enveloped, forms a continuous line about the eighth or sixth of an inch in thickness, and extending to the length of three or four feet. They are deposited about a fortnight later than those of the frogs, and the only difference in the tadpoles is that they are darker and smaller.

The food of toads consists of small molluscs, worms, and insects, which must be alive or in motion, as they never touch dead or motionless animals. When about to feed, the animal remains quite still, with its eyes turned directly forwards upon the object, and the head a little inclined towards it, and in this attitude it remains until the insect or other animal moves; when, by a stroke like lightning, the tongue is thrown forward upon the victim, which is instantly drawn into the mouth. So rapid is this movement, that it requires some little practice, as well as close observation, to distinguish the different motions of the tongue. They are for the most part truly nocturnal in their habits, seldom issuing from their sombre retreats till night comes on, or after the hot rains of summer. Toads can live a long time without eating. Instances have occurred, apparently on good authority, of their having been found shut up for years in old walls, hollow trees, or in the substance of the earth, without their having been able to get out, and without losing life.

The feet of toads are seldom used for walking. These animals, in fact, only creep, and when they are suddenly laid hold of or surprised, they do not attempt to seek safety in flight. They stop suddenly, swell the body, render it hard and elastic, distil from the tubercles on the skin a white and fetid humour, emit a peculiar fluid from the anus, and attempt to bite. Their bite, however, occasions no great inconvenience, merely producing at times a slight degree of inflammation. In temperate countries, or where the weather is cold, toads pass this season of the year in retired and sheltered holes, hollow trees, or spaces amongst large stones, and there, in a state of torpidity, remain until the return of spring calls them again into a state of life and activity.

Of the Bufonina forty-four species have been described by Dr. Günther in the British Museum Catalogue.

THE COMMON TOAD (*Bufo vulgaris*)—Plate 2, fig. 1—is very abundant throughout Europe, and occurs also in China and Japan. At all times this poor creature has been condemned as a disgusting, odious, and venomous reptile, and has in consequence suffered more undeserved persecution than almost any other animal of the class to which he belongs. As Professor Bell observes, in Great Britain the Common toad is held up as the emblem of all that is malicious and hateful in the human character, is placed under universal ban, and treated as an outlaw both by man and boy throughout the country. "As loathsome as a toad," "the loathed toad," is still the language used in reference to this poor inoffensive animal. In general form it is certainly far from being prepossessing, for the body is puffed out and swollen, the head is large and flat on the top, the muzzle rounded and very obtuse. The body is covered with warts, which are larger above and more numerous beneath, and on the nape of the neck are two thick, prominent, and porous glands called the parotids. The colour is sombre; a lurid brownish-gray, with reddish-brown tubercles. It is about three inches to three and a half in length. The Toad is terrestrial in its general habits, and is usually found in obscure and sheltered places. It is nocturnal in its mode of life, coming out in the evening to seek for its food. It is "heavy-gaited," as Shakspeare well observes, and its mode of progression is by crawling, its quickest movement being an imperfect leap. To compensate for this, the rapidity with which it darts out its tongue to seize its living prey is something extraordinary. Insects and worms form its chief supply, and generally the animal is swallowed alive. Earth-worms are a favourite article of food, and it is a very curious sight, says Professor Bell, to watch the manner in which the powerful and writhing worm is secured:—"If the toad happens to take it by the middle, the extremities of the worm are twined with great force and activity around the muzzle in every direction, in its attempts to escape; but the Toad pushes one portion after another into its mouth by means of the fore feet, until it all disappears, when it is swallowed whole." The Toad sheds its skin at certain intervals, and the process as described by Mr. Bell is rather a curious one. The old skin splits in the middle down the back and along the belly. In a short time these halves become wrinkled, and by means of the continued twitching of the animal's body, the skin is brought down on the sides in folds. The legs are then forced from the old cuticle, first the hinder, then

the fore ones, and finally the whole is detached, pushed by the two hands into the mouth in a little ball, and then swallowed at a single gulp!

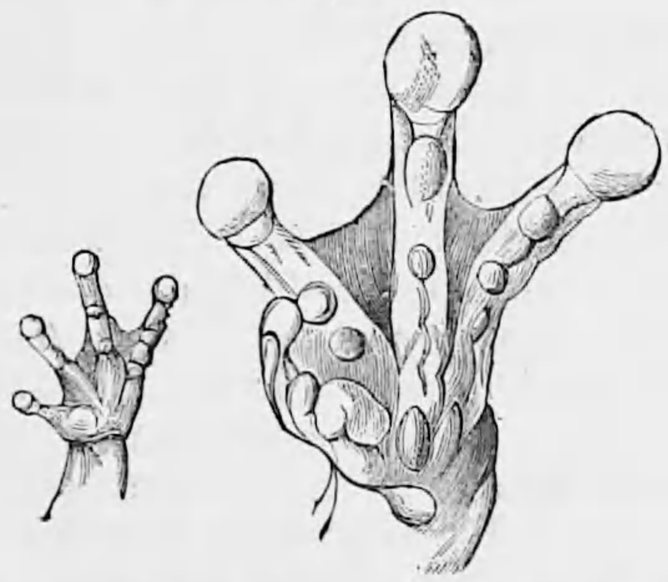
THE NATTER-JACK (*Bufo calamita*) is another European species, and is found, equally with the common toad, in various parts of Great Britain. It is, however, much more local than the other, and appears confined to certain districts. It is said to be truly indigenous to Ireland, the only instance of an indigenous native reptile in that country. It is not quite so large as the common toad, the body being only about two and three quarter inches in length. It is of a light yellowish-brown colour, clouded with dull olive, a bright yellow line running along the middle of the back. The Natter-jack is not so "heavy-gaited" as the common toad, for when it is excited it runs tolerably quick, its body being raised considerably above the ground during its progress. It is far more capable of sustaining drought than the other species, and is often observed to climb on walls and trees, and conceal itself in holes. Professor Bell says that this animal is very common in his garden at Selborne, and that he has often found several of them lying under the shallow layer of turf covering the top of a wall of a ha-ha there, exposed to the powerful rays of the summer's sun, in the hottest and dryest situation in the garden. It is common in France, and in Saxony it is frequently found in the houses. It never goes to the water but for the purpose of reproduction; the union of the two sexes taking place in spring, in the water, and the metamorphosis of the young undergoing the same stages as the common toad. The skin of the Natter-jack is said to exhale a strong odour of gunpowder.

America produces a number of toads, and of various sizes, but we hasten on to the curious "Tree-frogs."

TREE-FROGS (*Hylina*).

The second series of Batrachians with the tongue adherent in front (*Opisthoglossa*), is composed of species which have the fingers and toes dilated into discs at the extremities—fig. 26. These form the

Fig. 26.



Hyla—fore feet and dilated toes of two species.

Broad-toed Opisthoglossa (*Opisthoglossa platydactyla*), and are synonymous with what are well known as Tree-frogs. The species are numerous, and by far the greater number belong to the section *Hylina*, which is characterized by the animals belonging to it having maxillary teeth and a well and perfectly developed ear. Tree-frogs form a very natural group of Batrachians, and the distinguishing character of the fingers and toes being dilated into discs covered with a viscous secretion, is most important, and influences their whole mode of existence. By means of this organization these creatures can adhere to smooth surfaces, as glass, leaves of plants, &c.; and they are thus enabled to climb trees, to leap from branch to branch, and to traverse with facility the moving leaves of plants, shrubs, and trees agitated by the wind. Their actions are more like those of a bird than a reptile, and their great agility and extraordinary suppleness render them able to make their way with great dexterity on the most flexible branches. The mode, however, in which these animals are qualified for their arboreal habits yet remains to be explained. "The monkey," as Mr. Martin remarks, "grasps with his paws the perch on which he rests; the bird with its claws; the snake entwines itself around the branch; the iguana uses its long toes and hooked nails; the chameleon holds the bough tight between its vice-like toes; but the foot of the Tree-frog acts differently from the foot of these animals. It is not a grasping organ, nor is it furnished with claws for clinging; but it is provided with suckers, analogous to those we have noticed in the foot of the gecko. On the under surface of each finger (both of the fore and hind paws) at the tip, which is enlarged and rounded, is placed a sucker, consisting of a little cushion, moist with a thick glutinous fluid, and applying itself so closely to the surface it touches as to support the creature's weight. This mechanism is, however, under the animal's control, as it can disengage or fix its fingers at will." The Tree-frogs feed upon all kinds of insects, small worms, &c., and during the fine weather of summer they pursue their prey amongst the leaves of the trees, on which they then reside, with astonishing agility. Later in the season, however, they retire to the bottom of ponds, and, like frogs, pass the winter there in a state of torpidity. The union of the sexes takes place also in the water, the spawn is deposited there, and the development of the eggs and young take place in the same manner as in the frogs and toads. They are nocturnal in their habits. In the day-time, and particularly when the heat of the sun is greatest, they shelter themselves in shady places, where the trees afford a thick foliage; but when twilight begins they put themselves in motion, and enjoy their sports and gambols in security. The males are provided with large vocal sacs, and the croaking noise which they produce is stronger even than in the Edible frog itself. During or previous to rain, and in the middle of the fine nights in summer, the Tree-frogs may often be seen assembled in numbers on the tops of trees, sending forth in chorus their hoarse and discordant music. Besides the dilated tips of the fingers and toes possessed by these animals, they have another character which distinguishes them from the tribes already noticed. This is the existence of numerous small granulations with glandular openings on the inferior surface of their belly. Their hind legs also are very long.

Only one species of this family is found in Europe—**THE COMMON TREE-FROG** (*Hyla arborea*) is a pretty and interesting little creature, and one of the smallest of the European Tailless Batrachians. It is very common in the southern, and indeed in most of the countries of Europe, Great Britain excepted; and is also found in North Africa, Asia Minor, China, and Japan. It has a short, thick head, large projecting eyes, a thick, round tongue, a short body of a somewhat triangular figure, and a smooth skin, except under the throat, chest, and belly. The hinder limbs are of considerable length, and the fingers and toes are partially webbed. The general colour on the upper parts of the body is a fine, delicate green, except on the fingers and toes, which present a slight rosy hue, whilst the under surface is white. A yellow stripe bordered with pale violet stretches along the sides of the head and body, and down the hind legs to the feet, while a similar stripe branches off and extends down the arms to the fore feet. After the breeding season, however, the animal becomes of a reddish-brown, which soon changes to gray, mottled with spots of a reddish hue. The colour next assumed is one passing into blue, and in spring this changes again to its proper livery, green. The males are always larger than the females, and possess large vocal sacs under the throat. These, when swollen up, resemble a protuberance as large as the whole head, which at such times appears like a large globular bladder. Its chief food consists of insects, and, as Roesel remarks, its stratagems for securing its prey resemble very much those of the bat as it watches a bird or a mouse. "It is in the midst of the woods, among the foliage and branches of the trees, that the Tree-frog passes the greater portion of the summer. So adhesive are the glutinous cushions of its toes, that, however smooth and polished the surfaces may be on which it rests, they affix themselves intimately to them; nay, it matters not whether the creature adhere to the under or upper surface of a leaf; in either place it is alike secure. All the summer long, in the warm and sunny regions of the South, may this little animal be watched among the leafy woods, engaged in the pursuit of various insects, darting after them as they pass within the distance of its spring. It seizes them with its glutinous tongue, and rapidly draws them into its mouth; and having swallowed one insect, it darts at the next that flits by. This restless activity, this unceasing repetition of leaps, not unlike the short, darting flights of a bird, from leaf to leaf, or from bough to bough, have induced some to compare it to the Fly-catcher (*Muscicapa grisola*), which takes gnats and flies much in the same manner, by an abrupt attack on such as pass near its perch of observation. But the Tree-frog does more; it lurks under the leaves of the highest branches, and seizes such unwary moths or flies as settle within the reach of its tongue, which it can launch out to a considerable distance."—*Martin*. The alertness and agility which this little frog displays, are truly astonishing. It is able to leap a distance of many feet, and though Catesby's assertion that it leaps to a distance of twelve feet at a single bound may be exaggerated, yet the leaps which it does take are surprising, not only from their extent, but from their address and precision. As the season for reproduction advances, the Tree-frogs leave their abode upon the trees and take to the water. The union of the sexes takes place in the end of April, or not till the beginning of June, according to the temperature of the season. At that period the males croak very loudly, and when, as is usually the case, numbers are collected together, the clamour caused by them is so great, that at a distance it might be taken for the cry of a pack of hounds in full chase; and when the wind blows gently in the right direction, it may be heard at the distance of more than a league. When this season is over, they again seek their favourite haunts amongst the foliage of the trees, where they remain till the autumn sets in; and then, warned by the cold, they begin to prepare for their winter repose. They withdraw themselves to the water, and, plunging to the bottom, bury themselves there in the soft mud, where they tranquilly sink into a state of torpor, in which they remain till spring returns. From their agreeable colours and sprightliness, the Tree-frogs are sometimes kept as pets. "At Schwetzingen," says the late Mr. Loudon in his Magazine, "in the post-house we witnessed for the first time what we have since seen frequently, an amusing application of zoological knowledge for the purpose of prognosticating the weather. Two frogs of the species called *Rana arborea* are kept in a crystal jar, about eighteen inches high and six inches in diameter, with a depth of three or four inches of water at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather the frogs mount the ladder; but when moisture is expected, they descend into the water. In the jar they get no other food than now and then a fly, one of which we were assured would serve a frog for a week, though it will eat from six to twelve in a day if it can get them."

A great many species of Tree-frogs are natives of the New World. In most of them, as well as in the species already mentioned, the discs at the extremities of the toes are large and well developed; but there are some of the *Hylina* in which these organs are very small, while the toes themselves are broadly webbed.

THE ACRIS GRYLLUS is an example of this group. This little Tree-frog is commonly known in the United States of America by the name of the Savanna Cricket. It is only one and a half inch in length, is very common in Carolina and Georgia, and is found extending from lat. 43° north to the Gulf of Mexico. The body is slender and elongated, of a dusky colour above, with a vertebral line of bright green or reddish-brown, and of a silvery white beneath. As Mr. Holbrook says, this is a merry little frog, constantly chirping like a cricket, even in confinement. Bartram met with these little creatures in his travels, and thus describes them:—"There is yet an extreme diminutive species of frogs, which inhabits the grassy verges of ponds in savannas; these are called Savanna Crickets, are of a dark ash or dusky colour, and have a very picked nose. At the time of very great rains, in the autumn, when the savannas are in a manner inundated, they are to be seen in incredible multitudes, climbing up the tall grass, weed, &c., around the verges of the

savannas bordering on the higher ground; and by an inattentive person might be taken for spiders or other insects. Their note is very feeble, not unlike the chattering of young birds or crickets." This species of frog, like the others already mentioned, feeds upon insects, and is very active and nimble, making immense leaps to secure its prey, or to escape from its pursuers. It can easily be domesticated, and takes its food readily from the hand.

A number of Tree-frogs are also found in Africa, but we have not space to describe any of them.

Of the Second division of Anourous or Tailless Batrachians, the PROTEROGLOSSA, or those which have the tongue free in front instead of adhering, there is only one genus, RHINOPHRYNUS, and only one species of the genus, *R. dorsalis;* a toad-like reptile, with a broad, depressed, and rounded body, of a bluish-gray colour, marked with yellowish spots on the sides and along the back. It is a native of Mexico.

Of the Third division, the TONGUELESS FROGS (*Aglossa*), or those which have no tongue at all, the species are few in number; but amongst them there is one which, from its curious organization, is well worthy of attention:—

THE SURINAM TOAD (*Pipa Americana*)—represented in Plate 2, fig. 2—is this species. The genus PIPA is remarkable among the Anourous Batrachians from the female having pouches on the back, in which the eggs are placed by the male, and which are hatched there instead of in the water, as in all the other Batrachians. This is the only species known, and is a native of South America. It is common in some parts of Brazil and in Guiana, where it is often found taking up its abode in obscure corners of houses. It is more especially common in Surinam—hence its common name of Surinam toad. By the natives of Brazil it is called *tedo* and *curu-curu*. The Surinam toad is a larger species than our common European toad, and is remarkably ugly. It is from six to eight inches in length, and four or five in breadth. In shape it is horizontally flattened, the head being short, broad, and triangular. The skin is of a dirty brown colour, thickly studded with reddish tubercles. The most remarkable part of the history of these animals, however, is the peculiar method of reproducing their young. The female has the back fitted with a great number of cells or small pouches, and at the time of spawning, the male, firmly clinging to her, carefully deposits the eggs, to the number of about one hundred, as they issue from her, in those cells, and there impregnates them. The mother then hurries to the water, where she remains. In a short time the skin becomes slightly inflamed, a kind of irritation is set up, the skin swells, the pits deepen, and in due time the eggs become developed into the tadpole state. These young animals, however, remain in that position till they are fully developed, not leaving their place of abode till they have assumed the perfect form. They then take refuge in the water, and the mother returns to dry land. Notwithstanding the repulsive and somewhat disgusting appearance these animals present to the eye, in many parts of South America the natives use them as food. Three species have been described, but in reality there is only one.

SUB-ORDER II.—BATRACHIA GRADIENTIA, OR URODELA (WALKING OR TAILED BATRACHIANS).

THIS sub-order of Batrachians differs from the preceding in having the body elongate and tapering in form, and in the animals of which it is composed being possessed of a tail at all times of their life. The metamorphosis, or change which the young undergo in their progress to maturity is less complete than in the tailless species.

The Urodeles or Tailed Batrachians may be divided into three Families: SALAMANDRIDÆ, MOLGIDÆ, and PLETHODONTIDÆ, characterized by the position of their teeth.

FAMILY I.—SALAMANDERS (*Salamandridæ*).

In the animals belonging to this family, the teeth on the palate are placed in two longitudinal diverging series on the inner hinder edge of the elongated triangular vomerine bones. The skull has in general a more or less well-developed bony orbit above the eyes. The tongue is broad, only slightly attached, being free on the sides, and partially so behind.

Salamanders are either terrestrial or aquatic. They are generally found in moist places; the aquatic species living in lakes, ponds, and ditches. They prefer still water, and choose retired and shady places. Their food consists of animal matters, such as aquatic insects, earth-worms, small leeches, molluscs, and planariæ, &c. The tail, which, as we have already mentioned, in all the other species of the sub-order is persistent through life, is either round, or flattened and compressed. In general the species are of small size, and the greater number are natives of Europe and North America. None have as yet been found in South America, India, Australia, Madagascar, or in either Central or South Africa. North Africa furnishes a few, and there are some found in Japan. Eighteen species have been described in the Catalogue of Amphibia in the British Museum.

One of these was well known to the ancients, and has been the source of abundant fables and extravagant assertions.

THE COMMON OR TERRESTRIAL SALAMANDER (*Salamandra maculosa*) is the species, and is represented in our Plate 3, fig. 3, and Plate 8, fig. 19—(skull). The Salamander was formerly, and still is in many places, believed to be able to brave the violence

of fire, to pass through it unhurt, and even to extinguish it in its course; nay, it was even asserted that when it saw the flame, "this daughter of fire with the body of ice" charged it as an enemy which it knew how to conquer. This belief of the power possessed by this animal over fire is of very ancient date, for Aristotle mentions it as an opinion entertained by the common people previous to his time. "The Salamander," he says, "is an evidence that the bodies of some creatures are not wasted or consumed in the fire, for (as some say) it walketh in the fire and extinguisheth the same." It was also asserted by some of the early writers, that a kind of fireproof cloth could be fabricated of the skin of the Salamander; that a portion of this salamander-cloth was sent by a Tartar king to one of the popes, and that the holy napkin of our Saviour is preserved in it. Marco Polo, who mentions this cloth, observes shrewdly enough that it was no doubt made of some mineral substance, most probably asbestos, which the old writers actually call Salamander's wool. Another belief was that the Salamander was exceedingly venomous. "The biting of it," says Topsell, "is very exitial and deadly, and therefore the *French* men use this speech upon the biting of a Salamander:—

'Si mordu t'a une aressade,
Prens ton linceuil et ta flassade.'

That is, if a Salamander bite you, then betake you to the coffin and winding-sheet. The *Rhætians* do ordinarily affirm, that when a man is bitten by a Salamander, he hath need of as many physicians as the Salamander hath spots. And *Arnoldus* saith, that it hath in it as many venoms and means of hurting as it hath colours distinguished one from another." Such are only a few of the many absurd stories which were believed in by our forefathers, and which still linger among the peasantry of many parts of Europe. No wonder that "the sight of it is abominable and fearful to man." And yet this poor little reptile is in fact harmless and inoffensive. It is from six to eight inches long, is "thicker and fuller than a lizard, having a pale white belly, and one part of their skin exceeding black, the other yellow, like verdigris, both of them very splendent and glistering, with a black line going all along their back, having upon it many little spots like eyes."

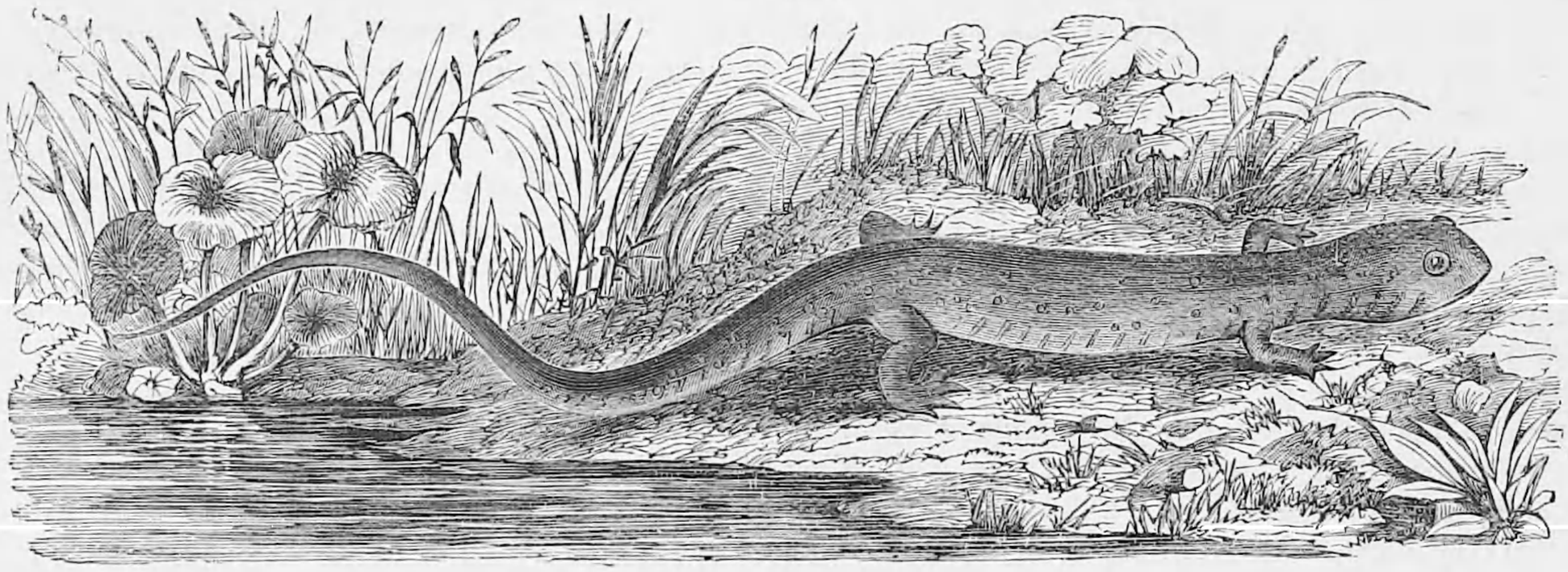
The Salamander inhabits principally Central Europe, and it occurs in many parts of France. During the day it lives generally under ground, but at night it leaves its subterranean retreats and sallies forth to seek food. This consists of worms, small molluscs, and insects, &c. In winter Salamanders retire to some hollow tree, some hole in an old wall or in the ground, where they coil themselves up and remain in a torpid state till spring revives them. In such places numbers of them are sometimes to be met with intertwisted together. The skin of the Salamander is largely covered with warty glands. These secrete a milky fluid of a glutinous and acrid nature, like that of the common toad. When irritated, it can, it is said, shoot out this liquid to the distance of several inches; and it was the abundance of this secretion that no doubt gave rise to the idea that it could quench the heat of fire and flame. As from some experiments, made by Laurenti, this milky fluid is found to be poisonous to lizards and some other small animals, it is to its existence, no doubt also, that we owe the accounts of its fearful poisonous powers. Its walk is slow and heavy, and though it has been said to be very courageous, its want of fear for the presence of man, or other larger animals than itself, would appear to arise rather from stupidity than from audacity. The Salamander utters no cry, and except at the time of producing its young, it is quite terrestrial in its habits of life. When thrown into the water, it tries immediately to get out again, and comes to the surface every moment to respire. Unlike most of the other Batrachians, the Salamander is ovoviviparous. The young are developed in the oviducts of the mother, remaining there till fully formed. When excluded from the parent, they only differ from her in appearance by the possession of branchiæ or gills, by the tail being compressed, and by their being of a black colour. They are deposited in the water by the mother, where they live a purely aquatic life for some time, till losing their gills they become sufficiently matured to live on dry land. The young are pretty numerous, amounting sometimes to forty and even fifty. M. Joly observed a Salamander bring forth twenty-five living young in one day.

The aquatic species of the family are much more numerous than the terrestrial. They are generally known in this country by the name of Newts or Efts, and are distinguished by their tail being always flat instead of round, and by the absence of the glands on the sides of the head, called the parotids. They are entirely aquatic in their habits, passing almost their whole life in the water. Several species are natives of this country, and some of them are very abundant.

THE COMMON WARTY NEWT or GREAT WATER NEWT (*Triton cristatus*)—represented in Plate 3, fig. 2—is one of the most common, and the largest of all the British species. When adult it is about six inches long. It has a flattened head, an obtuse and rounded muzzle, and a slightly pendulous upper lip. The body is continuous with the head, the neck being only distinguished by a small fold of skin beneath. The body is thick, round, and corrugated, and the skin is thick and covered with small warts or tubercles. The tail is about two-fifths of the entire length, considerably compressed and keeled on both upper and under edges. In the breeding season a crest appears on the back of the male, running the whole length, and separated from the corresponding crest of the tail by a notch at the loins. The Great Water Newt is of a blackish colour; the upper parts being of a blackish or yellowish-brown, with black round spots, while the under surface is of a bright orange, with round black spots. The sides are dotted with white, and in the male more especially, the sides of the tail are of a beautiful shining pearly white. It is a native of ponds and large ditches in many parts of England, and is also found in several places on the Continent. It lives upon aquatic insects and other small animals. In spring a great part of its food consists of the tadpoles of the common frog, of which it appears to be very fond; and, according to Professor Bell, it devours also the smaller or smooth

gated and cylindrical in shape, and the tail, which is round, is nearly twice its length. The hinder extremities are nearly twice the size of the fore ones, and are terminted by five toes, while those of the front are only four in number. It lives most of its time concealed under rocks, or under the bark of fallen and decaying trees, and they are frequently so numerous that many are found under the same tree. Fallen trees, indeed, seem to be the favourite residence of these animals, probably, says Mr. Holbrook, because the insects they prey upon choose the same locality. After rain, however, they emerge from their place of

Fig. 27.



The Glutinous Salamander (Plethodon glutinosum).

concealment, as also in the dusk of the evening, when they sally forth in search of food. Mr. Holbrook considers the Glutinous Salamander to be the most common of all the North American Salamanders, and the most widely diffused—fig. 27. The specific name has been given to it in consequence of the animal exuding from its skin a quantity of glutinous matter when it is taken up in the hand.

Want of space prevents us noticing other species of this family; but we cannot dismiss this sub-order of Tailed Batrachians, or *Urodeles*, without particularly mentioning a curious animal, which, in the opinion of many naturalists, is only the immature form of a large species of Salamander. This creature is the Axolotl of Mexico—represented in Plate 4, fig. 2.

THE AXOLOTL (*Axolotes Mexicanus*) is distinguished by having gills formed of three long ramified or branch-like processes on each side of the neck, teeth in both jaws and on the vomerine bones; four toes on the anterior, and five on the posterior extremities. The tail, which is nearly as long as the body, is compressed on the sides like that of the Water-newt, and keeled on both upper and under edges, the crest or keel on the upper edge being prolonged on the back as far as between the shoulders, but gradually becoming narrower as it ascends from the tail. The head is broad and flat, the nose blunt, and the eyes situated near the muzzle. The largest specimens measure about eight or nine inches in length. The ground colour is a uniform deep-brown, thickly mottled both on the upper and under surfaces of the head and body, limbs, tail, and caudal fins, with numerous small black spots. The legs are short, and the toes are free and unconnected by intermediate membranes. The Axolotl is very common in the Lake of Mexico, and is found also in mountain lakes at a considerable elevation above the plains surrounding the city. At the present day it is commonly sold in the markets of Mexico, and is esteemed a luxury by the inhabitants. It is dressed after the manner of stewed eels, and served up with a rich sauce. Hernandez, the Spanish historian of the conquest of Mexico, is the first writer who described this animal. The Spaniards of that period found it in great abundance in the lake, and Hernandez expressly mentions it as having been used by the ancient Mexicans as an article of food, and says it was considered by them as an aphrodisiac; that its flesh was wholesome and agreeable, and tasted like eel. Considerable difference of opinion exists among naturalists as to the true nature of this curious animal. Some regard it as a perfect form, and include it amongst the *Sirenidæ*, or those Amphibians which retain their gills throughout their whole existence; while others consider it only as an immature form, the larva or tadpole state of some hitherto undescribed and gigantic tailed Batrachian. Cuvier at first regarded it as a larva, but afterwards admitted it amongst the Perennibranchiate species. As Dr. Gray, in his Catalogue of Amphibia, remarks, the skull differs very little from that of the young *Triton marmoratus*, which had not gained its second pair of legs. Dr. Baird also, an able American erpetologist, says that it resembles so much the tadpole of a species of the family *Plethodontidæ* (the *Ambystoma Carolinæ*), both in external form and internal structure, that he could not but believe it to be the larva of some gigantic species of that genus. True, it has been long known to naturalists, and the specimens collected, as well as those sold in the markets, always retain the same form and structure; but, as Dr. Baird justly observes, "the non-discovery of the adult is no argument against its existence. I had caught hundreds of the very remarkable larva of *Pseudotriton* (*Spelerpes salmonea*) near Carlisle before I found an adult. Until then I knew nowhere to refer the animal, supposing this species to exist no nearer than the mountains of New York and Vermont."

We must now pass on to the consideration of the second order of Amphibia, the False Lizards.

ORDER II.—FALSE LIZARDS (PSEUDOSAURIA).

THIS second order of Amphibians is distinguished from the preceding (the *Batrachia*) by the animals belonging to it not undergoing any metamorphosis or change during the whole period of their lives. Their body is elongate, lizard-like (hence their name), and furnished with a tail. Their gills are rudimentary, internal; and they have an orifice or gill aperture on each side of the neck, which remains open during all their existence. They breathe by means of vesicular lungs. They possess four legs, but in some of the species these are nearly rudimentary. They have teeth both in the jaws and on the palate. The number of species contained in this order of Amphibia is very small, only five or six having been described. They may, however, be divided into two separate families; the one having tolerably well-developed legs, and the palatine teeth disposed in a transverse arched series, PROTONOPSIDÆ; the other having weak, slender, almost rudimentary legs, and the palatine teeth disposed in two longitudinal diverging series, AMPHIUMIDÆ.

Of the first family, the PROTONOPSIDÆ, one of the most singular species, is one which was discovered by the celebrated naturalist Von Siebold in Japan. This animal has received the name of its discoverer, and is now known to naturalists as the *Sieboldia maxima*.

THE GIGANTIC SALAMANDER (*Sieboldia maxima*) has a large trigono-ovate head, thickly covered with glands; a depressed body, with tranverse folds; and a long, thick, cutaneous appendage along each side. The hinder feet have a crustaceous appendage, and the toes, which are four in number in anterior and five in posterior feet, are free, small, and provided with a depressed, lateral, cutaneous lobe. The tail is round at the base, but very much depressed in the middle and behind. The eyes are very small, and scarcely distinguishable; the nostrils placed near each other on the anterior margin of the upper jaw; and the tongue is not distinct, but united to the skin of the base of the mouth. The Sieboldia is of considerable size, and was found in a lake on a basaltic mountain in Japan. Siebold brought away a living pair, a male and a female; but during the passage home the former devoured his companion, though he himself survived the long voyage, and lived for some time at Leyden. A live specimen of this curious animal (the Sieboldia) is now in the Zoological Gardens.

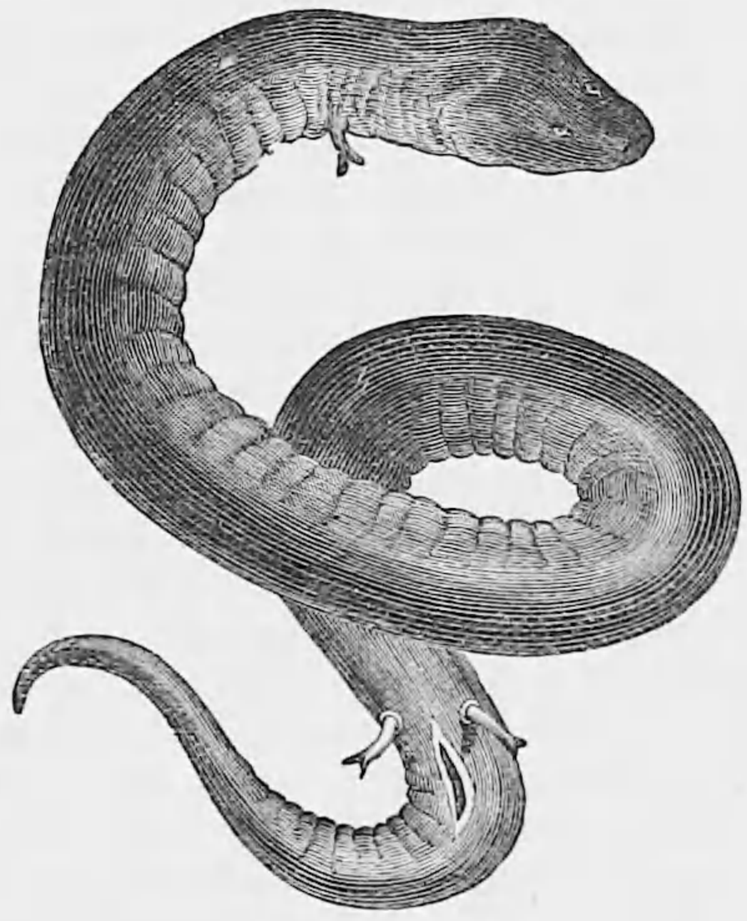
Another large species is a native of the fresh waters of North America—

THE HELL-BENDER, MUD-DEVIL, GROUND PUPPY, or YOUNG ALLIGATOR OF THE ANGLO-AMERICANS (*Protonopsis horrida*)—figured in Plate 3, fig. 1—is fifteen inches in length, and is of a pale slate colour, mottled with dusky. The head is large, flat, and broad, and the mouth wide, and covered with thick, fleshy lips. It has a stout, thick, subcylindrical body, and a large, laterally compressed tail. The neck is contracted, and there is a single spiracle or branchial slit on each side. It has a thin, very indistinct tongue, very small nostrils placed close together, and minute black eyes. The legs are short and thick, and broadly fringed on the outer edge. The toes, which are four in number on anterior, and five on posterior feet, are short, webbed, and without claws. The Hell-bender is found in the Alleghany river and its tributaries, and no doubt inhabits also many of the branches of the Ohio and Mississippi rivers. It lives entirely in the water, and is very voracious. It feeds on fish, worms, and mollusca, and indeed nothing that it can devour is spared by it. The fishermen dread it very much, and believe it to be poisonous. Specimens have been found two feet in length.

The second family, AMPHIUMIDÆ, contains only two species. One of these is known by the name of the Congo Snake.

THE CONGO SNAKE (*Amphiuma means*)—fig. 28—is a native of North America, being found in South Carolina, in the Floridas, Alabama, Mississippi, and, it is said, abundantly in Louisiana. It is about thirty inches long, and is of a deep, bluish-black on upper surface, tinged with violet, and of a dark purple hue beneath. The body is in shape like that of an eel;

Fig. 28.



The Congo Snake (Amphiuma means).

the neck contracted, with a transverse fold at the throat, and a single branchial slit on each side; and the tail is very long, round near the base, and compressed laterally towards the tip. The head is very large and oblong; the mouth large, with thick lips; the tongue broad, oblong, flat, attached posteriorly; the nostrils small, situate at the very margin of the upper lip, and placed close together; and the eyes are very small, and covered with a production of the skin. The extremities are but imperfectly developed, being short, slender, jointless, and of little use for progressive motion. The feet are in each extremity terminated

by two rudimentary toes. The Congo Snake has received its name from the negroes, who erroneously regard it as exceedingly venomous. It lives in muddy waters or in mud, being found sometimes three feet deep in mud of the consistence of mortar, and burrowing in it like the earth-worm. "They inhabit the ditches of our rice-fields," says Holbrook, "and feed on small fish and various fresh-water-shells, as unios, &c.; beetles and other insects have also been found in their stomachs. Sometimes, like eels, they are found on dry land, but for what purpose they approach it is unknown." Mr. Harlan tells us, that an individual in the possession of Dr. Mease escaped from the vessel in which it was confined, and when found several days afterwards was brisk and lively. They pass the winter season in the mud, collecting together at that time in great numbers, and remain in a state of torpidity till the spring. The other species possesses little interest.

ORDER III.—FALSE OR NAKED SNAKES (PSEUDOPHIDIA).

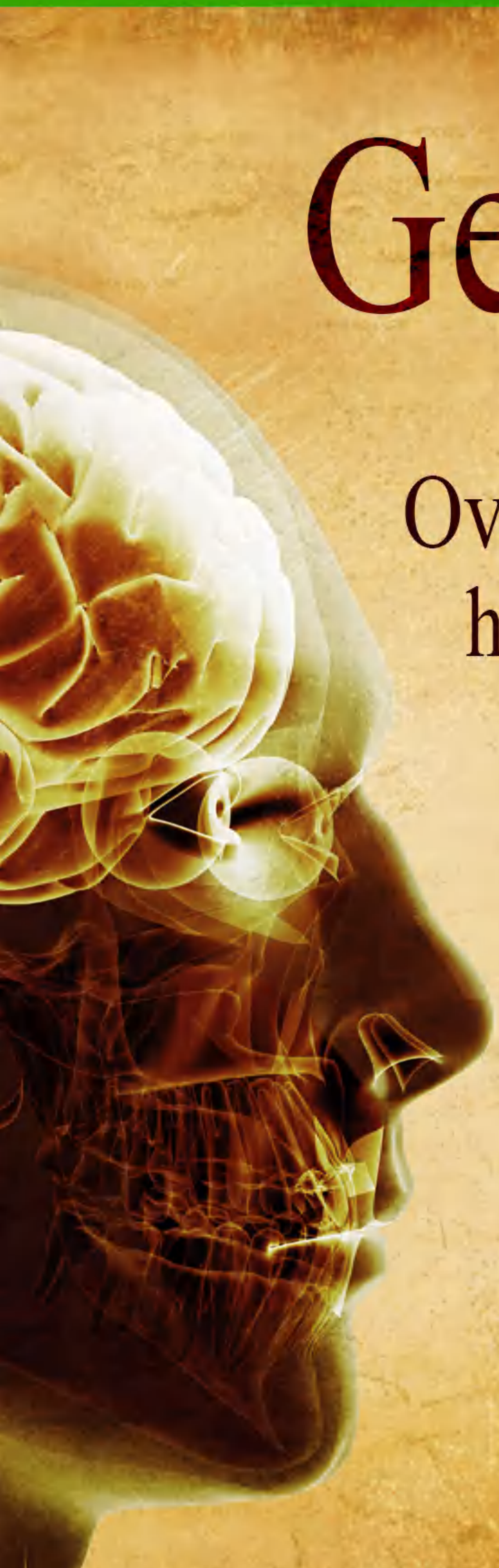
THE animals belonging to this order, though essentially amphibious, have a strong resemblance to serpents. They are destitute of legs, and have an elongate, cylindrical body, and the smooth, wrinkled skin has minute scales embedded in its substance. The tail is very short, and the vent opens at the extremity of the body. The vertebræ or bones of the spinal column resemble very much in their articulation those of fishes; they have short ribs, and no sternum or breastbone. The opening for the gills on the side of the neck is closed in the adults, but is open, according to the observation of the celebrated anatomist Müller, in young individuals. In these it was found, that in the opening on each side of the neck there were to be seen black-coloured fringes, or a kind of gills, apparently fixed to branches of the hyoid bone or base of the tongue, and that the gill openings freely communicated with the mouth.

There is only one family, and the species belonging to it are few in number. This family, CÆCILIIDÆ, is distinguished, in addition to the characters given above, by the skin being covered with a viscous secretion, and marked by a series of rings or annular furrows. The head is depressed; the eyes, beneath the skin, are either minute or very indistinct, if not altogether wanting; the tongue is thick, velvety, of a round form, and, besides the true external nostrils, there is a little pit or depression, termed a false nostril, generally placed beneath the former. They possess teeth both on the jaws and the palate. The species so nearly resemble serpents, that Cuvier retained them among the Ophidians, forming a separate section for their reception under the title of "Naked serpents;" and Dumeril and Bibron, and other naturalists, consider them as forming a link between the *Amphibia* and *Ophidia*, or Snakes. Müller's discovery, however, of the existence of gills in the young animals, is sufficient ground for placing this family amongst the former group. Little is known with regard to their general habits; but they have been observed to bury themselves in the moist earth or soft mud of the marshes, piercing through it like worms, often to the depth of many feet. They creep slowly on the ground, and when in the water swim like eels, striking to the right and left with their tails.

THE GLUTINOUS CÆCILIA (*Cæcilia* or *Ichthyophis glutinosus*) is a native of Ceylon. It is somewhat spindle-shaped, with a depressed, elongate head, and a blunt muzzle. The eyes are distinct, and the teeth are slender, acute, and hooked. Sir James Emerson Tennent particularly notices this animal in his "History of Ceylon." "The Rocky Jungle," he says, "bordering the higher coffee estates, provides a safe retreat for a very singular animal, introduced about a century ago to the notice of European naturalists by Linnæus, who gave it the name of *Cæcilia glutinosa*, indicatory of two peculiarities manifest to the ordinary observer—an apparent defect of vision, from the eyes being so small and imbedded as to be scarcely distinguishable; and a power of secreting from minute pores in its skin a viscous fluid, resembling that of snails, eels, and some salamanders. Specimens are rare in Europe, from the readiness with which the frame of the animal decomposes after death, breaking down into a flaky mass in the spirits in which it is attempted to be preserved. The creature is about the length and thickness of an ordinary round desk ruler, a little flattened before and rounded behind. It is brownish, with a pale stripe along each side. The skin is furrowed into three hundred and fifty circular folds, in which are imbedded minute scales. The head is tolerably distinct, with a double row of fine curved teeth for seizing the insects and worms on which it is supposed to live."

ORDER IV.—PERENNIBRANCHIATE AMPHIBIA (MEANTIA).

THE animals referred to this order of Amphibia are very remarkable. To them, and them only, truly belongs the title *amphibious*, or creatures possessing, as it were, a double life. The branchiæ or gills, which all the species of this class possess in their young or tadpole state, in the *Meantia* remain external and well-developed during their whole life. They also possess true lungs; so that on dry land they can respire atmospheric air, and in the water extract air from the liquid element in which they are submerged. They can thus live at pleasure either in the air or under water. Their body is elongate, naked, and smooth, and their tail is compressed. Their legs, which in some species are four, and in others only two in num-



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kept in a vessel containing a large quantity of water, or in which the water is frequently changed, it manifests but little disposition to rise to the surface for atmospheric air; but when the quantity of water is small, or not often changed, it soon finds the air in the water insufficient for its purposes, when it ascends to the surface, takes a mouthful of air, and sinks again with it to the bottom."

In the second family of this order, the SIRENIDÆ, we have only space to mention particularly one species. This is well known by the name of the Mud-eel.

THE MUD-EEL or SIREN (*Siren lacertina*)—represented in Plate 4, fig. 1—is a native of South Carolina and Georgia, and is about nineteen inches in length, and even sometimes reaches two feet, while it measures four or five inches in circumference. In its general form and aspect it bears a great resemblance to an eel, and the surface of the body is very smooth and slimy. The tail is long and compressed, and is margined for several inches both above and below by a narrow, rayless fin, which greatly assists it in moving through the water. It is of a deep blackish-brown colour, rather paler beneath, where it is partially tinged with a bluish hue, with a tinge of violet, and is marked all over with numerous small white or milky spots. The head is rather small for the size of the animal, is depressed, of a suboval form, and the muzzle is blunt and flattened. The mouth is not wide, but is covered with tolerably thick lips. The nostrils are small, placed near the anterior angle of the upper jaw, and the eyes are very small, dim, of a blackish colour, and covered with a prolongation of the skin. The gills, according to the late Mr. James Wilson, to whose memoir we refer the reader, consist of three fleshy peduncles, which increase in size from the first to the last. They are beautifully branched from beneath, and along their lateral and terminal edges; and these little branches are divided and subdivided into still more minute ramifications. This elegant fringe-work forms the true gills, the central and fleshy stalks serving merely as their support. Beneath, and rather in advance of these bodies, are three nearly vertical clefts, through which the water is ejected backwards from the inside of the month upon the gills, though with a much more languid and less perceptible action than in fishes. The feet are only two in number, the anterior pair; they are but slightly developed, however, and of little service, if any, in progressive motion. They are in constant motion, as the animal moves from place to place on land, and are folded back when it swims in the water. They are each terminated by four toes, the extremities of which are rather pointed, slightly curved, and terminate in semi-corneous tips. This animal, as its English name indicates, lives chiefly in mud, and, according to Mr. Holbrook, is abundant in the rice-fields of Carolina. "It is often thrown out," he says, "in great numbers, at certain seasons, when the ditches are cleaned. Being regarded, however, as venomous by the slaves, they are instantly killed or dreadfully mangled, and left to serve as food for racoons or for turkey-buzzards, ever on the watch. Sometimes they leave the soft mud in which they commonly burrow and take to the water, in which they swim with great swiftness. They are occasionally taken by persons angling for the common perch of Carolina (*Pomotes vulgaris*), with a bait of earth-worms. Sometimes they leave the water entirely, like eels, and are found on dry land; but whether in search of food, or to rid themselves of parasitic animals, cannot at this moment be ascertained." From its living in muddy places, it was called by the inhabitants the *Mud Iguana*. Its food is generally believed to consist of earth-worms, insects, &c. A specimen, which was kept alive in the Zoological Gardens, Regent's Park, in 1841, was supplied with about a dozen and a half of earth-worms daily. This individual was twenty inches long, and as large as the wrist of a stout child of six months old. Another specimen was kept alive by Dr. Patrick Neill, at Canonmills, near Edinburgh, for three or four years, and was made the subject of an elaborate memoir by the late Mr. James Wilson. During the whole of this period no change took place in its gills or lungs. Dr. Garden was the first person who discovered the Siren, and he sent an account of it to Linnæus through our countryman John Ellis. These three naturalists, and the celebrated John Hunter, considered it to be a perfect animal, and Linnæus established a distinct order for it amongst the Amphibia, which he called *Meantes*. Pallas, Count Lacépède, and some others, considered it only a tadpole of some large species of Salamander; and the celebrated anatomist Camper even went so far as to place it amongst the fishes. Cuvier, however, established most satisfactorily that the Siren was a perfect animal, and a true Amphibian, which respires at will throughout its life, either in the water by means of branchiæ, or in the air by means of lungs. The blood-globules of the Siren were ascertained by Professor Owen to be, like those of the Proteus mentioned above, of a very large size; and it appears now a well-established fact, that these globules are of a greater relative magnitude in the Perennibranchiate amphibians, or those which have persistent branchial apparatus, than in any other animals of the class to which they belong.

As we have mentioned, at p. 86, the order PSEUDOICHTHYAS will take its place in the article FISHES.

END OF REPTILIA.

THE MUSEUM

OF

NATURAL HISTORY.

ZOOLOGY.

CLASS IV.—FISHES.

"Forthwith the sounds and seas, each creek and bay
With fry innumerable swarm, and shoals
Of fish that with their fins and shining scales
Glide under the green wave, in sculls * that oft
Bank the mid-sea: part single, or with mate
Graze the sea-weed their pasture, and through groves
Of coral stray, or sporting with quick glance
Show to the sun their wav'd coats dropt with gold,
Or in their pearly shells at ease attend
Moist nutriment, or under rocks their food
In jointed armour watch."

—MILTON'S *Paradise Lost*, vii. 399.

FISHES rank in the scale of animated beings as the lowest division of Vertebrals. In the preceding pages of this work, the reader has been informed how the massive bony frame-work and other parts of the mammalian structure are modified in the instances of Seals and Cetaceans, to adapt an air-breathing vertebral for an aquatic life; and also how the Penguins are able to live the life of a fish, through peculiarities of their ornithic constitutions. These and similar facts afford us glimpses of the inexhaustible and admirable methods by which the great Creator has constructed animals for the performance of their special functions, yet without effacing the structural type of the particular class to which they belong. The discovery and just appreciation of such instances of creative wisdom, are delightful rewards of zoological study. By the contemplation of the creatures to which our attention is now to be directed, we perceive, at the outset, that the ponderous bones of terrestrial quadrupeds, or even the much lighter yet firmly knit skeletons of air-cleaving birds, are not essential for animals breathing and moving in a medium nearly as heavy as their bodies, which receive no shock in cleaving a way through it with the rapidity of an arrow. The nature of the medium in which they dwell not only allows great variety in the density of the skeletons of fishes, but also a diversity of external form surpassing anything that has been noticed among the higher groups of Vertebrals, whose aggregate numbers are, in fact, very inferior to those of the finny tribes, whether we look to species or individuals. Some fishes have little or no bony matter in their bodies, and one small fish, occupying the lowest place in the ichthyic scale, is actually destitute of the head and brain, so characteristic of the more highly organized members of the division.

Using the term FISHES in the broadest sense in which it is employed by naturalists of the present time, to denote a group of *vertebrals living habitually in water, and respiring that fluid during the whole course of their life*, and not merely temporarily, like the Amphibians, our purpose is to present such a view of the whole group as may be useful to the student of ichthyology, without overpassing the limits assigned to the subject by the projectors of "The Museum." The Natural History of two orders of osseous fishes only, written by Cuvier and Valenciennes, extends to twenty-two thick octavo volumes;* the work of Müller and Henlé on the Sharks and Rays, exceeds two hundred pages folio;† and the admirable lectures of Professor Owen on the Anatomy of Fishes, fill three hundred pages of small type.‡ The space allowed to the class in this work will not suffice for more than an attempt to present the characters of the *Orders* and principal *Families*, with brief notices of some of the fisheries; and to add a very few facts evincing intelligence or natural affection in some members of the Class.

The marine abodes of fish, secluded from continuous observation, limit our knowledge of their habits; and some kinds that are objects of important and costly fisheries, are known only in that epoch of their existence in which they approach the shores for the purpose of spawning. Several large species residing habitually in deep waters, and coming to the surface under the accidental circumstances merely of injury or disease, have been captured at rare intervals, by seamen

* Anglo-Saxon *sceole*, an assembly.

* Histoire Naturelle des Poissons, par M. Le Baron Cuvier et M. A. Valenciennes An. 1828–1849. Tom. xxii. A Paris.

† Beschreibung der Plagiostomen, von Dr. J. Müller and Dr. J. Henle, 1841. Berlin (60 plates).

‡ Lectures on Comp. Anatomy of Vertebrate Animals, by Richard Owen, F.R.S., 1846. London.

who, unable to draw up a recognizable description, have whetted the curiosity of naturalists, but have left the species which chance had placed in their hands to hold an uncertain niche in our systems.

A general acquaintance with the principal facts of ichthyology is of national importance to a maritime country like Great Britain, with an increasing population and a limited area of arable land. At the present time, the cost of fish renders it rather a luxury for the rich than food for the masses; but there is no doubt that, notwithstanding the number of people at present employed in catching, curing, and carrying fish to the markets, this source of food might be incalculably extended. We are still behind the Dutch and Biscayans in some of the fisheries carried on in the narrow seas; and Europe at large is vastly surpassed by the Chinese in the skill with which supplies for a teeming population are extracted from the ocean, or in the economical rearing of fish in every pond; a sheet of water in China being made as productive of food as the same extent of good arable land. Of late years cod-liver oil, having been ascertained to be a most valuable remedy against the national malady consumption, has already become an extensive article of traffic; and very recently, experiments made in France have shown that oil obtained from the livers of sharks is not less useful in the same disease. Now in March, 1858, when an unbroken scull of one kind of shark (the Picked Dog-fish) beset the northern coasts of Scotland, and extended twenty miles out to sea, filling every harbour and bay—had proper fisheries been established, not only might an incredible quantity of high-priced oil have been procured, but vast stores of sharks' fins might have been prepared for export to China, where they are in great request for the purpose of making excellent soup. It is, perhaps, too much to expect that Englishmen should lay aside their prejudices, and learn from the Chinese the modes of converting parts of these fish rejected by our fishermen as useless, into palatable and nourishing food. Not from the observations of our own seamen, but from researches made by order of the Dutch government, have we learnt that the Herring fishery is productive in those parts of the sea only, whose temperature ranges between 54° and 58° of Fahrenheit's thermometer.

Agassiz, a most important authority in classification, has carried the subdivision of the vertebrate animals further than his predecessors, and distributes the FISHES, as defined above, into four classes, viz :—

1st. MYZONTES, composed of two orders, *Myxinoids* and *Cyclostomes.*

2nd. FISHES PROPER, of two orders, *Ctenoids* and *Cycloids.*

3rd. GANOIDS, of three orders, *Cœlacanths* (fossil), *Acipenseroids*, and *Sauroids*, with the addition of other three orders, whose true position is to be ascertained by future research : these are *Siluroids*, *Plectognaths*, and *Lophobranchs.*

4th. SELACHIANS, of three orders, *Chimæroids*, *Galeodes*, and *Batides.* This arrangement, considered to be in part provisional, and depending on the result of investigations now in progress, is not adopted in the ensuing pages, though occasionally referred to; the fishes being treated in this work as a *single class*, having a common character—*the oxygenation of the blood by air diffused in water.*

Professor Owen has recently taken a very different view of the arrangement of the inferior vertebrals from the above, and proposes to unite the Fishes, Amphibians, and Reptiles into one class, which he names HÆMATOCRYA.

> "Our little systems have their day;
> They have their day and cease to be;
> They are but broken lights of *Thee*,
> And thou, O Lord! art more than they."
> —TENNYSON, *In Mem.* vi.

That a correct knowledge of the structure and development of any group of animals is as necessary to the zoologist as an acquaintance with their physiognomy and habits, is so evident, that it seems unnecessary to affirm that no one can hepe to become an accomplished ichthyologist unless he submits to the labour of patient anatomical investigation. For reasons already assigned, however, the notices of structure will not be extended in this work beyond what is requisite for explaining the terms used in characterizing the orders and family groups.

SCALES.—In some fishes scales are not developed, the skin being generally in that case thick, smooth, and slippery, owing to the abundance of defensive mucus secreted by its numerous glands. Comparative anatomists distinguish the internal more or less firm framework by the name of *endo-skeleton*, from the external or *exo-skeleton*, which is intimately connected with the skin or developed in its textures, and is therefore sometimes called the *dermal skeleton.* The *Myzontes* of Agassiz, or *Dermopteres*, furnish an instance of an entire order (or, as the author just named considers them to be, a whole class) destitute of scales, and with so little approach to the secretion of bony matter that systematic authors call the exo-skeleton "mucodermoid," or indurated mucus secreted from the skin, the internal skeleton at the same time being cartilaginous or membranous. Almost all the other great groups of fishes contain some species without scales, but allied by the rest of their structure to the scaly fishes with which they are classed. Scales, when present, originate in a little pouch of the external skin, technically named a follicle, and resembling the fold of the gum from which the germ of a tooth is evolved. Agassiz, when studying fossil fishes, was led to distinguish four kinds of scales, which he termed *cycloid*, *ctenoid*, *ganoid*, and *placoid.*

Cycloid scales are smooth on their discs and edges, but when examined through a lens, exhibit numerous concentric lines, variously flexed, yet having always a certain relation to the border of the disc. Most generally in that part of the scale which remains in the follicle, and is covered by the scale immediately before it, these lines of structure by dipping and undulating produce furrows radiating like the sticks of a fan. In all the most important groups of those fishes which are clothed with cycloid scales, the bones of the skeleton contain radiated or fusiform bone corpuscles.*

* Kölliker, Proceedings of the Royal Society, ix. p. 656.

posterior, designing thereby to render the term more applicable as a distinctive character to his order of *Acanthopteres*, whose ventrals have a spinous ray in front, and need the firm support of the coracoids when used as a defensive weapon. Only in a very few instances are the pubic bones united directly to the spinal column as the hind legs are in quadrupeds; they are almost always merely suspended in the soft parts. The term *apodal*, applied to fishes, indicates that the ventrals are absent; and *abrachial*, in like manner, denotes the non-existence of pectorals.

LATERAL LINE.—Most fishes have pores in the skin from which a lubricating fluid is poured out, in some very copiously, as in the glutinous hag, for which it suffices to convert the surrounding water into a jelly. These pores are rarely absent from a row of dermal bones that run under the eye, and are therefore named *sub-orbitals;* and they may generally be traced over the temples, in a chain of ossicles called *sur-temporals*, and onwards by the suprascapula to the side of the fish, which they traverse towards the tail, following the line of decussation of the two great lateral muscular masses. In this position the porous row acquires the name of the "lateral line," and it is a character of which special mention is generally made in the description of the external aspect of a fish. The scales that it traverses most commonly differ from the others in size, figure, or in being perforated, or tubular, or notched, and they form the points of meeting between the oblique rows of dorsal and ventral scales. In many fishes which have no other scales, the ducts of the lateral line are protected by cartilaginous or osteoid cases. Sometimes the lateral line runs only a short way behind the pectoral, sometimes it goes to the base of the caudal rays, sometimes onward to their tips; or it may be interrupted, and recommence again on a lower level; or, finally, it may be altogether imperceptible or absent, as in most sharks; or there may be two, three, or many lateral lines, as in the Mullets and Chiri.

WATER-TUBES.—Agassiz has discovered that in many fishes there exist external openings which have hitherto been mistaken for muciferous pores, but whose function is to admit water into the circulating system through a series of tubes that end in the blood-vessels near the heart. They are easily seen in the head of the common shad, but none have been detected in the Selachians; and they are generally few in fishes that live habitually in shallow waters. He considers them to be safety-tubes for balancing the system on sudden alterations of pressure. An analogous system exists in Molluscs, by which water can be admitted into the heart from the exterior.*

ENDO-SKELETON.—The very numerous groups of fishes cannot be described or recognized without a more frequent reference to the parts of the internal skeleton than is requisite in characterizing the fewer divisions of the Mammals or Birds. But we are restrained in this work from lengthened anatomical descriptions, and must confine our brief notices of the bones to those pieces whose names enter into the definitions of the family groups of fishes.

* Duthiers, Proceed. Roy. Soc. x. No. 37, p. 193. Dec. 1859.

In the skull of an osseous fish five ridges are sometimes very conspicuous. A *mesial* one, chiefly developed on the *super-occipital*, which is the hindmost bone on the top of the skull, and is conspicuous in figure C of Plate 17. The distal point of this ridge is frequently called the "occipital spine." This mesial ridge is often prolonged forwards on the *mid-frontal* between the orbits. Next follow the pair of *intermediate ridges*, one on each side developed on the *par-occipital*, exteriorly to the super-occipital, and running forwards over the *parietal* and *mid-frontal* near the upper edge of the orbit. To the distal point of the intermediate ridge one limb of the chevron-shaped suprascapula is attached. Still more exterior or lower down on the side of the head run the *external ridges*, also a pair, one on each side. To the distal end of this ridge, which is a process of the *mastoid* bone, the lower limb of the suprascapula is attached; the fore part of the ridge reaches to the hinder margin of the orbit on the *post-frontal*. Fishes with round heads like the loaches want these five ridges; some, as the carp, have merely the occipital spine. In the Chætodons the mesial ridge is greatly elevated, and in the Sclerogenids the whole five ridges are more or less conspicuous.

The upper profile of the face or snout is supported by the *nasal bone;* and on each side of it are the nostrils, opening by one or two small orifices into the pituitary sacs, but not penetrating to the cavity of the mouth. Under the nasal bone are the jaws, variously formed in various groups of fishes, but retaining their relative positions and connections pretty exactly. The *premaxillaries*, a pair of bones applied to each other on the mesial line, form the middle part of the upper jaw, and in a considerable number of osseous fishes border the entire upper half of the mouth. Articulated to the palatine, behind the premaxillary, lies the *maxillary*, whose lower end in many fishes comes forward to the corner of the mouth, and enters into the composition of its upper border. When the jaws are protractile, each premaxillary sends out a long pedicel, which glides backwards and forwards by the side of the nasal on a tubercle of the maxillary. The *mandible*, composed of two limbs, each consisting of two or more pieces, makes up the lower jaw. Underlying the nasal, within the roof of the mouth on the mesial line, is the *vomer;* and on each side of it is one of the pair of *palatine bones*. In the back part of the roof of the mouth, over the gullet, is the *sub-occipital*, which is confluent with the *sphenoid* that articulates anteriorly and above with the vomer. All the bones here named as belonging to the orifice of the mouth or its roof are dentiferous in one species of fish or another. Interiorly between the limbs of the mandible there is often a lingual or *tongue-bone*, frequently bearing teeth, and opposed to the vomer. There are also in almost all cases teeth on the branchial arches or on parts of the hyoid bones connected with them.

THE GILLS AND HYOID APPARATUS.—Descending from the mastoid bones of each side a series of pieces meet at the tongue, and form an elastic inverted chevron like the letter V. Running backwards in the lower angle of the V, and on the mesial line from the tongue, between the limbs or *cornua* of this arch, there is a

narrow isthmus of ossicles, which are frequently studded with hair-like teeth; and, rising in backward curves from the isthmus, there is a series of successive pairs of branchial arches, whose upper ends are connected to the sub-occipital by membrane. Each arch consists of several pieces with joints, rendering it pliable and elastic; and each has, a little above the middle of its limb, a larger joint, which enables it to fold up on itself when necessary. On the interior edge of each arch there are two rows of knobs, cones, plates, or lancet-shaped processes beset with fine teeth; these are named *rakers*, and act as sieves in straining the water, and preventing gross substances from passing between the arches. To the extero-posterior side of each arch are attached the gills, whose general aspect needs no description, but which present considerable modifications of form and arrangement in particular groups of fishes. Generally there are four gill-bearing arches, but sometimes the gills are fewer. In the embryo fish six arches may be perceived, and even seven are indicated, but the first is atrophied before the sixth is developed, and only five are matured. The last arch does not in general carry gills, but is modified into a pair of pharyngeal jaws, being dentiferous on its sides, having two bony dental plates or groups of plates below named the *inferior pharyngeals*, and very frequently similar superior plates lining the sub-occipital and called *superior pharyngeals*. The union of the inferior pharyngeals into a single bone is an essential character of the group of PHARYNGÓGNATHS.

In cartilaginous fishes the jaws and parts of the skull are so different as to need special descriptions. The gills of these Selachians, though adherent to the sides of gill-chambers, each of which opens externally, have essentially the same ultimate structure and the same function as the gills of fishes proper, which is to submit the blood extensively to the action of the oxygen contained in the waters that fishes inhabit.

In osseous fishes the tips of the gills are free, and there is only one external opening on each side, by which all the water that bathes the gills flows out. This opening is regulated by a valve called the operculum or *gillcover*, which consists of four pieces—viz., the *pre-operculum*, a chevron-shaped or crescentic bone, bounding the cheek posteriorly; the *operculum*, often quadrangular, and filling the space between the pre-operculum and upper part of the gill-opening; the *sub-operculum*, lying as its name denotes under the operculum, and bordering the lower part of the gill-opening; and, fourthly, of the *inter-operculum*, which lies before the sub-operculum, and runs forward under the lower limb of the pre-operculum towards the mandible. Between the sub-operculum and inter-operculum of the one side and those of the other a membrane named the *branchiostegous* stretches across the throat, and fills the interval between the limbs of the mandible. It is distended on rib-like bones called *branchiostegals*, which are articulated to the horns of the hyoid bone. Care is generally taken to note the number of the branchiostegals in the description of a fish, and in some groups the number is very constant, furnishing in that case a good character. When the gill-opening is large, and runs forwards to the root of the tongue, the branchiostegous membranes are narrow and are completely separated from each other. On the contrary, the membranes are continued into one another when the gill-opening is small and high up.

THE HEART.—In fishes all the blood is propelled through the gills by the heart, which, lying behind them, is protected by the coracoid arch. This central organ of the circulation consists of a single series of chambers—viz., in the osseous fishes, of the *venous sinus*, the *auricle*, the *ventricle*, and the *arterial bulb* or *stem*. There are generally two valves at the auriculo-ventricular opening; but the Rays have three valves there, the Sun-fish four, and in the Sharks there is one large valve like a parachute with several marginal attachments. The numbers and arrangement of the valves in the arterial stem serve as a primary character of the Ganoid fishes; and in the Sharks and Rays also the valves are numerous.

SWIM-BLADDER.—The swim-bladder, or *air-bladder*, is an organ peculiar to fishes, and lies in the belly near the spinal column. In some fishes it is closed completely, and then the included air is found to consist chiefly of oxygen; in other fishes it opens through a tube directly into the stomach or œsophagus by a valvular orifice, and then it is found to be distended with azote and a small proportion of oxygen; but in no case have its contents been found to be atmospheric air. In some groups of fishes the air-bladder is connected with the acoustic organs by chains of small bones.

HEARING.—In the class of fishes the organs of hearing are wholly within the head and cannot be discovered except by dissection, the Plagiostomes alone having a fine tube leading to an external orifice from the interior labyrinth. This external opening is not easily detected, and it is not surprising that the sense of hearing has been denied to fishes by some authors; but many facts may be cited both from ancient and modern writers, showing that when kept in stews fishes will come to the call of those that feed them, or may be assembled at the sound of a whistle or bell. It is probable that the senses are less acute in fishes than in animals higher in the vertebral scale; but as they are furnished with nerves of touch, taste, sight, and smell, as well as of hearing, there is no reason to suppose that they are not endowed with all the five senses in greater or less perfection; and as certain large nerves are in a few species supplied to galvanic or electric organs, we have an instance of a nervous function peculiar to this class. A notice of this galvanic power will be more appropriate when we have to speak of the groups in which it is displayed.

With respect to INTELLIGENCE, fishes in stews have been known to recognize those that feed them; and we have seen one kept in a glass tank that, though very shy of strangers, evidently distinguished the lady who supplied it with food. The gregarious fishes that move about in large sculls cannot be expected to evince much individual attachment; but some that live in pairs are known to have refused to eat, and to pine away when deprived of their companion. Many fishes make elaborate nests for their eggs, some instances of which will be alluded to hereafter.

In the ensuing pages the Primary Groups of Fishes will be ranged in the following orders:—

TABLE OF ARRANGEMENT.

I. ORDER.—DERMOPTERES (Owen), equivalent to the MYZONTES of Agassiz, who considers them to hold the rank of a Class in the Vertebral Branch of Animals.

Sub-order A.—Pharyngobranchs or *Cirrhostomes*, represented only by the Lancelets, which Agassiz surmises to be merely embryos of more highly organized fishes.

Sub-order B.—Marsipobranchs (sacculated gills), or *Cyclostomes* (round mouths), called also *Suckers*.

The next four orders belong to the FISHES PROPER of Agassiz, and are considered by him to constitute a class, divisible into *Ctenoids* and *Cycloids*:—

II. ORDER.—ANACANTHS (no spinous fin-rays) having shut swim-bladders, and no radiated or fusiform bone corpuscles in their skeletons.

Sub-order A.—Helmichthyans or *Tape-fishes* of Kölliker.

" *B.—Apodal Anacanths.*

" *C.—Thoracic Anacanths.*

" *D.—Heterosomes* (Bonaparte), Dissimilar sides, or Flat-fish.

" *E.—Colacides*, parasites or Ship-stayers.

III. ORDER.—PHARYNGOGNATHS, whose right and left inferior pharyngeal bones are confluent, forming one piece. Their skeletons are destitute of bone corpuscles.

Sub-order A.—Malacopterygian Pharyngognaths.

" *B.—Acanthopterygian Pharyngognaths.*

IV. ORDER.—ACANTHOPTERES, with ossified eudo-skeletons without bone-corpuscles; one or more anterior rays of the fins, especially of the ventrals, unjointed or inflexible spines. Ventrals more generally situated in the thoracic or guttural regions; swim-bladders closed.

Sub-order A.— Ctenoids (Owen).

" *B.—Cycloids* (Owen), Scomberoid-scaled fishes.

V. MALACOPTERES or PHYSOSTOMES, have open air-bladders, flexible, articulated fin-rays, and most generally true bony structure in their skeletons.

Sub order A.—Apodal Malacopteres, or *Serpentiform Apodals.*

" *B.—Abdominal Malacopteres.*

The GANOIDS, as an order of vertebrals in the usual acceptation of the name, consist mostly of palæozoic fishes, and have comparatively few existing representatives. Professor Owen enumerates their essential characters, as they appear in fossil remains, in these words: "Endo-skeleton in some osseous, in some cartilaginous, in some partly osseous, partly cartilaginous; exo-skeleton formed by enamelled bones; fins usually with the first ray a strong spine."

Agassiz ranks them as the third class of vertebrals, and includes in the class the six following orders, but the first three merely provisionally, and dependent on further investigation for their true position in his system.

VI. ORDER.—SILUROIDS (Agassiz).

VII. ORDER.—LOPHOBRANCHS, or fishes with tufted gills.

VIII. ORDER.—PLECTOGNATHS, named from the confluence or union by indented suture, of the right and left halves of the upper-jaw and mandible respectively.

This structure of the jaws is not, however, altogether confined to this order.

IX. ORDER.—ACIPENSEROIDS, or STURIONIDANS.

X. ORDER.—SAUROIDS (Agassiz), or LIZARD-FISHES.

XI. ORDER.—CŒLACANTHS (Agassiz), or HOLLOW SPINES. A palæozoic order which became extinct before the tertiary epoch. The dermal spines were ossified only externally, and are found hollow in the fossil state. The vertebral column ends in a prolonged appendage which separates the upper caudal lobe from the under one, as in some few existing fishes.

The fourth class of Vertebrais, according to Agassiz, is composed of SELACHIANS, a term which is equivalent to that of PLAGIOSTOMES (oblique mouths) of Dumeril. It embraces the three succeeding orders:—

XII. ORDER.—HOLOCEPHALIDS or CHIMÆRÆ of Agassiz.

XIII. ORDER.—GALEODES or SHARKS of Agassiz. (*Squali* or *Haifische* of Müller and Henle.)

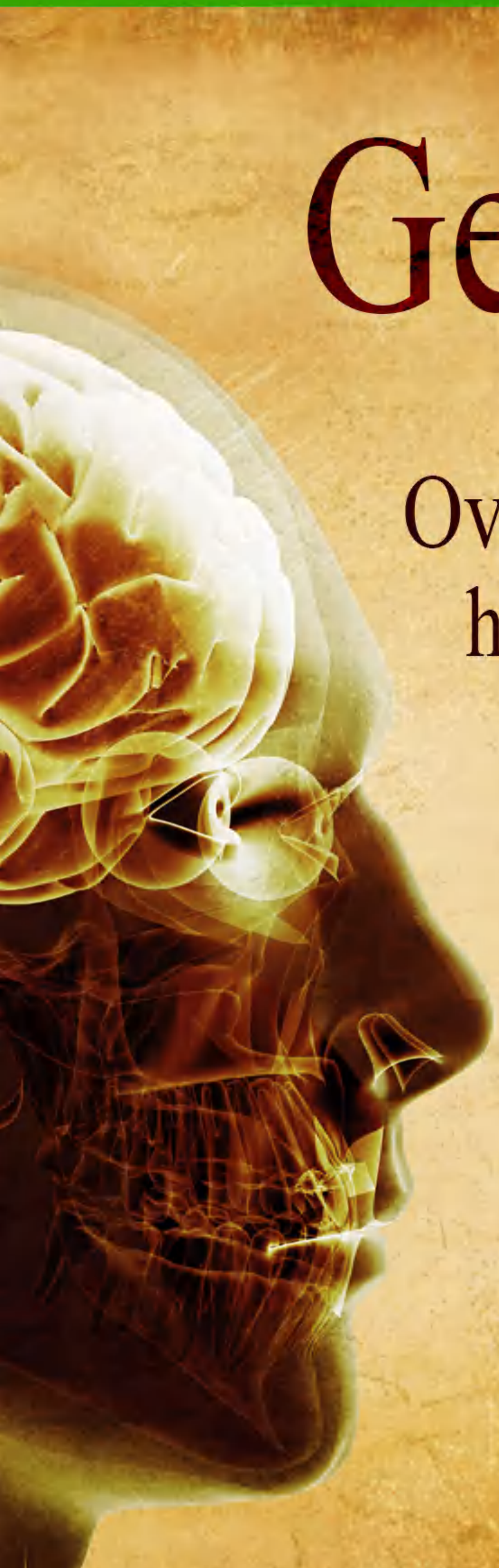
XIV. ORDER.—BATIDES (Agassiz), *Rays* and *Skates* of other ichthyologists. *Raiæ* or *Rochen* of Müller and Henle.

XV. ORDER.—PROTOPTERES of Owen, an osculant form between Fishes and Reptiles, considered by some zoologists to be Amphibians. (*Ichthyodi* of Agassiz.)

ORDER I.—DERMOPTERES.

PALÆONTOLOGISTS have by successive discoveries carried back the first appearance of Fishes to an early period in the formation of the crust of the earth; and Professor Agassiz is of opinion, that it would not be difficult to show on physiological grounds, that their presence in primæval oceans dates contemporaneously with that of the Radiata, Mollusca, and Articulata; the plan of structure and means of subsistence of these three great types of the animal kingdom, constituting with the Vertebrals a mutually dependent system. There is, however, as yet no unequivocal evidence of fossil fishes below the newer silurian beds. The earliest remains of fishes have an embryonic character in the position of the mouth on the ventral aspect of the head, in the heterocercal caudal fin, in the absence of a hard internal skeleton, and in other parts of structure, which, as far as they can be made out, seem not to have been so highly developed as in the modern osseous fishes. The Dermopteres have a more decidedly embryonic aspect than any of the other existing groups of fishes. No remains of them have been identified in the palæozoic strata, either because they were not early creations, or because the softness of their textures militated against their preservation, so as to be recognizable in indurated deposits that have been subjected to the action of heat, great pressure, and sundry displacements. Ichthyologists now concur in ranking this order at the bottom of the scale of fishes, and consequently, as the lowest of the vertebrals; but though in common parlance the Dermopteres are said to be comparatively feebly organized, they are not imperfect, being in every way adapted to fill their station in nature, and to perform their allotted functions.

The essential characters of the group, as drawn by eminent zoologists, are the want of the lateral pairs of fins representing hands and feet, that is, they are abrachial and apodal, with long vermiform bodies; their internal skeleton is not ossified, being either cartilaginous, or merely membranous: their external skeleton does not take even the consistency of scales, but remains in the condition of soft, muciferous skin; and the fin-rays and teeth when present are muco-dermoid



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fishes to which they adhere by their mouths. In the Myxinoids, the water of inspiration enters by a single opening on the ventral surface of the body of the fish, into the pharynx, from whence it passes by six or seven short tubes into an equal number of suborbicular or discoid sacs, to whose walls the gills adhere in form of highly vascular radiated and plaited folds. After having imparted oxygen to the blood circulating in the minute branches of the branchial vessels, the water passes out by as many short tubes and openings on each side of the neck as there are gill-sacs (in *Bdellostoma*); or the short expiratory tubes of one side open into a common canal that leads to an orifice close to the inspiratory one, which is single, and interposes between the expiratory ones, which are a pair, as in the Glutinous hag or *Myxine*—(Plate 1, fig. 1). The other characters of the group are, a naso-palatine tube or solitary mesial nostril, with a valvular opening in the roof of the mouth; a feebly organized eye; and a mouth furnished exteriorly with barbels, and armed interiorly by two rows of lingual teeth, with a solitary movable tooth on the palate. In the Myxinoid fishes the spinal column is of firmer structure than that of the lancelet, which has merely a membranous envelope to the myelon. It is an elastic, very flexible gelatinous chord, technically called *notochord*, composed of a central band of fibres and an exterior sheath, whose dorsal layers separate and form a canal for lodging the myelon; as do its ventral layers behind the vent, for inclosing the large blood-vessels. No part of this chord is cartilaginous, and the greater part of the skull remains soft, though the acoustic capsules and some other parts of the head are of cartilage. A cartilage also represents the lingual bone, and sustains the lower teeth. None of the Dermopteres have a mandible, and they are, moreover, destitute of a distinctly organized upper jaw. Teeth, however, exist on the palate, which resemble indurated mucoid papillæ. There are also some cartilaginous rings in the single mesial nostril tube, whose inner membrane is longitudinally plaited. These fishes are destitute of an arterial bulb or stem, but they have a contractile organ, or portal heart, for expediting through the liver the venous blood coming from the viscera of the abdomen.

THE GLUTINOUS HAG (*Myxine glutinosa*)—Plate 1, fig. 1—of the northern seas, is the best known member of the sub-order. Bloch called it *Gasterobranchus cœcus*, from the situation of its gill-openings and the minuteness of its lowly-organized eyes, giving it the appearance of blindness. By English fishermen it is frequently named the "Borer," because of its presumed habit of perforating fishes. Sundevall, who studied it in the Norwegian seas, says that it is common in places where cod-fish abound, choosing a clayey or muddy bottom, and avoiding a sandy one; living habitually in a depth of water varying from thirty feet to seven hundred. When placed in a vessel full of salt water it lies as if dead, or if disturbed swims slowly like an eel; and if put into fresh water it speedily dies. He is of opinion that it does not attack living fishes, but enters dead ones by the gill-openings. As many as twenty of these parasites were found in a haddock, which had died when suspended to a hook. They had consumed all the flesh to within two or three inches of the gills. When from any cause a series of hooks have not been visited for a week or so, the fishermen on taking them up often finds merely skeletons of fish hanging to them, the Borer having picked the bones clean. On this account the Norse fishermen name the plunderer, *Pir-al*, or *Pil-al* (the Picking-eel or Pillager).

The southern member of the family was discovered in Queen Charlotte's Sound, New Zealand, during Cook's second voyage. Forster says that it is lively and nimble, and that it was often taken adhering to pieces of fish let down into the sea as bait. It shed mucus of a milky hue copiously. The New Zealanders roasted and ate it, notwithstanding its disgusting aspect. There is a third species in the seas of Chili (*Bdellostoma polytrema*), which has fourteen stigmata on each side.

FAMILY III.—PETROMYZONTIDS OR LAMPREYS.—(Plate 1, fig. 2.)

In this family there are seven stigmata on each side of the neck, each entering a transversely oblong gill-sac, which internally communicates by a small opening with a mesial tube common to all the sacs of both sides, and lying beneath the œsophagus or commencement of the digestive canal, but distinct from it. This pharyngeal respiratory tube is closed at its distal end, and anteriorly communicates with the gullet by a valvular opening. When the mouth is free, the water of inspiration enters by it, fills the pharyngeal tube, and then flowing into the gill-sacs, and bathing the fixed gills lining their sides, is finally expelled by the seven *stigmata* on each side of the neck. When a Lamprey adheres by its suctorial mouth to another fish, or to a stone, access being then denied to the respiratory fluid through the proximal opening of the pharyngeal tube, the water enters the lateral stigmata and is expelled again by them, the current in and out alternating. Professor Owen experimenting on a Lamprey found that when the fish was allowed to fix itself to the side of a vessel, and was held so that the stigmata of one side only were out of the water, the respiratory currents were observed to enter by the submerged orifices, and to be discharged with force through the exposed ones. The gill-sacs of the Lampreys are supported by what Müller has well named a cartilaginous basket, which is wanting in the myxinoids, and yet has an obvious homology with the soft respiratory pharyngeal barrel of the lancelets. It is a firm but elastic frame-work of cartilage, perforated by numerous wide interstices in addition to the seven on each side for the gill-openings, which are themselves, each encircled by its own detached, cartilaginous ring. The basket is suspended by about seven pairs of cartilages to the fore part of the spinal cord, and occupies most of the diameter of the fish. Thin cartilaginous plates exist in the fibrous sheath of the spinal cord itself, being an advance in the structure of the neural arches from the membranous neural canal of the myxinoids; a broad, heart-shaped cartilaginous plate of the skull covers the suctorial mouth, and various cartilaginous processes

support the large tooth-bearing tongue. When a Myxinoid or a Petromyzontid is preserved in spirits, the teeth readily flake off in cap-shaped layers, leaving a comparatively soft, conical nucleus, and furnishing evidence of the muco-dermoid origin of these organs in the Dermopteres. The arrangement and form of the labial, palatine, and lingual teeth of the different Petromyzontids supply the generic characters of the various groups that compose the family. One Australian genus (*Geotria*) has a remarkably large guttural pouch before the gill-openings, corresponding to the rudimentary dilatation of the same part in the common Marine Lamprey, and having an external resemblance to the goitre of the iguana.

The single mesial nostril-tube of the Dermopteres is flask-shaped in the Lamprey, and descends to the base of the skull, but is there closed by the imperforate mucous lining of the palate, differing in that respect from the naso-palatine tube of the myxinoids, which terminates by a valvular opening on the roof of the mouth. In the Lampreys, the eye-ball is supplied with muscles for effecting its various movements, which are wanting in the rudimentary optic organs of the myxinoids; and, on the other hand, the acoustic capsules are less conspicuous on the base of the skull than in myxine, such prominence being an embryonic character. There is also a greater extension of the organ of hearing of the Lampreys into a *membranous vestibule*, a *fenestrum*, or as Breschet names it an *aqueduct*, and an *accessary sinus*, but there are neither semicircular canals nor otolites. The author just named, considers the organ of hearing in the Lampreys to have a stronger resemblance to that of the crustaceous or cephalopode molluscs, than to the acoustic apparatus of osseous fishes.* None of the Dermopteres present a greater development of the hyoid apparatus, than that which consists in the presence of a lingual cartilage, and some ligamentous bands which we shall notice below, as existing in the larval state of some members of the group.

A small Dermoptere, inhabiting the streams frequented by the Lampreys throughout Europe, and known in England under the various names of Prid, Pride, Sandpride, Sandburker, Stonegrig, and Mudlurker, was ascertained by Auguste Müller some few years ago, to be merely a larval condition of the Fringed Lampern. Its eyes are so small, that it was named the Blind Lamprey by the distinguished British naturalist Ray; and its mouth, instead of being circular, has a horse-shoe shape, and cannot act as an adhesive sucker; but the rudiment of a future suctorial muscle is perceptible in it. Neither is the pharyngeal inspiratory tube as yet distinct from the œsophagus, and the gills, instead of being wholly adherent to the walls of the gill-chambers, have their tips free. This part of the structure is an approach to the free gills of the osseous fishes, and is suited, doubtless, to the free non-parasitic habits of the larva or ammocœte—so the young Lampreys are now called; the appellation having been taken from the generic name Ammocœtes, given when the fish was supposed to be a distinct species, and which is translated "mud-lurker." In the ammocœte, then, each gill-sac communicates directly with the pharynx, and opens on the side of the neck, as we shall hereafter show to be the case in the Selachians. No teeth are formed in the mouth of the ammocœte, but very early in its life a valve is developed within the mouth, which allows the water to enter, but prevents its reflux; and this muscular membrane is fringed so as to act as a strainer out of noxious particles. The food of the Pride consists chiefly of infusorial animalculæ (*Bacillaria*). Auguste Müller watched Lamperns in the act of spawning, secured the roe, kept it under observation until it was hatched, and afterwards carefully observed the larval or ammocœte life of the fish. In the fourth year of its existence, he saw the transformation to the adult form begin, and go on to completion in the course of ten days. There is no increase of size, but in that time the respiratory pharyngeal tube is formed, teeth are evolved, the valve or *velum* in the mouth disappears, the intestinal canal is sensibly abbreviated, and the roe which was previously transparent, becomes opaque. This transformation, though not so remarkable externally as that which occurs in the Tadpoles, was, previous to Auguste Müller's time, unsuspected in the class of fishes. The facts he have stated, has been testified too by other observers; and the Ammocœtes, not only of the Fringed Lampern, but of other European Lamperns and Lampreys have been detected.*

The following genera compose the Petromyzontid family:—*Petromyzon*, *Lampetra*, *Geotria*, *Velasia*, *Caragola*, and *Mordacia*, all of which are characterized by Dr. Gray in one of his catalogues of the Fishes in the British Museum.

THE LAMPREY (*Petromyzon marinus*)—Plate 1, fig. 2—is the species best known, and the only one so far as we know, that is used in Europe as food. It is said to be a highly esteemed fish for the table in the United States of America, and has long been held to be a delicacy in England. Henry I. is said by Matthew of Paris, to have died, in 1135, at St. Denis le Forment, of a sudden illness occasioned by eating too plentifully of lampreys, as the poet Pope is reported to have done in more recent times; and Henry IV. is stated by Pennant, quoting from Rymer's Fœdera, to have granted protections to such ships as brought over lampreys for the table of his royal consort. Henry VI. contracted with William of Nantes for a supply to his army, whithersoever it might march, of lampreys to be taken between the mouth of the Seine and Harfleur. It was anciently a custom of the city of Gloucester, to present the British sovereign with a lamprey pie. Camden, speaking of the lampreys of the Severn, says, that they are finest in the spring, being then more tender, and that, in his time, the Italians prepared them for the table by drowning them in Cretan wine, placing a nutmeg in the mouth and a clove in each gill-opening, rolling them up spirally in the flour of filbert-nuts and crumbs of

* See Recherches sur l'organe de L'ouie des Poissons par G. Breschet. Paris, 1838.

* Dr. M. S. Schultze has written still more recently on the early life of *Petromyzon Planeri* up to six weeks after its exclusion from the egg. At that age the small eye is buried under the skin, and the oral velum of the ammocœte is present instead of a separate respiratory tube, so that thus far the memoir confirms Auguste Müller's observations.

bread mixed with oil, spices and Cretan wine, and then boiling them carefully for some time in a cloth. In Pennant's day, vast quantities of lampreys were taken in the Thames, near Mortlake, and sold to the Dutch, who salted them for use as baits in the Turbot fishery.

ORDER II.—ANACANTHS (NO SPINOUS FIN-RAYS.)

FINS supported by flexible or jointed rays; ventrals present in some groups, absent in others; when present, most commonly beneath the pectorals. Skeleton soft or indurated, but in the latter case, having merely an osteoid structure, differing from true bone in the absence of radiated or fusiform bone-corpuscles.—(*Kölliker.*) Dermal skeleton in the form of cycloid scales in some, in others as ctenoid scales. Swim-bladder having no air-duct; often wholly absent.

With this order we enter on the FISHES PROPER of Agassiz, which have one gill opening on each side with an operculum, though in a few instances the openings are so approximated on the mesial line of the throat, as to appear single externally. The heart consists of a linear series of four cavities, viz., the *venous sinus*, the *auricle*, the *ventricle*, and the *arterial bulb*. This bulb has generally a pair of semilunar valves at its orifice, but wants the interior rows of valves which exist in the Ganoids and Placoids or Plagiostomes.

FAMILY I.—LEPTOCEPHALIDS.—(Plate 3, fig. 12.)

Kölliker, who has examined skeletons of the *Leptocephali* or Tape-fishes under the microscope, says, that the bones are structureless homogeneous substances, and, indeed, in most of the species the induration is confined to the jaws, teeth, and some portions of the skull, so that, when one of these delicate creatures is laid out on paper, and suffered to dry, it becomes a mere film, in which, nevertheless, the internal structure may be traced. One species, named the Morris, occurs on the British coasts; and the others which much resemble it, are fishes of a small size, greatly compressed, with a lancet-shaped profile, destitute of scales, and so diaphanous that the arrangements of the musonlar fibres and of the internal organs are distinctly visible. The dorsal and anal fins are narrow cutaneous seams which unite at the point of the tail to form an acute or a bluntish, and, in one species, a forked caudal fin, with generally perceptible rays. Some members of the family have pectorals, others want these fins, and only one known species (*Esunculus*) has ventrals. Some Tape-fishes have a series of strong acute teeth on the jaws; others appear to be toothless. The genera belonging to the family, which is co-extensive with the sub-order of HELMICHTHYANS are characterized by Dr. Kaup in his catalogue of the apodal fishes in the British Museum, under the following names, *Esunculus*, *Hyprorus*, *Oxystomus*, *and Leptocephalus*, and are generally diffused over the temperate parts of the ocean in both hemispheres. The British species called Morris (*Leptocephalus Morrisii*), inhabits the Mediterranean sea also; and in the museum of Haslar Hospital there is a specimen, which, having been brought up from the deep in the eruption of Graham's island, was picked by a naval officer from the smoking cliffs of that short-lived volcano. *Stomasiunculus* and *Porobranchus* are two new Leptocephalid forms recently discovered by Dr. Kaup.

FAMILY II.—OPHIDIOIDS.—(Plate 2, fig. 9.)

These Apodal Anacanths are elongated cycloid-scaled fish, more or less compressed and lancet-shaped posteriorly, without ventrals, and having the tip of the tail edged by the vertical fins without a break.

The genera are—*Machœrium*, *Ophidium*, *Gymnelis*, *Fierasfer*, and *Encheliophis*, the last-named being destitute of pectorals as well as ventrals.

None of these fish are of importance in an economical point of view, though their transitional characters, and the uncertainty of their true affinities have directed the attention of systematic ichthyologists towards them. The Bearded Ophidium, which is a Gymnelis, and Drummond's Fierasfer, inhabit the British seas.

FAMILY III.—AMMODYTIDS.—(Plate 2, fig. 10.)

This family is composed of Sand-launces, which are elongated, scabbard-shaped, apodal fishes, with large lateral gill-openings, cycloid scales, three separate vertical fins, supported by unbranched but jointed rays, and having the anal opposite to the posterior half of the long dorsal. They have neither pyloric cœca nor a swim-bladder. *Ammodytes* is the only genus; and two species, known on our coasts by the names of Sand-eels, Horn-eels, Sand-launces, and Riggles, burrow in the moist sands when the tide ebbs, and are raked out by fishermen to serve as bait.

FAMILY IV.—GADOIDS.—(Plate 6, figs. 29, 30.)

These Thoracic Anacanths are second in importance to no family of fishes, the fisheries established for their capture yielding a great quantity of nutritive food, and being the means of training up many thousands of able and hardy seamen. The members of the family are more or less elongated, generally with tumid bellies. The ventrals are subbrachial or jugular, have seldom much spread, and are sometimes mere filaments; the dorsals are one, two, or three in number, all anacanthous; the scales are cycloid, small and soft. Card-like or rasp-like patches of teeth cover the jaws, front of the vomer, and occasionally the palatines. The branchiostegals are seven in number; the air-

are handed to the *salter*, who places a bed of salt at the bottom of a large wooden vat, and over it a layer of fish, and so on alternately, salt and fish, till the vat is filled. Above all are laid heavy stones to keep the fish beneath the pickle. After some days they are taken out, well washed, brushed, and laid in small heaps, called *clumps*, to drain. They are then spread upon the shingly beach slantingly, with the back uppermost, and exposed to the sun and air; after alternate clamping and exposure, they are built into larger heaps called *steeples*, which are taken down and rebuilt several times, on purpose that each fish may be subjected to equal pressure. The completion of this drying process, or *pining*, as it is technically called, is indicated by a white efflorescence, or *bloom*, appearing on the surface of the fish, and then the whole are transported to a dry cellar, lined with wood, where they are piled up until shipped off to market. The Yorkshire curers, who are thought to be the best, expedite the process of drying by laying the fish on wooden bars raised three feet above the ground, so as to allow a free current of air to pass below them. Fish for the Spanish market are required to be rather lightly salted, to have a pure greenish colour and transparent aspect, and to be very hard dried. Care must be taken that the fish are neither sun-burnt, blistered, nor scalded by being laid on stones that are too much heated by the sun's rays.

The same distinguished ichthyologist gives the following account of the Newfoundland fishery:—Each fisherman has a stout line of sixty or seventy fathoms' length, to which is attached a lead of five pounds. From this proceeds the *pennant*, a cord three feet long, having a copper swivel at its end, that supports the middle of the *craft*. The cord bearing this latter appellation is two and a half feet in length, is stiffened by three strips of whalebone, and has at each of its extremities a smaller swivel, to which the *gauging* of the hook is attached, the whalebone serving to keep the hooks a foot apart being so named. The men arrange themselves on the windward side of the deck, with the hooks ready baited, throw over their leads and reel out their lines, till the lead rests on the bottom. It is then drawn up, so far that the hook shall touch the bottom with the downward pitch of the vessel. The fish on taking the bait gives a slight jerk, to which the fisherman replies by a sudden pull so as to fasten the hook in the fish's mouth, and then standing back, hauls in the line, hand over hand, till the fish is landed on the deck. It is then unhooked, and thrown into a square box called a *kid;* and the hooks being baited afresh, are hove over again. Early in the season, *clams* are the bait used, and are mostly taken from the stomachs of Cod already caught; afterwards *lobsters*, then *herring* and *sand-launce;* and in June, *capelan* are resorted to; herring coming into use again in August. While the line is descending, the fisherman picks up the Cod that he has caught and cuts out its tongue. Towards night the fish are counted out from each man's kid, and thrown into a large receptacle near the main hatch, called the *dressing kid*. Each fisherman keeps his own account, and reports to the skipper, who enters the several catches in the log-book. The dressing gang consist of a *thrvater*, a *header*, a *splitter*, and a *salter*. The three first, operating as indicated by their names, reduce the fish to the shape in which they come to market; and the salter, stationed in the hold, builds them up in alternate *kenches*, or layers of salt and fish. The decks are then washed down, and the vessel anchored and made snug for the night.

The voyage of John Cabot in 1497 led to the modern fishery on the banks of Newfoundland; and the most authentic notice of that voyage, taken by Hakluyt from Cabot's map cut by Clement Adams, reports that "especially there is great abundance of that kind of fish which the savages call *Baccalaos*"—a name of Basque origin, by which, with little change, the Spaniards designate the Cod to this day. Ramusio in his third volume, published in 1565, says with the enchantment lent to his view by distance, that the *Bacchalaos* are in such quantities on the coast of Newfoundland, as at times not to leave room for a carvel to pass! and that the Bretons and Normans call these fish *Molve*, and go every year to derive great profit from the fishery. The voyage of Verazzano in 1524 led to the subjects of France engaging in this fishery; and at first the Bretons seem to have sent more vessels to Newfoundland than the English. In 1578, according to Mr. Anthonie Parkhurst, in a letter published by Hakluyt, there were one hundred sail of Spaniards, fifty Portuguese ships, and of French and Bretons one hundred and fifty sail of small tonnage, engaged in the Newfoundland Cod-fishery, the English still being in inferior numbers, but lording it over the strangers who came into their neighbourhood, causing them to fish for them and to supply salt, in return for protection they afforded against pirates. In the present day, six thousand ships of all nations are calculated to be employed in Cod-fishing, and the produce is supposed to amount to thirty-six millions of fish prepared in various manners, the whole of which immense quantity would be replaced by the eggs of four fish coming to maturity, according to the estimate made above. M. Valenciennes says that France now employs twelve thousand seamen in four hundred vessels in taking Cod. The fishery of the United States must find occenpation for a much greater number of seamen, and Newfoundland is a great nursery for our own navy, which was valued so much even in days of compulsory service, that the fishermen while engaged in their occupation were protected from impressment.

The Haddock (*Morrhua æglefinus*) is finer on the Scottish coasts than in the southern parts of England, and is consumed in large quantities in Edinburgh, Glasgow, and other important towns. Dried in a peculiar way at Findhorn, it becomes the "Finnan Haddie," which is a northern delicacy, and is exported to London, but deteriorates greatly if kept beyond a very few days. Dried more perfectly, so as to keep longer, it is called "Speldron," a much inferior article to the other. The Finnan, Buckie, and Bervie smoked Haddocks, are the most prized. The Bib (*Morrhua lusca*), and Whiting (*Merlangus vulgaris*), are smaller but good fish, brought in great numbers to market during the season. They are used only in the fresh state. The Coal-fish (*Merlangus carbonarius*) visits

the surface more frequently than most other Gadoids, and is often taken by a bait towed after a vessel which is making some way through the water. The young Coal-fish, under the various local names of Sillock, Piltock, Kuth, Harbin, Cudden, Seth, and Ley, afford excellent sport to the angler, as they leap eagerly to a white feather, and may be caught as fast as the line can be thrown. The Lythe, or Pollack (*Merlangus pollachius*), the Hake (*Merluccius vulgaris*), the Ling (*Lota molva*), and the Torsk (*Brosmius vulgaris*), are also good fish, the last named being most abundant among the Zetland Isles; and the Hake and Ling on the Cornish coasts. Several other members of the family, of smaller size and less value, inhabit the British seas. The Burbot (*Lota vulgaris*), which is found in a few English rivers, is the only European fresh-water species. In the temperate and colder parts of the southern hemisphere, there are also various representatives of the family. In Rupert's Land a very nutritious bread is made of the eggs of a Burbot mixed with a little wheaten flour.

FAMILY V.—MACROURIDS.

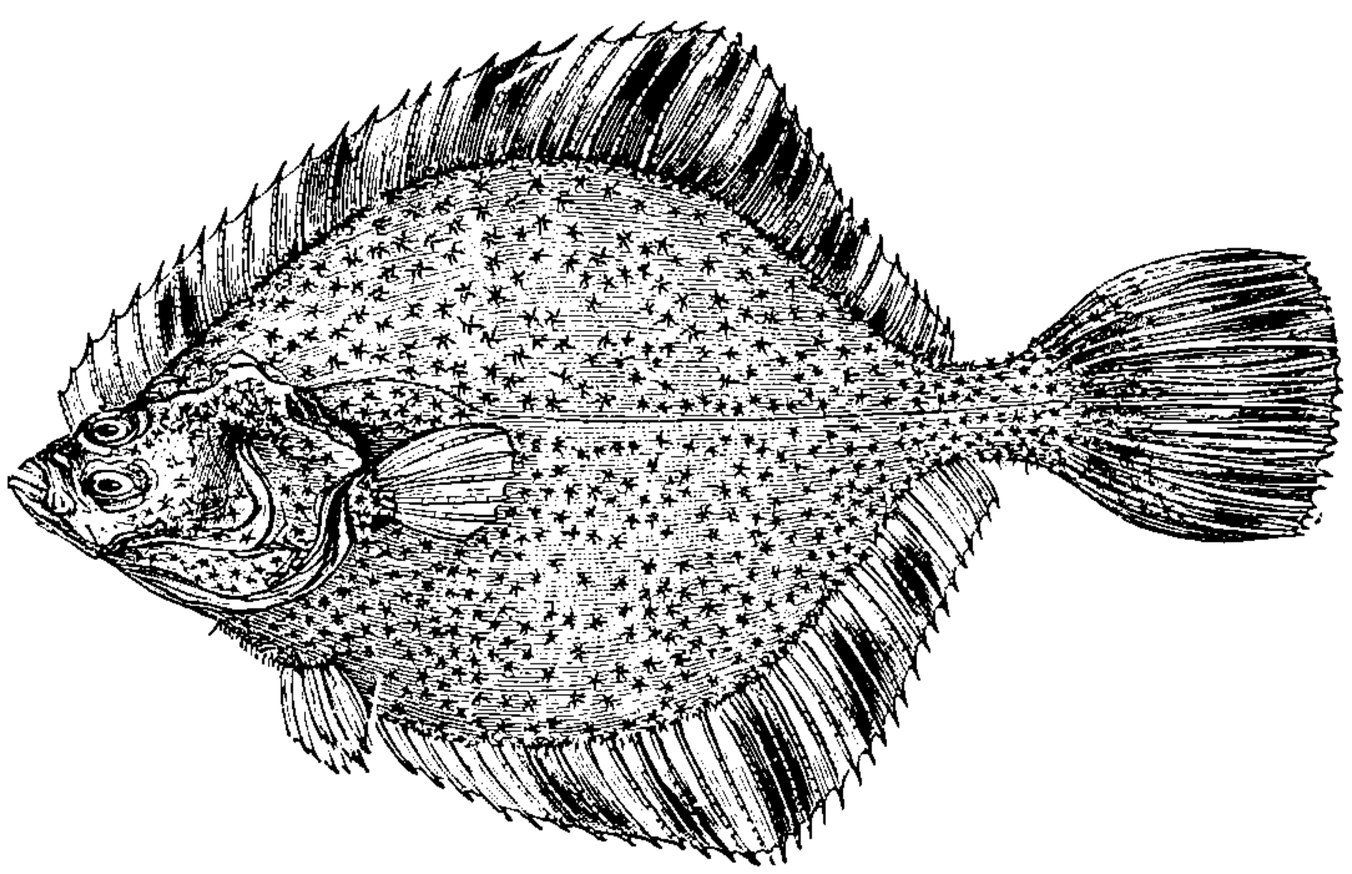
This family is composed of a single genus of fishes, *Macrourus* of Bloch, or *Lepidoleprus* of Risso, and belongs, like the Gadoids, to the Thoracic sub-order of Anacanths. By many the genus is annexed to the Gadoids, instead of being made the type of a separate family, to which distinction, however, its peculiar dermal skeleton seems to give it a strong claim. Species exist in the Greenland and Norwegian seas, in the Mediterranean, and on the coasts of Australia, but none have been detected in the British Channel, perhaps from their being inhabitants of deep water beyond the action of trawl nets. They seldom exceed a foot in length. They have the turbinals or nostril-bones largely developed, so as to form, by the apposition of their vertical plates, a mesial crest on the snout, which is flanked on each side by a wing-like lateral process. These bones, in conjunction with the broad reverted pre-orbitar plates, support an acute snout. The body is highest and fullest in the pectoral region, and is compressed posteriorly, tapering gradually into the thin acute pointed tail, at whose tip the broad anal and long second dorsal unite, without any separate caudal being interposed. Teeth villiform; mouth inferior, behind the projecting snout, with a barbel on the chin. The premaxillaries border the anterior half of the mouth, and are protractile directly downwards, their long pedicels moving in the vault of the turbinals. The scales are armed on their discs with acute spines, and the head is encased in bones with scaly and muciferous surfaces. The Branchiostegals are six.

FAMILY VI.—PLEURONECTIDS. (FLAT-FISHES.)

Plate 6, figs. 31, 32, 33.

This family is distinguished among vertebrals by a want of symmetry—the two sides being not only dissimilar in colour, but having the lateral fins differently developed, and the bones of the base of the skull and face so twisted that the two eyes are placed one over the other on the coloured side of the fish. On this account Prince Charles Bonaparte named the family *Heterosomata* (diverse sides), and it had previously been denominated *Pleuronectidæ*, or "Swimmers on the side." In these fishes the body is very greatly compressed, so that both the ventral and dorsal edges are acute, and the sides are circumscribed in the forms of round, oval, ovate, or elliptical discs, the paler side being beneath in the usual position of the fish when swimming, and simulating the belly. The dorsal fin edges the whole back, and in some genera runs forward over the forehead to the nostrils, the anal fringing the ventral edge in the same manner. Sometimes these two fins unite at the point of the tail; in other species they fall short of the end of the back-bone, and a good-sized caudal is interposed. Branchiostegals, six. No air-bladder. There is no want of symmetry in the spinal column posterior to the scapulo-coracoid arch; the interneural and interhæmal spines are in pairs, each pair supporting one dermo-neural, or dermo-hæmal spine.

Fig. 29.



Polar Flounder (Pleuronectes glacialis.)

The genera are *Platessa* (Plaice, Fluke, Flounder); *Hippoglossus* (Holibut); *Psetta* (Turbot, Brill); *Zeugopterus* (Top-knot); *Solea* (Sole); *Monochir*; *Achirus*; *Plagusia*; *Paralicthys* (Girard); *Platichthys* (Girard); *Pleuronichthys* (Girard); *Parophrys* (Girard); and *Psettichthys* (Girard).

The Flounder family, or Pleuronectids, are of much importance in the fish-dict of England, France, and Germany, as they keep longer after death than other fish, and can therefore be safely transported to a greater distance inland. In certain districts of Eng-

land that still lie at a distance from the railways as well as from the coast, Soles are almost the only marine fish that can be procured. The Flounders and Soles come into shallow water; and on the flat sands of the Solway Firth are often taken by the women and children wading over the sank-banks, who, when the fish is felt under the naked foot, press it down until it can be grasped behind the head, and transferred to a basket. Greater quantities are captured in weirs or trawl nets; and the Turbot and Holibut which inhabit deeper water, are mostly taken by lines and hooks baited with herrings, pilchards, smelts, lob-worms, molluscs, &c.

THE TURBOT (*Psetta maxima*, or *Passer* of Valenciennes) is the most highly esteemed for the table of this family of fishes, and bears a high price in the London market, as being, while it is in season, indispensable at all formal dinner parties. Not only are great numbers of British fishermen employed in procuring this coveted article of luxury, but recourse is had to the industry of other nations for a sufficient supply to our markets. Yarrell informs us that the Dutch receive annually £80,000 for turbots carried to the London market; and the Norwegians £15,000 for lobsters, to make sauce to them. Turbot fisheries are pursued on the coasts of Scandinavia, Holland, France, and Britain. Those which are caught in rocky places are supposed to have the firmest flesh and the finest flavour.

The mode of taking Turbots by the Scarborough fishermen is described as follows by Pennant:—Each person is provided with three lines, which are coiled on a flat oblong piece of wicker-work, the hooks being baited and placed regularly in the centre of the coil. Fourteen score of hooks are attached, six feet two inches apart, to each line, by sneads of twisted horse-hair twenty-seven inches in length. In fishing there are three men to each coble, and, consequently, nine lines, which being joined together end by end, reach nearly three miles, and bear two thousand five hundred and twenty hooks. A buoy and anchor are fastened to each line, and the whole series is placed at low water across the current of flood and ebb. The best baits are herrings and lampreys—the latter being brought in the winter-time from Tadcaster. Small shell-molluscs put on the hook alive, are also favourite baits; and the Turbot will not take a bait cut from a fish that has been above twelve hours out of the sea. The lines are shot and hauled at every turn of tide; and some fishermen shoot one set of lines while they are taking up the other.

THE HOLIBUT (*Hippoglossus vulgaris*) is the largest fish of the family, and has been taken on the Scottish coast weighing three hundredweight. It is often sold in our markets under the name of Turbot, but is of inferior quality to that fish. It is very voracious, and devours cod, skates, and crustaceans, attacking even large fish and biting pieces out of them. The Holibut is sold fresh, cut in slices; and on the Norway coast the shoes are salted like herrings, or, after being slightly salted and rolled, are hung up in the shade and dried. A distinction is made of three different portions of the prepared fish—viz., the fins, which are named in Danish *raff;* the fat slices, which are called *rœckel;* and the lean ones *skare flog*. The Holibut was called *Helgar fiskar* in the old Norse language; and its English denomination has a similar meaning of Holy flounder—*but* or *bot* being the Dutch for Flounder. The *Helgar fiskar* is mentioned in the Icelandic annals as having been procured abundantly on the coast of Massachusetts by the Greenlandic discoverers of America in the eleventh century. In the following list of fishes, taken by Havelock the Dane, the Turbot, the Flounder, and the Sole are included:—

"Mani god fish ther inne he tok,
Both with neth and with hok.
He tok the *sturgiun* and the qual;
And the turbut and lax withal;
He tok the sele and the bwel;
Keling he tok, and tumberel;
Hering and the *makerel*;
The *butte*, the *schulle*, the *thornbake:*
God paniers did he make." *

FAMILY VII.—ECHENEIDANS, OR SHIP-STAYERS.

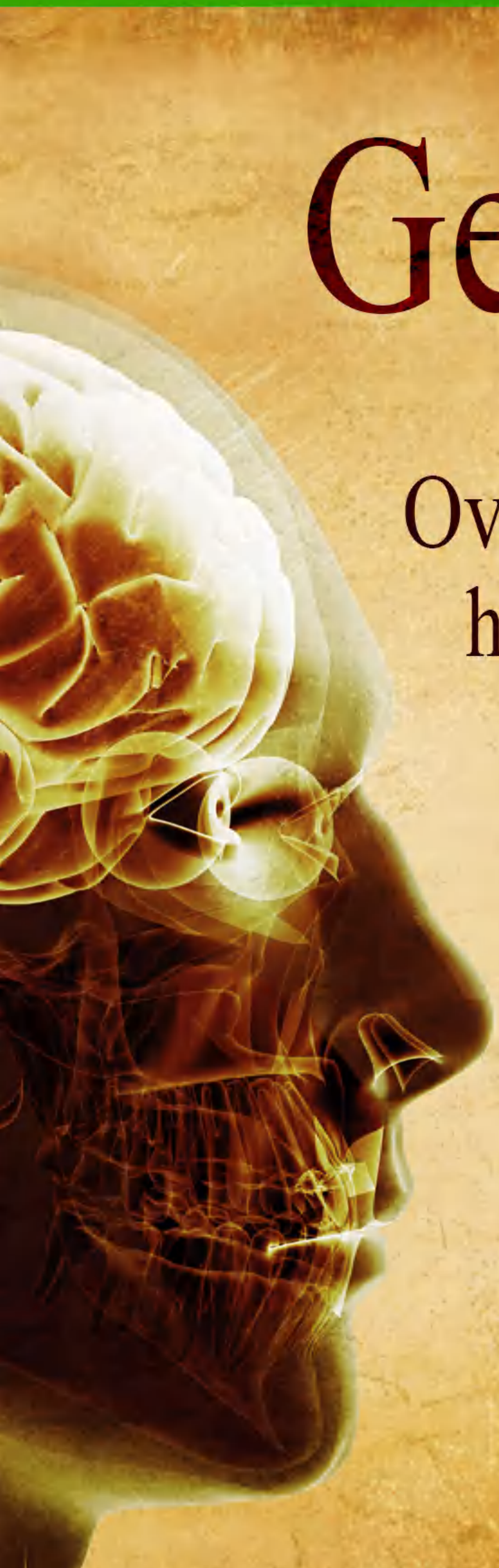
Puppis retinet in mediis Echeneis aquis.—(*Lucian*, p. 675.)

The position of this family has not been satisfactorily ascertained. Some ichthyologists considering the cephalic disc to be a modified spinous dorsal, have ranged the Echeneidans with the Squamipennes or the Scombrids. We prefer placing the group provisionally among the Anacanths. The members of the family are included in the single genus *Echeneis*, a Greek appellation, which is translated *Remora* by Pliny; and are remarkable and peculiar in having the perfectly flat top of the head occupied by an adhesive organ, by means of which the Remora attaches itself strongly to other fishes, or to rocks or ships' bottoms.

The adhesive disc is formed of pairs of transverse ridges or plaits, edged with short slender bristles. As to general form, the Echeneidans are longish, and taper towards the caudal fin, without keel or crests on the tail. The head is the widest part; and the mouth, which is small or of moderate size, is cleft horizontally. Villiform bands of teeth arm the jaws; and the vomer and tongue are likewise rough. Branchiostegals seven or eight in number. Skin smooth to the touch, but containing minute imbedded scales. Stomach large, with a bag-like projection, followed by a short, wide intestine, and a moderate number of pyloric cæca. The air-bladder is absent.

The Remora swims awkwardly; and owing to its convex throat, and flat head and nape, has the aspect of a fish with the belly uppermost. Its disagreeable appearance prevents it from being often used for food; but sailors sometimes eat it, and it is not poisonous. Seemingly it prefers being transported from place to place on ships' bottoms, or the bodies of sharks, to swimming far by its own exertions; and in the warmer parts of the ocean it avails itself of that mode of gestation in bands of nine or ten, or more individuals.

* From Notes and Queries. Second series, vi., 317.—*Qual* and *hwel*, grampus, or porpoise; *Lax*, salmon; *Scle*, seal; *Keling*, cod-fish; *Tumberel* (?), *Tumlare*, porpoise (?); *Butte*, flounder; and *Schulle*, sole.



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West Indies; and in Barbadoes they constitute an important part of the negro diet. Two thousand people of that island are estimated to live by the fisheries, and at Bridgetown fifty boats may be seen coming in of a morning, each, when fully charged, carrying three tons of fish. The fishery is carried on at some distance from the shore, during the night, with hoop nets baited with pounded fish. The Flying-fish are gutted and cleaned as they are caught. Thus prepared they keep over the day, having in that respect the advantage over most of the fish of the Caribbean seas. Some method of preserving the freshness and firmness of fish caught near the equator, and keeping them from becoming tainted before they can take the salt, is needed, before the very productive fisheries of hot climates can be of the economic value to which they might be raised. Weak sulphureous or pyroligneous acids might, perhaps, be used to advantage; and the skill of chemists could not be better directed than in seeking for some cheaper and more effective material. So much has been written eloquently on the flight of flying-fish by the lamented Humboldt, and other scientific voyagers, that we shall not enter on the subject here.

FAMILY II.—CHROMIDANS (*Chromididæ*).

The *Chromides* of Müller have an interrupted lateral line, villiform teeth, a single dorsal, and only one nostril or opening to each pituitary sac. They are short, moderately compressed, symmetrical fishes, with large ctenoid scales, spinous rays in front of the dorsal and anal, and scaly integument enveloping the bases of these fins. The ventrals have a spine in front of the five soft rays, and are situated behind the pectorals. The stomach is cæcal, and the pancreatic cæca are few in number. The family belongs to the sub-order of Acanthopterygian Pharyngognaths, and is made up of the following genera:—

Chromis, inhabiting the Nile; *Sarotheroden* (Rüppell), frequenting the Bight of Benin; and *Acara*, *Chætobranchus*, *Crenicychla*, *Geophagus*, *Heros*, all Brazilian genera, described by Heckel; also *Cycla* (Bloch) from Surinam.

The Bolti (*Chromis nilotica*) is said to be the best fish in the Nile. It is compressed, with a sub-orbicular profile. A *Crenicychla* of the fresh waters of the island of Trinidad is known locally by the name of *Le Brochet* or Pike. *Haligenes*, is a chromidan genus recently characterized by Dr. Günther.

FAMILY III.—CTENOLABROIDS (Plate 5, fig. 26).

This family, named by some *Pomacentridæ*, is composed of oval or oblong fishes, with the head forming part of the general elliptic profile. The scales are large and ctenoid, and the general aspect is neat, compact, and peculiar, so that the family is readily recognizable by those who have seen a few species. The dorsal and anal are placed on the posterior curves of the oval profile, and are supported in front by spinous rays. The naked part of the tail intervening between the three vertical fins is short and moderately high. There is only a single nostril to each pituitary sac, as in the Chromidans, and the closed air-bladder is without appendages. The ovisac opens externally by a tube that issues behind the vent. There are no caverns in the outer walls of the cranium, as in the Sciænoids; between which and the Ctenolabroids there is some resemblance in form.

The genera are—*Caprodon* (Schlegel); *Amphiprion*; *Premnas*; *Pomacentrus*; *Pristotis* (Rüppell); *Dascyllus*; *Glyphisodon*; *Etroplus*; and *Heliases*.

They are inhabitants of the warmer districts of the ocean, are of small size, do not assemble in sculls, and are not the objects of any special fishery.

FAMILY IV.—CYCLOLABROIDS (*Cyclolabridæ*). Plate 5, figs. 27, 28.

In this family cycloid scales are associated with spinous fin-rays, a combination which impairs the exactness of the distinctive characters which Agassiz had at first assigned to his ctenoid and cycloid orders. Systematists have always met with similar impediments to their grouping animals by one or two peculiarities of structure. The members of the family are more or less compressed scaly fishes, with an oval, elliptical, or oblong profile, and generally with a parallel-sided naked part of the tail intervening between the vertical fins. The ventrals are thoracic, with one spine and five branching rays. The dorsal is single, with anterior spinous rays, which have frequently membranous processes behind their tips; and there is always a distinct well-developed caudal. The lateral line is either continuous or interrupted. The jaws are covered by fleshy lips, and their dentition varies with the genera, being villiform, or subulate, or conical, and in one group incorporated with the bones so as to form horseshoe-shaped jaws, which have been compared to the bill of a parrot. The palate is smooth, without teeth, and there is one pharyngeal bone below and two above, which are armed sometimes with cylindrical teeth having flat cusps, sometimes with lamellated plates, sometimes with flat teeth simulating mosaic, and sometimes the pharyngeal teeth are card-like. The air-bladder is simple and closed, as in the rest of the order. There are no pancreatic cæca, and the eggs are discharged through a tube which opens behind the vent.

The genera are—*Labrus*; *Cossyphus*; *Crenilabrus*; *Ctenolabrus*; *Acantholabrus*; *Coricus*; *Clepticus*; *Lachnolaimus*; *Tautoga*; *Koplarchus* (*Kaup*); *Malacanthus*; *Cheilio*; *Malapterus*; *Julis*; *Chærops* (Rüppell); *Anampses*; *Gomphosus*; *Xyrichthys*; *Novacula*; *Cheilinus*; *Cirrhilabrus* (Schlegel); *Epibulus*; *Scarus*; *Callyodon*; and *Odax*.

In *Xyrichthys* and *Novacula* some of the front rays of the dorsal are detached forwards, forming, as it were, two dorsals. The British species are the Wrasse-conner (*Labrus bergylta*); the Comber Wrasse (*Labrus comber*); the Cook or Red Wrasse (*Labrus mixtus*); the Corkwing (*Crenilabrus melops*); the Corkling (*Crenilabrus pusillus*); Goldfinny (*Ctenolabrus rupestris*); the Scale-rayed Wrasse (*Acantholabrus couchii*); the Sea-wife (*Acantholabrus yarrellii*); the Rock-cook (*Acantholabrus exoletus*); and the Rainbow Wrasse (*Julis Mediterranea*). Some of these species are plentiful

on our coasts, but none are in much request for the table. They abound on the Cornish shores, and at some seasons are shipped in quantities for consumption by the poor of the eastern districts. As they are common fish in the Mediterranean, they must have been well known to the ancients; but, from the want of precise descriptions, few of the species named by the Romans can be recognized with any degree of certainty, though some of the generic names have been borrowed from ancient writers. The *Turdus* and *Merula* are supposed to have been *Labri*. Some *Crenilabri* are so brilliant that they are called in Rome at the present time *Papagelli*, or Parrakeets. Our fishermen, probably from their gay dress, also name several of the family Maids or Wives; sometimes Old Wives. The Tautog or Black-fish of New-York (*Tautoga nigra*) is much esteemed, and fetches a high price in the market. It is fed and fatted in preserves. During the winter it refuses to eat, but regains its appetite as the weather becomes warmer in the spring. Later in the season the Tautog procures its food so easily that it does not take the fishermen's hook readily. These habits are expressed by the following lines:—

> "When chestnut leaves are as big as thumb-nail,
> Then bite Black-fish without fail;
> But when chestnut leaves are as long as a span,
> Then catch Black-fish if you can."

The fishing for Black-fish is, according to Mitchill from whom these particulars are borrowed, a favourite New York pastime.

The *Epibulus insidiator* has very protractile jaws, which it suddenly thrusts out to seize any unwary insect that comes within their reach. The slyness with which it preys on the insect race has obtained for it from the Dutch of the Moluccas the appellation of *Bedrieger*, or "the deceiver," while the Malays call it Big-mouth.

The term *Scarus* is considered by Cuvier to be correctly used in modern ichthyology to designate the genus to which the celebrated *Scarus* of the ancients belonged. This fish was said to utter sounds, to have great skill in avoiding nets, and if any of its associates were inclosed, knew how to deliver them by gnawing the meshes. Aristotle adduces some reasons for believing that the *Scarus* ruminates, and that it is the only fish that does so. Pliny repeats the saying without hesitation, and adds that therefore it is the chief of fishes; and Ovid, Oppian, and others, have sung its praises in verse. Moreover, Seleucus asserts it to be the only fish that ever sleeps; and Ælian says that it is of all fishes the most strongly inflamed with love of its kind. Pliny assigns to it the Carpathian sea as its proper habitation, affirming that voluntarily it never passes the southern cape of the Troad; and Horace speaks of it as being driven into the Adriatic only by winter storms. According to Columella, it had not even at a later time passed to the westward of Faro di Messina. In the days of the Emperor Claudius, however, Optatus Elipertius brought some of these fish from the Troad, and turned them loose near the mouth of the Tiber. During five years all that were taken in nets were returned to the sea, after which they became abundant on the Italian shores. The pains that Elipertius took to bring a supply of this fish within reach of the Roman epicures, was justified by the great value set upon it. Martial speaks of the intestinal fat of a sea-fed Scarus as most excellent; and Xenocrates tells us that the viscera of a Scarus newly brought from the sea, and not kept in a vivarium, are most agreeable. The liver was in high estimation, and formed, along with the melts of murries, the brains of peacocks and pheasants, and the tongues of flamingoes, the dish named by Vitellius, "the shield of Minerva." So careful were Roman dinner-givers to have this fish perfectly fresh, that, according to Petronius, the custom was to present it alive to the guests before it was consigned to the cook. Its flesh was considered to be tender, savoury, and easy of digestion. The *Scarus Cretensis* is even in the present day esteemed as a most delicate fish by the inhabitants of Asia Minor; but it is said to be taken with difficulty, and only by highly-skilled fishermen.

FAMILY V.—EMBIOTOCIDS.

The *Embiotocidæ* of Agassiz, or *Holconoti*, are of a compressed oval shape, are clothed with middle-sized cycloid scales, and their opercular pieces are without spines or serratures. The branchiostegals are six in number, the lips are moderately thick, and the orifice of the mouth is formed above by the premaxillaries—the maxillaries being excluded. Both these bones are somewhat protractile, and support teeth, as do also the mandible and pharyngeals—the vomer and palatines being smooth. A stripe of integuments along the base of the dorsal fin on each side is destitute of scales. The fronts of the dorsal and anal are supported by spines, and there is a spine and five branching rays in the ventrals. The family name has reference to the development of the young in a manner which Agassiz considers to be analogous to that of the kangaroos.

The genera are—*Embiotoca*; *Holconotus* (Agass. in Trosch. Archiv. für Naturg., 1854, and Sillim. Journ. of Sc., 1853); *Phanerodon* (Girard); *Damalichthys* (Girard); *Abeona* (Girard); *Rachochilus* (Girard); *Heysterocarpus* (Girard); *Ennichthys* (Girard); and *Amphistichus*.

ORDER IV.—ACANTHOPTERES.

MÜLLER'S *Acanthopteri* include the greater part of the Acanthopterygians of Linnæus (certain Pharyngognaths and some other groups of soft-finned fishes being excluded). In this order the internal skeleton is indurated, but none of them, except the Tunnies, develop true bone-corpuscles in their hard parts—the

bone they form being merely the substance called "osteoid" by Kölliker. The dermal or exo-skeleton exists generally in form of ctenoid scales, though some Acanthopteres have cycloid scales, and some are destitute of scales. The ventrals are situated in the great majority of the order on the thorax, and have a spine in front. The first dorsal, or when that fin is solitary, its anterior rays and the front rays of the anal, are spinous. In many, spinous angles or processes are developed on the cranial or opercular bones, there being a considerable variety of defensive armour exhibited by different members of the order. Normally the number of branching or jointed rays in the ventrals are five, but there are many exceptions, and some families want ventrals The swim-bladder when present is closed. All the fishes of this order have a single gill-opening on each side, generally four pairs of double-ranked gills with free tips, and but one pair of valves at the root of the arterial bulb, guarding the ventriculo-arterial orifice, and no spiral rows of valves in the interior of the bulb. The maxillary bone lies behind the extremity of the premaxillary, and does not constitute any part of the upper border of the mouth.

The first sub-order of Acanthopteres has most generally ctenoid scales, there being only a few exceptions in which the scales are small, tender, and cycloid; but the other parts of their structure agreeing closely with the ctenoid genera, it has not been thought expedient to separate them. On the limits of the sub-order, genera and species destitute of scales occur.

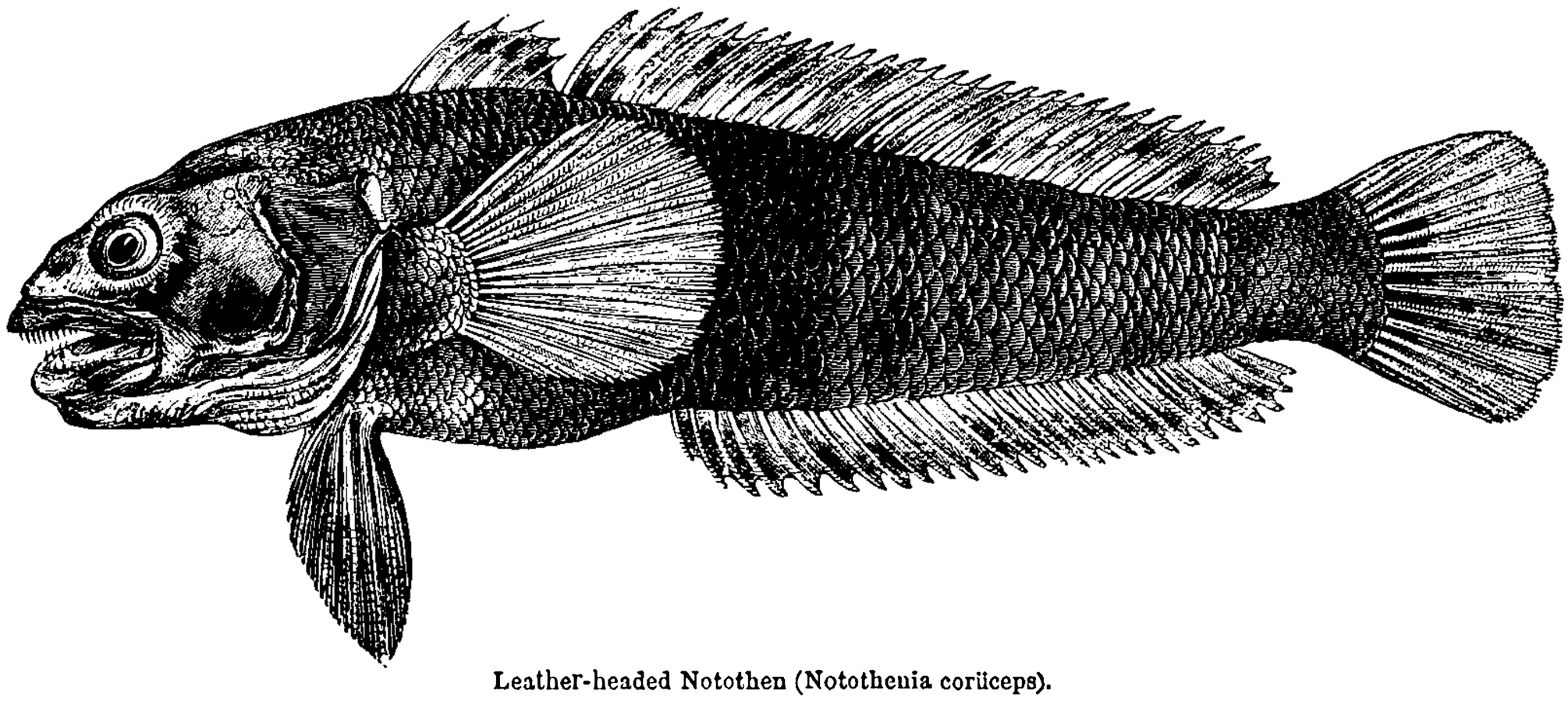
SUB-ORDER I.—CTENOID ACANTHOPTERES.

FAMILY I.—PSEUDOCHROMIDS (*Pscudochromidæ*).

THE members of this group are scaly Acanthopteres, with a long dorsal fin, preceded by a few spines either in a detached fin, or joined to the soft rays by membrane. Their lateral line is interrupted; the cheek is not cuirassed by the second sub-orbitar, and there are no sharp serratures or spines on the opercular bones. Branchiostegals six.

The family includes the following genera—*Cichlops*; *Pseudochromis*; *Pseudoplesiops* (Bleeker); *Notothenia* (Richardson).

Fig 30.



Leather-headed Notothen (Notothenia coriiceps).

Notothenia is a genus of the high southern latitudes, discovered on the antarctic voyage of Admiral Sir James Clark Ross.

FAMILY II.—URANOSCOPIANS, OR SKY-GAZERS.—(Plate 7, fig. 35.)

This family group, equivalent to the *Trachinidæ* of Bonaparte, consists of fishes whose ventrals of one spine and five soft rays are situated before the pectorals, or close behind them, and which have either a naked skin, or scales of cycloid structure. The vent is generally before the middle of the fish, so that the tail exceeds the body in length. The caudal is distinct from the other vertical fins, and the spinous dorsal is usually abbreviated, and sometimes absent. A projection of the mandible in some genera gives a vertical aspect to the orifice of the mouth, which is always terminal, and is bordered above its angles by the premaxillaries to the exclusion of the maxillaries. No sharp points or serratures exist on the sub-orbitar or preopercular pieces, but in some cases a strong spine issues from the surface of the operculum or from the shoulder-bone. The branchiostegals generally number six or seven; more rarely five. Occasionally the cavity of the abdomen is prolonged past the vent into

are firm and wholesome fish, and are more or less common in our markets. Also we reckon among the British fish the Mailed Gurnard (*Peristedion malarmat*); the Miller's Thumb (*Cottus gobio*); the Sea-scorpion or Sutor (*Acanthocottus scorpius*); the Father Lasher (*Cottus bubalis*); the Horned Bullhead (*Acanthocottus quadricornis*); the Kaniok (*Acanthocottus grœnlandicus*); the Poggie or Lyric (*Aspidophorus europœus*); the Bergylt (*Sebastes norvegicus*); the Rough-tailed Stickleback (*Gasterosteus trachurus*); the Half-mailed Stickleback (*Gasterosteus semiarmatus*); the Smooth-tailed Stickleback (*Gasterosteus leiurus*); the Short-spined Stickleback (*Gasterosteus brachycentrus*); the Four-spined Stickleback (*Gasterosteus spinulosus*); the Tinker (*Gasterosteus pungitius*); and the Bismore (*Gasterosteus spinachia*).

The Gurnards are remarkable for producing sounds by some mechanism which has not been clearly demonstrated. The fact, however, has long been known to fishermen, and has been productive of various speculations by physiologists. Many of the local names of the species have reference to the sounds they produce when in the act of being drawn from the sea. The *Prionotus pilatus* is called "Pig-fish" on the coasts of New Jersey, because of its loud croaking or barking as it is drawn to the shore in a seine. Mr. Spencer Baird, secretary of the Smithsonian Institution, who had an opportunity of witnessing the phenomenon, thought the sounds were produced in the belly of the fish. Dr. Davy has discovered flat grinding teeth in the œsophagus of the Red Gurnard.

By the great size of the pectoral fins the species of *dactylopterus*, called at Barbadoes the "Guinea-man" —(Plate 7, fig. 37)—are able to rise from the water and fly through the air like the *Exocœti* or Flying-fishes already mentioned. With such force does the *Dactylopterus* pursue its flight, that it will spring upon the deck of a ship of war; and it has been known to strike a sailor on the forehead in its flight and knock him down. In the clear waters of the Bocca Tigris, off Trinidad, great sculls of these fish may be seen near the bottom, perpetually fluttering their large wing-like pectorals. *Synanceia horrida* is the *Ikan-swangi* or Sorcerer-fish of the Malays, and *Synanceia brachio* is the abhorred *Fi-fi* of the negroes of the Mauritius. The Sticklebacks or Benticles abound in the fresh-water ponds and streams of Europe and North America, and multiply to such a degree that they are taken by cart-loads for the purpose of manuring the land. Some species inhabit the sea or fresh-water indifferently, and they flourish far within the arctic circle. In the Catalogue of Fishes in the British Museum, formed by Dr. Albert Günther in 1859, the Sticklebacks form a proper family named *Gasterosteidæ*.

Many fishes, having deposited their eggs in suitable places, visit them no more, and evince no traces of parental instinct; but this is not true of all, and both ancient and modern observers have recorded instances of the boldness and pertinacity with which certain fishes defend their progeny. The action of this instinct in the Sticklebacks has attracted attention of late years; and as these small fishes breed readily in glazed vivaria, the principal facts have been verified by several ichthyologists. Mr. Thomas Crookenden published Observations on the Nidification of the Stickleback in the "Youth's Instructor" for 1834. Signore Costa and M. Lecoq watched the proceedings of these fish in the Mediterranean in 1846, and sent accounts of what they saw to the Academie des Sciences, since published in Wiegman's "Archiven für Naturgeschichte," and in D'Orbigny's "Dictionnaire d'Histoire Naturelle." Albany Hancock, Esq., read a paper on the same subject before the Tyneside Naturalists' Field Club, and Messrs. R. Q. Couch, Kinahan, and Warrington sent interesting accounts of their observations to the "Zoologist" for 1852-54.

All the Sticklebacks, whether they are inhabitants of fresh or salt water, make nests for their eggs, and the methods the different species pursue do not differ much; though some species give a preference to one situation, others to another. The Rough and Smooth-tailed Sticklebacks, for instance, prefer a muddy or sandy foundation, while the Tinker and Bismore select a niche among the leaves or branches of water plants. Some species make a nest resembling a mole-hill in form; others construct one like a muff, open at the two ends. Signore Costa is the authority we chiefly follow in giving the ensuing details. The work of nidification is performed solely by the male Stickleback, the female taking no part in the labour; and when the spawning season arrives, the male fish, having assumed a brilliant nuptial lustre, shows extraordinary activity in securing a site for his edifice, and transporting the building materials thither. These are fragments of plants of all kinds within his reach, which he often seeks at a distance and brings home in his mouth. He arranges them so as to form a kind of carpet-work, but as there is some danger of the current carrying away the light materials, he brings sand to weigh them down and keep them in their places. Then having entwined them with his mouth to his satisfaction, he slides gently over them on his belly, with a vibratory motion of the body, and glues them together with the mucus that exudes through his pores. Having in this manner firmly established the floor of his edifice, he seeks somewhat more solid materials for the walls, sometimes bits of wood, sometimes pieces of straw, which he always seizes with his mouth, and lays either on the surface of the floor or sticks into its sides, withdrawing them and thrusting them in anew until he is satisfied; or if he cannot adapt a piece properly to his building, he carries it to some distance from the nest and rejects it. After the side walls are raised, the tiny architect proceeds to throw over the chamber a roof of the same materials with the floor; and to give firmness to the whole structure, he again and again creeps over it, and by the rapid action of his fins, and the vibratory movements of his tail, fans out the light and useless particles. In carrying on his building operations he takes care to preserve a circular opening into the chamber, often thrusting in his head and great part of his body, widening and consolidating it so as to render it a fit receptacle for the female, whose belly is distended with eggs. When choosing building material, the fish has been seen trying its specific gravity, by letting it sink once or

twice in the water, and if its descent were not rapid enough, finally abandoning it.

The time occupied in collecting building materials and constructing the nest is about four hours, and when all is ready the male proceeds to seek a female, and, having found her, "conducts her," says Signore Costa, "with many caresses and polite attentions to the prepared apartment;" or as Mr. Warrington describes his motions, "darting round her with the madness of delight."

The female enters the nest by one door, and having in a few minutes laid several eggs, escapes by the opposite outlet, leaving the eggs exposed to the current of cool water which flows through the nest. Then the male establishes himself as guardian of the precious deposit, not suffering even the female to approach it again. Every fish that comes near, even though much larger than himself, is furiously attacked; and he gives battle valiantly, striking at their eyes and seizing their fins with his mouth. His acute dorsal and ventral spines are effective weapons in these combats, and able to rip up the belly of a small fish. The constant watchfulness of the male is fully needed; for if he is removed by way of experiment, the Sticklebacks and other fish lurking in the vicinity rush with one accord upon the nest, and devour the eggs in an instant of time. For a whole month does the male parent provide for the safety of his offspring. In the first few days the openings are enlarged so as to admit a larger current of water to the eggs; and about the tenth day the male employs himself in tearing down the nest and transporting the material to some little distance. With a lens the fry at this time may be observed in motion. Round these the male guardian continually moves, suffering no encroachment; and as the young brood gain strength and show an inclination to stray beyond bounds, he drives them back within their precincts, until they are advanced enough to provide for themselves, when both old and young disappear from the place of observation.

There are several American fishes which take an equal care of their young, some of which belong to the genera *Catastomus*, *Exoglossum*, *Pomotis*, and *Pimelodus*. The species of *Exoglossum* are named "Stone-toters," because they pile up little heaps of small stones, among which they deposit their spawn. Professor Agassiz describes the operations of the *Pomotis*, or Sun-fishes, after watching them for eight successive years, as follows:—

When the breeding season approaches, a pair of Sun-fishes approach the shore of the pond in which they live, and, selecting a shallow gravelly spot overshadowed with pond-weed, water-lilies, or other aquatic plants, clear a space of about a foot across, rooting out the plants by violent jerks of their tails, and carrying away the coarser gravel in their mouths, so as to leave an area of fine sand. There the female deposits her eggs, embowered under the overhanging aquatic plants. In this inclosure one of the parents keeps watch over the eggs, driving off intruders—an office which is shared alternately by the male and female. The fierceness with which the watcher attacks an enemy, and the anxiety which it manifests for the safety of its charge, show the strength of the parental instinct. The pairs of Sun-fishes are not solitary in their selection of a breeding-place. Hundreds may be seen along the same bank of a pond establishing nests near to each other, and often separated merely by a partition of plants, living peaceably together, and passing over one another's domiciles when they go in search of food, without producing any disturbance; but an unmated fish is chased away from the nests as being an unprincipled intruder. In about a week the young are hatched, and the parents soon cease to take further care of them. The Cat-fish (*Pimelodus catus*) clears a space for the eggs like the Sun-fish, but the young brood remain longer, after being hatched, under the superintendence of the parent fish.

FAMILY IV.—SURMULLIDANS (*Mullidæ*).

Plate 7, fig. 38.

This small but very natural family is distinguishable from other groups of the same order, by two dorsals widely separated from each other by the large, strongly-ciliated, easily-detached scales of the head and body; the steep facial profile; and a pair of barbels attached to the skin under the tongue, close to the symphysis of the mandible, and retiring between the limbs of that bone when not in use. These appendages are, however, wanting in the foreign genus *Acropoma*. The preorbitar is high and narrow; the mouth is small, with feeble teeth; and the head is unarmed, except merely by an angular point of the operculum in some species; the gill opening is wide; and there are from four to seven branchiostegals. The muco-ducts of the scales forming the lateral line are arborescent. The stomach is bent like a siphon, the pylorus being at the end; and the prancreatic cæca are numerous.

The Romans named these fishes *Mulli*, because they are coloured like the bright red buskins worn by the kings of Alba, and subsequently by various Roman officials.

The genera are—*Mullus*; *Upeneichthys* (Blecker); *Upeneoides* (Bleeker); *Mulloides* (Bleeker); *Upeneus*; and *Acropoma* (Schlegel)

In the present day a well-fed Surmullet (*Mullus barbatus*) is considered to be an excellent fish, and being generally cooked with the entrails, is often called the "Sea-snipe" by epicures. It was still more highly prized by the Romans in the luxurious days of the empire. Pliny says that it surpasses other fishes in excellence and beauty; that it seldom weighs more than two pounds, and will not grow in a fish-pond. Martial speaks of a fish of this size as a costly gift, exacted from him by his mistress; and says that a Surmullet of three pounds was an object of insane admiration, while the cost of one of four pounds was a ruinous extravagance—Calliodorus having paid £10 sterling for such a fish. Seneca reports that a Surmullet of four pounds and a half being presented to Tiberius, that emperor, in an excess of economy, sent it to the market. Apicius and Octavius bid for it against one another, and the latter carried away the prize at the cost of £39 of our money. Juvenal men-

tions one weighing nearly six pounds that was obtained for £46 sterling. And the consul Asinius Celer, in the time of Caligula, paid upwards of £62 for one; on which Pliny exclaims that had the prodigious Surmullet of eighty pounds, caught by Licinius Mutianus in the Red Sea, been taken in the vicinity of Rome, what wealth the luxurious fish would have brought to the captor! At length Tiberius, in consequence of £234 sterling having been given for three Surmullets, made a sumptuary law to repress this extravagance, and to tax the provisions brought to market.

Though the Surmullets did not improve in vivaria, and bore confinement ill, the Romans took great pains to rear them; but the mortality was so great that only a few survived of several thousands put into a pond. This attempt at keeping them was made for the purpose of presenting them alive at banquets, and allowing them to swim down rivulets made to flow under the tables, or to die in glass vessels, so that the guests might enjoy the play of colours exhibited by the fish in the agonies of death. Nothing, says Seneca, is finer than a dying Surmullet. The struggles it makes against death diffuse over the body the most brilliant red tints, which end in general paleness; but in the passage from life to death, what beautiful shades of these two colours are displayed! Apicius prepared a garum from the livers of Surmullets, in which he drowned the fish presented alive on his table, and then sent it to be cooked.

FAMILY V.—POLYNEMIDS.

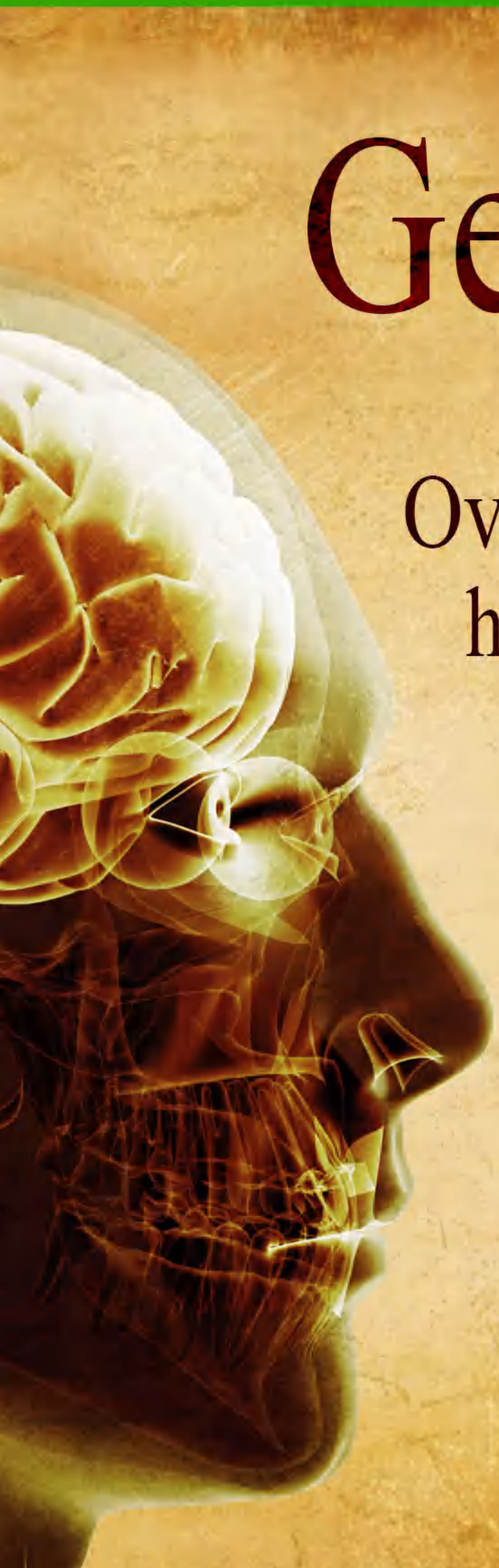
The *Polynemidæ*, equivalent to the *Polynemini* of Bonaparte, are a group of Acanthopteres, with ventrals situated on the belly, but attached to the scapulo-coracoid arch by long pubic bones. The principal genus consists of the Paradise-fishes—so named because the under pectoral rays are detached from the rest in form of tapering threads, which are as long or longer than the fish itself, and, together with the brilliant colours, produce a fancied likeness to the bird of paradise. The family name, of Greek derivation, meaning "many threads," has reference to these elongated pectoral rays. The two dorsals are far apart—the second one opposed to the anal being also at some distance from the caudal. The ctenoid scales are feebly ciliated, and extend to the head much reduced in size; the vertical fins also are scaly; with the exception of some serratures on the preoperculum there is no armature on the bones of the head. The stomach has an obtuse sac-like projection below the pylorus. The air-bladder in some species is fringed by many projections; in others it is wanting. Gill-openings wide. Branchiostegals six. *Pentanemus* and *Galeoides* are subordinate groups of the Paradise-fishes.

Some of the Polynemes are highly valued as articles of food, and among others the *Salanghi* or *Salliah* (*Polynemus tetradactylus*), which inhabits the Bay of Bengal and the coasts of the Malayan peninsula. The *Sele*, or *Ikankurow* (*Polynemus indicus*), also a frequent fish among the Malay islands, has a large thick-skinned, silvery air-bladder, with about thirty or thirty-six appendages. One of these organs taken from a fish of from four to six pounds, weighs, when dried and ready for market, two ounces, and is considered to be good isinglass, worth from twenty-five to thirty Spanish dollars per pikul. Under the name of *Loo-pa* the Chinese traders collect these air-bladders from various parts of the Indian peninsula and Malay archipelago, to sell in their native country; and the trade yields a quick return and good profit. Among the European merchants the article is named indifferently isinglass or fish-maws, and is the produce not only of the Sele, but of fish of other families; Dr. Cantor, from whom these facts are obtained, enumerates the following species as yielding fish-maws of good quality:—*Lates heptadactylus; Polynemus Indicus; Otolithus biauritus, ruber, argenteus, maculatus; Johnius diacanthus; Lobotes erate; Arius truncatus;* and *A. militaris.* In the course of ten years the export of fish-maws from Penang alone, amounted in value to nearly seventy-four thousand dollars. Crawfurd says that the price of fish-maws at Bombay is sometimes £14 per hundredweight; and that the exports from that Presidency vary from one thousand five hundred to two thousand five hundred hundredweight. Bengal exports about four thousand pounds, and Madras fifty hundredweight.

FAMILY VI.—CIRRHITIDS (*Cirrhitidæ*).

The Gurnards, and some other members of the Sclerogenid family, have the under rays of the pectorals detached from the rest, and organized like tapering, slender, flexible-jointed fingers, for examining the bottom of the sea by touch. Other fishes have sensitive tips to some pectoral rays not detached from the rest, but probably serving to direct the motions of the animal along an uneven bottom, where the eyes being on the upper aspect of the head, need such aid. A similar function is, perhaps, performed by the mandibular barbels of the Surmullets, and the long, thread-like pectoral rays of the Polynemids. The *Cirrhitidæ* are connected with these groups, by some of the rays of the pectorals having simple tapering tips extending beyond the membrane. They are Acanthopteres, with a depression at the junction of the spinous and articulated portions of the dorsal, which in some amounts to a complete separation into two dorsals. The ventrals of one spine and five branching rays are situated behind the pectorals, but their pubic bones stretch forward to the coracoids. Sometimes the preoperculum is serrated on the edge, more generally it is entire and smooth; and the operculum has often two thin, flat, bony angles, but is not armed with strong spines. The jaws are formed like those of the Percoids or Sciænoids, with terminal mouths, but are in general more protractile. Sometimes there is a cluster of teeth on the vomer, but none exist on the palatines. The scales are in some cycloid and smooth; in others, striated on the edges, or ciliated. The stomach is cæcal, and rather small; the pyloric cæca are few in number, seldom exceeding four; and the air-bladder is simple, or wholly absent.

The genera are—*Cirrhites; Cirrhitichys* (Bleeker); *Oxycirrhites* (id.); *Chironemus; Chilodactylus; Nemadactylus; Latris; Mendosoma* (Gay); and *Aplodactylus*, or *Haploductylus.*



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FAMILY VIII.—APOGONIDS (*Apogonina*, Günther).

In the method of Linnæus the genus *Perca* included a very large part of all the Acanthopteres then known, and the group was not, in the condition of the ichthyology of that day, altogether unnatural; but when additional species were discovered, and further subdivision became expedient, trenchant characters for the dismemberments could not be found. The Cuvieran families of Percoids and Sciænoids were intended to comprehend Acanthopteres without prolonged second suborbitars, but having their cranial bones or gill-covers serrated or spinous; and these two families were distinguished from each other chiefly by the presence or absence of teeth on the roof of the mouth; though this character cannot be strictly adhered to, as in many species the vomerine teeth, and in some the palatine ones also, are deciduous. Dr. Günther in his catalogue of the Percidæ (*Percœdæ*) in the British Museum, has made the Cuvieran family more nearly co-extensive with the Linnæan one, by scattering the members of the Sciænoid group among the sub-families of the *Percœdæ* and their allies. In this elementary treatise some of Dr. Günther's minor groups are treated as separate families.

The Apogonids are small or moderate-sized sea-fish, a few species only existing in fresh waters. Their scales are generally large and easily deciduous; their bodies compressed and elevated; their mouths obliquely cleft, approaching to vertical; and their gill-plates toothed or spinous. They have most generally teeth on the palate-bones, and their branchiostegals are generally seven, but sometimes only six. The dorsals are two in number.

The genera are—*Ambassis*; *Microichthys* (Rüppell); *Apogon*; *Aponichthys* (Bleeker); *Cheilodipterus*; *Scombrops* (Schlegel); *Pomatomus*; and *Acropoma* (Schlegel).

These fish are of little economical importance. Some species of *Ambassis* inhabit hot springs. In Pondicherry the *Selintan* (*Ambassis Commersonii*) is given to sick people as an excellent article of diet.

FAMILY IX.—THERAPONIDS (*Theraponidæ*).

Seven branchiostegals is the number of the typical Percoids. The Theraponids have seldom more than six—sometimes only four or five; but in their general structure and external aspect they have much similarity to the common Perch. The scales are often ctenoid, but sometimes cycloid; the opercular pieces are variously denticulate or spinous, or even unarmed. They have villiform teeth, often mixed with larger ones on the jaws, and villiform teeth also on the palatines and vomer, from which they in some cases disappear with age. The dorsals are two, or one only with the fore part spinous; and the thoracic ventrals have one spine and five soft rays. The air-bladder is in some genera contracted in the middle. Distinct pseudobranchiæ. No barbels.

The genera are — THERAPONINA — *Therapon*; *Helotes*; *Datnia*; *Pelates*; *Macquaria*; *Priacanthus*; *Lobotes*; *Scolopsis*; *Heterognathodon* (Bleeker); *Dules*; *Badis* (Bleeker); *Arlina* (Girard); *Estrella* (id.); *Alvordius* (id.); *Boleosoma* (Dekay); *Pileoma* (id.); *Lepisoma* (id.); *Paralabrax* (Girard); and *Polycentrus* (Müller).

GRYSTINA (Günther)—*Oligorus* (Günther); *Grystes*; *Homodon* or *Arripis* (Jenyns); *Huro*; *Percilia* (Girard); *Pomanotis* (Giuchenot); *Centrarchus*; *Bryttus*; *Pomotis*; *Anoplus* (Schlegel); and *Odontonectes* (Günther).

Both these groups are comprised in Dr. Günther's family of *Pristipomidæ*.

Many members of the second group, and some of the first, are inhabitants of the fresh waters of North America, Asia, or Australia. They are wholesome eating, but are not objects of special fisheries. The Trout of Carolina is the *Grystes salmoides*, which has merely a very distant resemblance to the Salmon. The Sea-trouts of Australian seas belong to the genus *Arripis*. The Trouts of the Australian rivers are, however, *Galaxias* of a totally different family.

FAMILY X.—PERCOIDS (*Percœdæ*).

The Common Perch (*Perca fluviatilis*) conveys a good notion of the aspect of this family, being the type round which Cuvier grouped the other members. With us the family is restricted to a single division of Cuvier's *Percoides*, namely, to that having seven branchiostegals and five branching rays only, with one spine in the sub-brachian ventrals. Other characters of the family are common to allied groups, such as an oblong body; clothed with ctenoid scales; opercular bones variously serrated or spiniferous; teeth on the vomer and frequently on the palatines, as well as on the jaws; fins always amounting to seven in number, or when there is a separation between the spinous and articulated dorsal, to eight; a cæcal stomach; few and not bulky pancreatic cæca; no barbels, except in one or two instances; and no extension of the second suborbitar across the cheek, as in the Sclerogenids. The skeleton is firm and hard, but is destitute of true bony corpuscles.

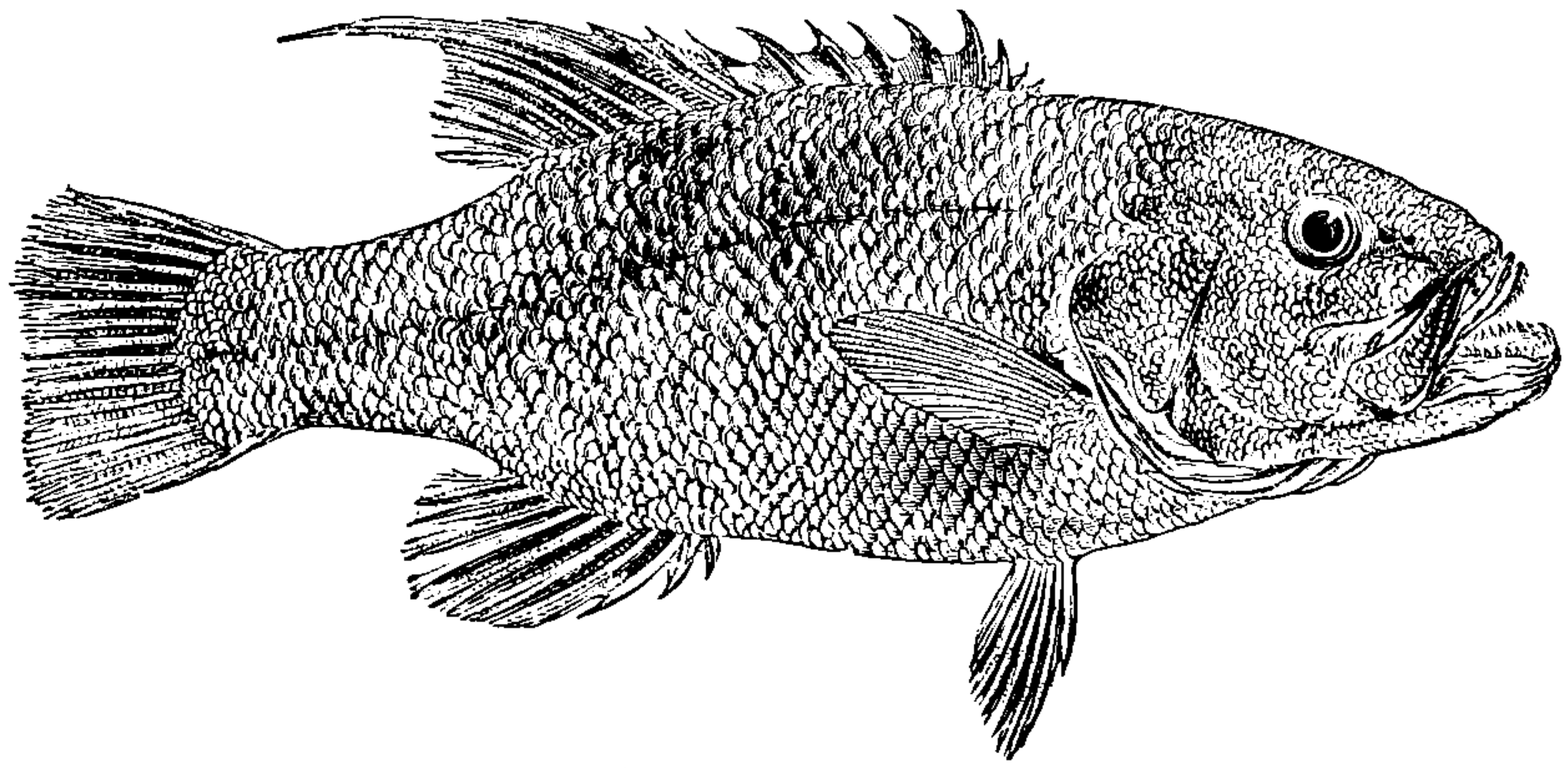
Some of the genera have two dorsals or a deep notch between the spinous and articulated portions. Such are—PERCÆNINA (Günther)—*Perca*; *Percichthys* (Girard); *Labrax*; *Lates*; *Cnidon* (Müller); *Psammoperca* (Richardson); *Percalabrax* (Schlegel); *Acerina*; *Percarina* (Nordmann); *Lucioperca*; *Aspro*; *Etelis*; *Grammistes*; *Pogonoperca* (Gunther); *Centropomus*; *Niphon*; *Enoplosus*; *Lembus* (Günther); *Oreosoma*.

Others have one dorsal only—SERRANINA (Günther)—*Aprion*; *Apsilus*; *Centropristis* (Günther); *Callanthias* (Lowe); *Anthias*; *Serranus*; *Prionodus* (Jenyns); *Plectropoma*; *Trachypoma* (Günther); *Polyprion*; *Rhyptieus*; *Aulococephalus* (Schlegel); *Diploprion*; *Myriodon* (Barneville); *Diacope* (vel *Genyoroge*, Cantor); *Mesoprion*; *Glaucosoma* (Schlegel); and *Pentaceros*.

Most of the typical Percoids are light agreeable articles of diet, and some are in high esteem. None has been more celebrated than the Basse (*Labrax lupus*). By the ancient Greeks it was so highly valued, that Archistratus calls a Basse brought from Milet, "Offspring of the gods." It had replaced the Sturgeon as highest in repute at feasts, in the days of Augustus; and it was a matter of importance to ascertain the exact locality of the capture of a Basse. At certain seasons the Basse of rivers was most prized, particularly those taken between the two bridges over the Tiber. These were the younger fish, and were

spotted. The finest were named *lanati* (woolly), because their flesh rivalled wool in softness and whiteness. According to Columella, the cultivated taste of Marcius Philippus first taught the Romans to prize the Basse that were taken while exhausting their strength in stemming the current of the Tiber; and Horace satirically asks, Whence is it that your palate can distinguish between the Tiberine Basse, and those taken at sea? and why do you dislike the older fish of that kind, when you praise insanely an over-grown Surmullet?

Fig. 32.



Jew-fish (Glaucosoma hebraicum).

To this he himself replies, that it is solely because the Basse is naturally of larger growth, and the Surmullet of less, and rarity adds to the value.

The Basse was supposed by the ancient writers to be very careful of its safety. Aristotle calls it the most cunning of fishes; and Ovid and Ælian say that when inclosed by nets, it will burrow in the sand, and allow them to pass over it. It will strike off a bait with its tail, or if caught by the hook, it will twist about so as to widen the wound, and suffer the barb to come out. It received its ancient name of *Lupus*, from its cunning, and that of *Labrax*, from its voracity. The *Keschr* (*Lates nilotica*) has been supposed to be the fish mentioned by Strabo as forming the object of worship at Latopolis, or Esnè, in Egypt, but no representation of it has been found at the temple there; and it is still doubtful whether modern ichthyologists have fixed the species correctly or not. The *Syakoup*, or *Cockup* (*Lates nobilis*), is a large Indian fish, of whose air-bladder isinglass is made; but the coats of the vessel are thin, and when dried do not exceed an ounce in weight. The *Camuri* (*Centropomus undecimalis*) is common on the warmer coasts of South America, where its roe is salted and dried in cakes, so as to form a caviare like that known in Italy and Sardinia by the name of *Botargo*, which is mostly made of the eggs of mullets or of tunnies.

As the rearing of sea-fish in fresh-water is a project of much utility, could it be extensively realized, the successful experiment of Mr. R. Poll of New York, described in the following extract from the ninth annual report of the Smithsonian Institution, is well worthy of notice:—"I have succeeded in rearing the Striped Bass (*Labrax lineatus*), known in our river as the Croton Bass, thus: Male and female were placed in a small pond, the water of which was salted twice a-week, until the small fry appeared, when the salting ceased. Sixty days afterwards the old became excessively weak, and in ten days more died. The small fry of the Bass, and also of the Shad grew rapidly, and when six weeks old were placed in a larger pond, and their progeny became fresh-water fish" (p. 322).

FAMILY XI.—HOLOCENTRIDS.

This is another group of Cuvier's Percoids, which is distinguished from the rest by having more than seven branchiostegals, and upwards of five articulated rays in the ventrals, in addition to the spine. Its members are recognizable by their general aspect, their large strongly serrated scales, the existence of sharp furrows and streaks on the bones of the skull, face, or gill-covers, the serratures or spines of the opercular bones, and the general stoutness and acuteness or angularity of the spinous fin-rays. The dorsals are single and even, or deeply notched between the spinous and articulated parts, or there are two contiguous dorsals. Several spines are incumbent on the bases of the caudal lobes above and below. The otolites or acoustic bones are large, and the air-bladder is connected with the otocrane or capsule of the internal ear, through an ossicle and the tympanum or drum. The pancreatic cæca are numerous, being from eight to twenty, or more. The group displays the more prominent characters of the ctenoid Acanthopteres.

It comprises the following genera—*Holocentrum*; *Rhynchichthys*; *Myripristis*; *Beryx*; *Anoplogaster* (Günther); *Heterophthalmus* (Bleeker); *Hoplostethus*; *Trachichthys*; *Polymixia* (Lowe), with half the usual number of branchiostegals.

Many of these have brilliant red and blue colours, or golden tints. None enter the British seas; but they are ornaments of the intertropical seas, and some of them have been named "marine gold-fish," others *matejuelo*, meaning a soldier armed *cap a piè*. One (*Holocentrum longipinne*) is called the Welshman in Jamaica, the Red-man at St. Thomas', the Cardinal at St. Domingo, and the Squirrel in Carolina; names springing from their red tints of colour.

FAMILY XII.—SPAROIDS.—(Plate 8, fig. 41, 42.)

In this family the dorsal is single, with the spinous part scaleless or nearly so, falling into a furrow when not in action, and equal to or surpassing the articulated portion in extent. The pectorals and ventrals are acute, and the caudal, which is not connected with the other vertical fins, is crescentic on its distal edge. The mouth is terminal, and when it is in the act of closing, the maxillary glides beneath the edge of the generally high preorbitar. The jaws are but little protractile, and the snout does not project beyond them. The family differs from the Sciænoids in the bones of the skull not being cellular externally, and from the Sciænoids, Percoids, and Sclerogenids, in having neither armature nor strong serratures on the gill-covers. The branchiostegals are generally six in number, sometimes five, and more rarely seven. There are no palatine teeth. The scales are peculiar, being described by Agassiz as thin, broader than they are long, with the lines of structure parallel to the posterior or free border; and circulating round a centre of growth which is situated near that edge, they become longitudinal and parallel to the sides as they proceed towards the base.

Several genera are remarkable for their flatly-rounded posterior teeth or molars, of which are—*Sargus*; *Charax*; *Chrysophrys*; *Pagrus*; *Pagellus*; *Sphærodon* (Rüppell); and *Lethrinus*.

The other genera are—*Dentex*; *Synagris* (Günther); *Pentapus*; *Cantharus*; *Box*; *Oblata*; *Boxaödon* (Guichenot); *Scatharus*; *Crenidens*; *Girella* (Gray); *Tephræops* (Günther); *Pachymetopon* (id.); *Proterocanthus* (id.); *Dipterodon*; *Doydixodon* (Valenc.); and *Gymnocrotaphus* (Günther).

The following species are British—the Gilt-head (*Chrysophrys aurata*), the Braize or Becker (*Pagrus vulgaris*), the Orphus (*P.* or*phus*), the Pagel or Sarofino (*Pagellus erythrinus*), the Bezugo (*Pagellus acarne*), the Sea Bream, (*Pagellus centrodontus*), the Sparus (*Sparus dentex*), the Choupa (*Cantharus griseus*), the Bogue (*Box vulgaris*). None of them are much prized for the table. According to Ælian and Oppian, the Sar (*Sargus Rondeletii*) is a polygamist, and fights desperately to protect his harem from other males. He constructs, they say, a bower of the leaves of marine plants, into which he compels his females to enter, and goes in last himself. Modern observation has neither proved nor disproved these reports. The *Sparulus* of the Romans, a fish held in small esteem, was, according to Cuvier, a Sparoid. Martial, comparing his own diet with that of a more luxurious feeder, says, "You eat oysters from the Lucrine ponds, I merely suck in a mussel; you dine on turbot, I on a *Sparulus* only." What the *Sparus* of the ancients was has not been as yet ascertained, but it was said to be more nourishing than most other fishes, and to be, like the *Scarus*, such delicious food, that the gods themselves did not throw away its excrements. Such praise does not belong to any of the family found in the British seas; but Dr. Mitchill, speaking of an American Sparoid called the Sheep's-head (*Sargus ovis*), says, that it is the most highly esteemed of New York fishes, and fetches the highest price, with the exception of fresh salmon and trout. Nothing, he says, can exceed boiled Sheep's-head in the opinion of a New-Yorker. This fish attains a weight of eighteen pounds. It is in season from the beginning of June till the middle of September; and is taken with the seine. As it also bites at a baited hook, fishing parties are elaborately got up for the capture of this desirable fish; and the incidents of the sport furnish the successful fishermen with topics of conversation to a distant date, much skill being required to allure and secure a Sheep's-head. Dr. Mitchill laments sorely that the want of a sufficient supply of ice often allows this valuable fish to spoil; but, as in the half century that has elapsed since Dr. Mitchill wrote ice has become more abundant in the New York markets, the Sheep's-head is not only brought cool and fresh to the hotels of that city, but is transported also to Philadelphia and more distant quarters. The fisheries established on the coasts of Long Island for its capture, are of considerable importance in an economical point of view.

The Porgee (*Sargus rhomboides*) is no less esteemed at the Bermudas, than the Sheep's-head is at New York. Fishing for Porgee is the chief amusement of the Bermudians, and parties go out to the coral reef of North Rock, forty miles from the shore, to enjoy it. The same species frequents the coasts of the United States, and the name of Porgee is extended to other Sparoids of America, such as the *Pagrus argyrops*, which is esteemed to be a most excellent fish, and is termed by Dr. Mitchill, the Big Porgee. The *Chrysophrys* of the Greeks, and *Aurata* of the Latins, is the Gilt-head of English fishermen. The most esteemed Gilt-heads were, Martial says, those which had fed on the shell-fish of the Lucrine Lake. Sergius Orata is said by Pliny to have invented Oyster-nurseries at Baia before the Marsian war; not to pamper his own appetite, but as a mercantile speculation. The same inventive genius found out hanging baths, and furbished up villas for sale. He first also pronounced the Lucrine oysters to be the best, and extolled the Basse taken between the two bridges of the Tiber, the Turbots of Ravenna, and the Murries of Sicily. His surname of *Orata* arose from his cultivation of the Gilt-head in ponds. The British shores were not yet subdued, says Pliny, when Sergius rendered the Lucrine Lake famous. The Sandwich oysters were consequently then unknown.

FAMILY XIII.—MÆNOIDS (*Mænoidæ*).
Plate 8, fig. 43, 44.

This group was considered by Cuvier to be merely a subdivision of the Sparoid family, from which its members differ chiefly in the protractility of the mouth. They have short villiform teeth on the jaws. Their premaxillary pedicels are long, and permit these bones to be thrust directly forwards when there is a corresponding length of mandible; but when the latter bone is abbreviated, then the premaxillaries incline downwards as the mouth opens, being bridled by the soft parts, and compelled to move in that direction. Some genera have no teeth on the palate, others have small ones on the vomer. The ventrals are situated under

FAMILY XV.—MUGILOIDS (*Mugilidæ*).

Plate 9, fig. 48.

This family approaches the last in having also a greater development of the pharyngeals than other fishes. The Mugiloids have cylindrical bodies with broad backs and two widely-separated dorsals, of which the first is supported by four stiff acute spines and no more. The ventrals are situated generally on the abdomen. The large scales are extended with little diminution of size to the head, as in the genus *Ophicephalus* of the preceding family. The small maxillaries are mostly concealed by a thick premaxillary lip that presses against the peculiarly-serrated preorbitar when the mouth is shut; mandible shelving, with a small cutaneous tubercle at the symphysis that fits into a notch between the premaxillaries; teeth when present so slender as to be almost invisible, and they pass through the substance of the lip. The pharyngeals are so large that they nearly fill up the gullet, and allow only soft and thin matters to pass. The branchiostegals number four, five or six, and the stomach is usually thick, like a gizzard, with a muscular ascending branch; in Nestis, however, the stomach is membranous. The pancreatic cæca are few, being mostly two, and not exceeding four.

Four genera have been characterized—*Mugil*; *Cestræus*; *Dajaus*, and *Nestis*.

The British species are the Grey Mullet or *Ramado* (*Mugil capito*); the Thiek-lipped Mullet or *Sciorino* (*Mugil chelo*); and the Short Mullet (*Mugil curtus*).

Mullets abound in the Mediterranean; and as they are welcome fish at table, they were well known to the Greeks and Romans. By the former they were named *Kestræus* or *Muxinos*, whence the Latin *Mugil* is supposed to have come. Aristotle distinguished several kinds of Mullet by the names of *Challones*, *Chelona*, *Myxon*, *Kephalos*, of which some traces survive in the Sicilian appellations of these fish as reported by Rafinesque, *Calvinu*, *Cirrinu*, *Cefalu*, and *Cefalune*. They are called also in some parts of Sicily, *Molettu*, *Lampune*, *Lustru*, and *Ozzone*. In Italy their designations are still more numerous, one Roman name being evidently a combination of two of Aristotle's epithets, viz., *Cefalo musino*. The Mullets are quiet, timid fish, that feed in small sculls; and as they approach closely to steep shores, their habits may be studied in the pellucid waters of the Mediterranean by a cautious observer. The shadow of a passing cloud, however, is sufficient to drive them away into deep water. The fishermen feed them with pounded macaroni or other farinaceous pastes; and when they have been attracted to a convenient locality, and acquired confidence by several days' undisturbed feeding, a very small hook enveloped with paste, and attached to an exceedingly fine line, is dropped noiselessly into the scull. When the bait is swallowed dexterity is required to withdraw the hooked fish without alarming the others, yet an experienced fisherman possessing a large share of patience is able to collect in a day as many as he can carry, and to gain a comfortable livelihood. Mullets afford sport to the angler during flood-tide, with which they enter rivers and rise freely to artificial flies, the gaudier the better. If inclosed in a net, they begin as soon as they discover the snare to throw themselves over the headline. The ancients supposed that the Mullets were in the habit of feeding on the mucus that exuded from their own bodies. The species are numerous in the rivers and seas of the warmer and temperate regions of both hemispheres. The roes of Mullet, compressed into cakes and dried, are sold in the Mediterranean under the designation of *Botargo*.

FAMILY XVI.—TETRAGONURIDS (*Tetragonuridæ*).

This family is founded on a single known species, the *Courpata* (*Tetragonurus Cuvieri*) of the Mediterranean, for which Cuvier had much difficulty in finding a proper station in his ichthyological system. As it has, however, several characters in common with the Mugiloids, he has placed it next that family. This fish has a lengthened, spindle-shaped body, with an obtuse snout. The first dorsal is composed of a series of very short spines, each with its proper membrane falling back into a dorsal groove; the more elevated and longitudinally abbreviated soft dorsal is opposed to an anal of similar extent and form; the ventrals are situated a little behind the pectorals, and the caudal, which is separated from the other vertical fins, has a lateral keel on each side of its base, giving a quadrangular form to a section of the tail, wholly due to the distribution of the bundles of muscles. The scales of Tetragonurus are arranged obliquely, and are grooved with the points of the ridges projecting beyond the free margin, as in the genus *Chanos*. There is no armature on the head, but many muciferous pores. The peculiarly-shaped mandible is a little shorter than the premaxillaries, and the teeth standing on both these bones are uniserial, compressed, pointed, and recurved. Teeth exist also on the chevron of the vomer adjoining the corners of the palatines and down the mesial line, in addition to which there are card-like patches on the pharyngeals; but the tongue is smooth. The stomach depends below the pylorus in form of a long narrow bag, and there is a valve in the interior of the lower intestine and round part of the anal orifice. Numerous pyloric cæca enter the ascending branch of the stomach, and the adjoining part of the small intestine. There is no swim-bladder. Mittenheim examined this somewhat anomalous fish at Messina, and came to the conclusion that the genus does not enter the Mugiloid family, nor is it a ganoid, as some have supposed, since it has neither the heart proper to that order nor a heterocercal caudal. Further examination of the brain is needed, he says, to determine its real affinities.

FAMILY XVII.—ATHERINIDANS (*Atherinædæ*).

This group consists of the genus *Atherina*, or Sand-smelt, and the similar one of *Atherinopsis* (Girard). The

species have moderately compressed, scaly, fusiform bodies, and usually a silvery stripe along the flanks. The dorsals are two—the first one supported, as in the Mullets, by only a few spinous rays, not, however, limited to four; and the ventrals are situated under the belly. The premaxillaries are very protractile, and the maxillaries taper at their distal ends—a form which prevails also in the Mugiloid family, but is unusual among other Acanthopteres. The teeth are slender and sparse. The preorbitars are not serrated like the teeth of a comb, as in the Mullets; neither have the Atherines the notch in the upper jaw, nor the corresponding mandibular knob. The membranous siphonal stomach is only a little wider than the rest of the intestinal canal; there are no pancreatic cæca; and the lining of the belly is coloured by a black pigment. The air-bladder is large; the eggs are large for the size of the fish; and the vertebræ are more than double the number of those of the Mullets.

Though the Atherines seldom exceed six or eight inches in length, yet, as they swim in sculls, and are easily taken in small-meshed nets; they are fished in quantities for sale, and are esteemed to be delicacies. The young especially, called *Nonnat* (*nouveaux nés*), in France are prepared for the table by frying in a mass, or by boiling in milk. The species are numerous in the seas of both hemispheres. One, the Sand-smelt (*Atherina presbyter*), is very abundant on the southern coasts of England, and is procured largely in Portsmouth harbour, where it frequents the mouths of sewers falling into the sea.

FAMILY XVIII.—CHÆTODONTS (*Chætodontidæ*). Plate 9, fig. 45.

Called also *Squamipennes*, are a well-marked group, composed of pretty, compressed fishes, whose vertical fins are so covered with scaly integument that the membrane is mostly hidden, leaving only the spines and the tips of the jointed rays visible. In profile the body is generally oval, sometimes so high as to be nearly orbicular; in other instances the length and obliquity of the dorsal and anal rays make the height greater than the length, and the profile is more or less rhomboidal. It is the gradual thinning off of the body into the scaly fins without a perceptible line of demarcation, that gives the peculiar aspect to the Chætodonts. Some of these fishes have serratures on the preoperculum; two genera have an unusually strong spine at the angle of that bone, and other members of the family have spines or protuberances on the forehead; but the majority are destitute of armature on the bones of the head. Very frequently some of the bones of the skeleton swell into bumps; and one genus is named "the Horseman," because the crest of the skull resembles the helmet of a cavalry soldier. These cranial bones are frequently brought to England as curiosities by seamen, and are not uncommon in museums. Usually the head is small comparatively, the shoulder of the fish sloping up high above it; the mouth especially is small; and the teeth are brush-like, or villiform, sometimes tricuspid, and in one tribe trenchant. In the typical genus the teeth resemble hairs closely set together, as the Linnæan name of *Chætodon* indicates. Most frequently the dorsal is perfectly single, the spines graduating into the front of the soft rays, which are the highest; but occasionally there is a depression or notch between the two kinds of rays. In all cases the caudal is distinct from the other vertical fins.

The beauty of the Chætodonts, as they are seen sporting among the coral rocks in the pellucid tropical seas, caused Cuvier to compare them to the humming-birds.

The genera composing the family are—*Chætodon*; *Chelmon*; *Megaprotodon* (Guichenot); *Heniochus*; *Zanclus*; *Histiopterus* (Schlegel); *Ephippus*; *Drepane*; *Scatophagus*; *Taurichthys*; *Holocanthus*; *Pomacanthus*; *Platax*; *Psettus*; *Hypsinotus* (Schlegel); *Pimelepterus*;* *Dipterodon*; *Taractes* (Lowe); *Brama*; *Nemobrama*; *Schedophilus* (Cocco) or *Crius*; *Scorpis*; *Pempheris*; *Toxotes*; *Hoplegnathus* (Richardson), or *Scarodon* (Schlegel).

One species called Ray's Sea-bream (*Brama Raii*), inhabits the British seas, and it is not very uncommon on the coasts of Scotland, Ireland, and England. It spreads even to the Norway shores, and is abundant in various districts of the Mediterranean; yet it was long supposed to be very rare indeed, and has been correctly described only very recently. It is the *Castagnollo* of the Genoese, and the *Palometa* of the Spanish fishermen, but was not named in old times so as to be recognizable now; and the only Chætodontoid ascertained to be known to the ancient Greeks or Romans, is the *Mami*, or Emperor of Japan (*Holocanthus imperator*), of which Ælian gives a good description under the name of *Citharœdus*, mentioning that it is an inhabitant of the Red Sea. The Chelmons, which inhabit the sea and rivers of the Indian Archipelago, have long slender faces, with a small terminal mouth, from which they can project a drop of water with such accuracy, as to strike insects from a distance, and cause them to fall into the water, so that they can seize them. The Chinese of Java keep these pretty fishes in vases, over which they place an insect on a thread or twig, that they may see the Chelmons bring it down. The Archers (*Toxotes*), with a much larger mouth, and a face altogether different in form, procure their prey in the same dexterous manner, and are said to be able, at the distance of three feet or more, to knock down an insect off an aquatic plant, or from the branches of a tree, by a spurt of water. The *Zanclus cornutus* is remarkable for having a horn over the eye; and it is said that if the fishermen of the Moluccas catch one, they bow the knee to it, and then return it to the water.

FAMILY XIX.—TEUTHYOIDS (*Teuthydidæ*).

These fishes have compressed, oval bodies; small mouths, which are not protractile, and uniserial teeth on both jaws, the palate and tongue being toothless. The dorsal is single, and occupies much of the back; the anal also is long; and the caudal, usually crescentic, is well separated from both. The ventrals are situated under the axillæ of the pectorals. In some genera

* *Pimelepterus*, associated with *Boridia*, form Dr. Günther's group of PIMELEPTERINA, which he ranks among the Sparoids.

there is a recumbent spine in front of the dorsal; and in several the sides of the tail are armed by one or more lancet-shaped thorns. The scales are cycloid; and the branchiostegals, usually five in number, are sometimes only four.

The genera are *Amphacanthus*, which is remarkable for having the last ray of the ventrals spinous, as well as the first one; *Acanthurus*; *Naseus*; *Prionurus*; *Axinurus*; *Priodon*; and *Keris*.

They are phytophagous fishes, all of them strangers to the European seas. A Seychelle species is known locally by the name of the "Coral Shoemaker."

FAMILY XX.—AULOSTOMIDANS (*Aulostomidæ*).
Plate 10, fig. 49, 50.

In this group the face is a prolonged tube, into whose construction there enter the nasal, vomer, preoperculum, interoperculum, pterygoids, and tympanics; the small mouth, formed as usual of the premaxillaries, maxillaries, palatines, and mandible, being suspended at the proximal end of the tube. The intestines have no remarkable dilatations, and few or no pyloric cæca; and the ribs are either short or wholly absent. The branchiostegals are few, and an air-bladder is present. In form the body varies considerably, from long and slender to short, high, and compressed. It is scaly, and in some of the family the scales are mixed with radiated plates. The dorsals are two in some genera, single in others, and are preceded by strong spines or bony shields; or they are without that kind of armature. The anal is opposed to the soft dorsal; and the caudal, which is distinct from them, has in some a long central filament.

The genera are—*Fistularia*; *Aulostoma*; *Polypterichthys* (Bleeker); *Siphonostoma* (Richardson); *Centriscus*; and *Amphisile*.

They are named vulgarly Tobacco-pipe fishes, or *Bouches-en-flute*, and in Germany *Röhrenmauler*. The Trumpet-fish or Sea-snipe (*Centriscus scolopax*) is the only species that has been discovered in the British seas, but is so rare that only six examples are known to have been taken on our coasts.

FAMILY XXI.—CEPOLIDS (*Cepolædæ*)—BAND-FISHES.—Plate 11, fig. 55.

These are ribbon-shaped or stiletto-formed fishes, possessing an anal, a pointed caudal, and a long dorsal; with small scales, and a medium-sized non-protractile mouth, which is armed with slender, acute teeth. The eyes are large or middle-sized, the stomach retort-shaped, and the pancreatic cæca (unlike those of the Scomberoids) are neither numerous nor complicated.

The genera are—*Cepola*; *Lophotes*; *Krohnius* (Cocco); *Bibronia* (id.); and *Pelori*.

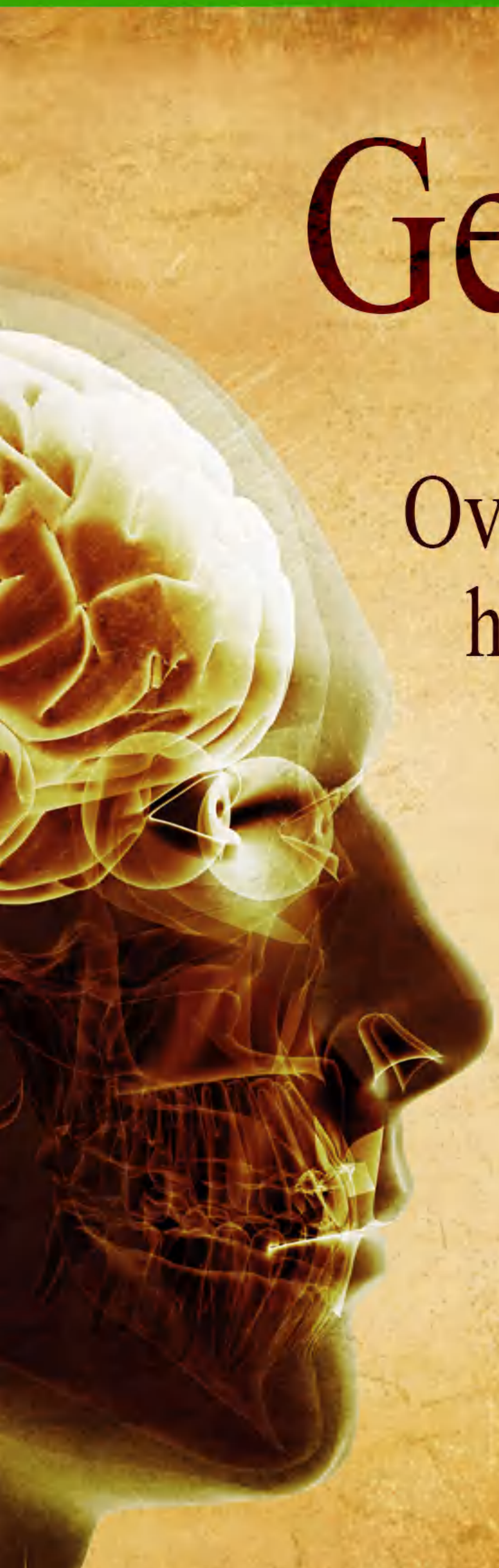
The only British species resembles the Gobioid genus *Amblyopus* in general aspect, and is rare in ordinary seasons; but in some years it is taken abundantly on the Devonshire coasts, where it is called the Red Band-fish (*Cepola rubescens*). Species of the same genus are known in the Mediterranean by the names of *Rougeole*, *Calegnairis*, *Cavagero*, *Freggia*, and *Lauria*.

FAMILY XXII.—GOBIOIDS (*Gobiidæ*).
Plate 12, fig. 59.

In this family the most characteristic genera have the ventrals united on the belly behind the pectorals into an oblique, funnel-shaped fin, by continuous membrane, which not only joins the branching rays of the two fins together, but is also stretched across in front from one spine to the other, so as to form the proximal lip of the funnel. Some of the genera, however, have distinct ventrals, and the family is characterized chiefly by the simple rays of the dorsal being slender, flexible, and not pungent, and by the simplicity of the intestinal canal, which has but very slight dilatations in its course, no cæcal protuberance of the stomach, and no pancreatic cæca. Many have a conical papilla behind the vent at the origin of the efferent duct of the reproductive organs. The head is not armed by serratures or sharp points, but the scales are often pectinated or strongly ciliated. Considerable variety exists in the form of the dorsal, which is sometimes single, sometimes double; and the caudal is in some species pointed, and united to the dorsal and anal; in others distinct and truncated, rounded, or crescentic. The teeth are very various. The branchiostegals are five in number.

The genera are—*Gobius*; *Chænogobius* (Gill); *Lepidogobius* (id.); *Euctenogobius* (id.); *Gobioides*; *Apocryptes*, *Chæturichthys* (Richardson); *Trypauchen*; *Amblyopus*; *Sicydium*; *Tridentiger* (Gill); *Trænophorus* (id.); *Periophthalmus*; *Boleophthalmus*.

The British species are the Black Goby (*Gobius niger*); the Double-spotted Goby (*G. ruthensparri*); the Freckled Goby (*G. minutus*); the One-spotted Goby (*G. unipunctatus*); the Slender Goby (*G. gracilis*); and the White Goby (*G. albus*). None of them are of the slightest importance in an economical point of view. The Gobies are not the fishes named Kobios by Aristotle, often produced at feasts, since that naturalist describes these as possessed of numerous pancreatic cæca. Cuvier was inclined to believe that Phycis (*Phukis* or *Phuca*) was the Greek name for one of the Mediterranean Gobies, and Aristotle is quoted as describing the *Phukis* to be a littoral fish, and the only marine one which constructs a nest of leaves, wherein it deposits eggs. Now Olivi reports that a male Goby of that sea, which is also the first-named of our British species, builds a nest of sea-weeds and zostera, and after the female has there placed her eggs, watches over the deposit during the period of hatching, extending his supervision to the young until they are able to shift for themselves. Many members of the family pass a part of the day on sands left wet by the ebbing tide, hunting insects and minute crustaceans, and seemingly carrying on the oxygenation of the blood by the direct action of the atmospheric air on the moist gills. Many of these fishes, perhaps most of them, can move their eyes separately, like a chameleon, turning one upwards and



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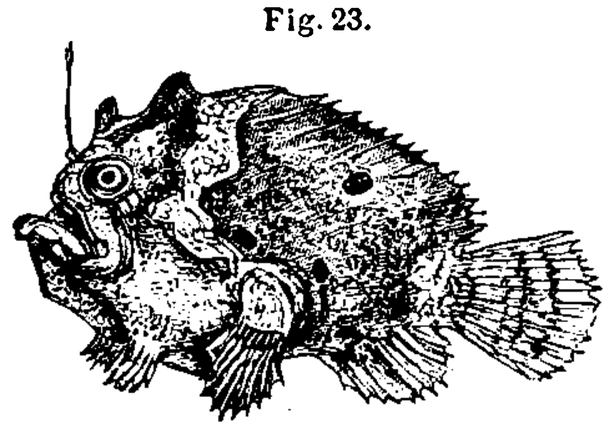
the habits of the Shanny (*Blennius pholis*):—"A specimen of this fish was brought to me on the 3rd of June. On placing it in a glass vessel of sea-water, it appeared perfectly quiet for some hours, but at length became restless, and made frequent attempts to throw itself out of the water. It then occurred to me that on a former occasion, when occupied by the sea-side, I had a Gattoruginous Blenny in a vessel with some *Actiniæ* and *Serpulæ*, which regularly passed a portion of its time on a stone; I therefore placed a pebble in the glass. The Shanny immediately leaped on it completely out of the water. It therefore appears that these changes of medium are necessary to its existence. On going to the front of the house, I perceived that it was near low water. Knowing that it would flow till ten o'clock that night, I watched the movements of my little captive, and as the clock struck, had the gratification of seeing it plunge again into its natural element. It has now been five months in my possession, and has proved throughout that period a regular and correct tide-indicator. I was well aware that these fish are constantly left by the receding tide on the rocks, remaining concealed in small basins or holes under the weed, till the returning flood; still I was not prepared to see a fish voluntarily quit the water, and pass so large a portion of its existence in a different element, and by instinct alone time its changes so exactly. Whilst in the water the colours of the Shanny are less strongly marked; but after being a short time exposed to, and inhaling atmospheric air, the colour changes to a deeper brown, and the markings become nearly black, with a regular series of white spots above and following the course of the lateral line. I have noticed that it has the power of altering its position on the stone with great facility, by means of its pectoral and ventral fins. At times it reclines on its side; at others it is perfectly erect, resting on its broad pectorals, and turning its head from side to side. It will take crumbs of bread and small earth-worms, two or three a day being sufficient. It continues in good health, and has become so familiar as to take its food from my hand; and if it is not attended to, will dash the water about to let me know that he is on the look out for his bit of meat or rice."

The Eel-pout (*Zoarces viviparus*) brings forth its young alive; and the apodal Wolf-fish (*Anarrhichas lupus*) is remarkable for its formidable teeth, and their unusual form.

FAMILY XXVI.—LOPHIOIDS (*Lophiidæ*).
Plate 12, fig. 62.

The most obvious peculiarity of the fishes of this family, is the lengthened arm which supports the pectoral fin, whence the German ichthyologists call them Arm-finners, corresponding to the French designation of fishes having pediculated or stilted pectorals. The skeletons of the Lophioids are fibrous, though but little indurated, and in some genera are in great part cartilaginous. No bone-corpuscles enter into their composition. Scales are rarely present, except in the form of tubercles, or of grains supporting spines, which occur in some genera. The sub-orbitar bones are absent; and the gill-openings are restricted to a round hole, or a short vertical slit. Most of these fishes have strange and rarely handsome forms. Some have enormously large heads; others are oval and compressed; and others again are greatly depressed, the breadth being augmented by the laterally expanded pectorals. The dorsals are two, often with some detached flexible or spinous rays on the head; more rarely there is only a

Fig. 23.



Three-spotted Cheironect (Chironectes trisignatus).

single dorsal placed far back. The ventrals have five or fewer branching rays, with or without a spine, and are mostly placed before the pectorals. The caudal is distinct from the dorsal and anal. Generally the branchiostegals are six in number. Some members of the family have gills on only three of the branchial arches; in others, four arches bear gills. Many have large stomachs; in all the pancreatic cæca are few; and the air-bladder, though present in some genera, is absent in the greater number.

The genera are—*Lophius*; *Cheironectes*, *Brachionichthys* (Bleeker); *Halieutea*; *Batrachus*; *Ceratias*; and *Chaunax*.

The only British species is the Angler, Briarbot, or Wide-gab (*Lophius piscatorius*), a fish most remarkable for the capacity of its mouth as compared to the size of its body, and the bag-like expansion of its branchiostegous membrane. Though common enough on the south-coast of England, it is often exhibited as an unknown fish. It is reported in almost all ichthyological treatises to be in the habit of attracting other fishes into its cavern-like maw, by dangling the piece of membrane attached to one of the long flexible dorsal rays, which rise from the head, as an angler does his bait or atificial fly; but I have not been able to discover any account of this process related by an eye-witness. The story occurs first in Aristotle; and Pliny instances the "Sea-frog, called the Fisher," as a notable instance of address in fishes, while the moderns have repeated the story one after the other, seemingly without inquiring into its truth. The Angler is common in muddy harbours and tideways, where its enticing bait could scarcely be visible; and when taken in such places, its stomach is generally well stored with fishes or crustaceans. It is rarely or never brought to table in England. Democritus, as quoted by Pliny, says that if the tongue of this fish be plucked out without any other part adhering to it, and the fish itself returned alive into the water, then the tongue being laid above the heart of a sleeping woman, she will give a true reply to any question put to her. We have not heard that this mesmeric process has been revived in modern times.

The Toad-fish of the United States (*Batrachus varie-*

gatus), called also Oyster-fish, derives its latter designation from its habit of depositing its roe in oyster shells, whose inhabitants have died, or on small piles of pebbles. The fish assiduously watches its eggs until they are hatched, snapping at a finger or stick thrust near to the deposit.

Sub-order II.—CYCLOID ACANTHOPTERES, or Acanthopteres with Scomberoid Scales.

This sub-order of Acanthopteres is characterized by Professor Owen in his "Palæontology" as being composed of teleostian fishes, having undivided and jointless spines at the fore part of the dorsal, and smooth, circular, or elliptical scales. It is not represented, he says, in the fossil world by any species of older date than the cretaceous epoch. In the present day the Sphyrenoid, Scombride, and Xiphiad families are its richest groups. Among these, the Tunnies are distinguished by the advanced bony composition of their skeletons, which are, nevertheless, very light, owing to the looseness of their texture.

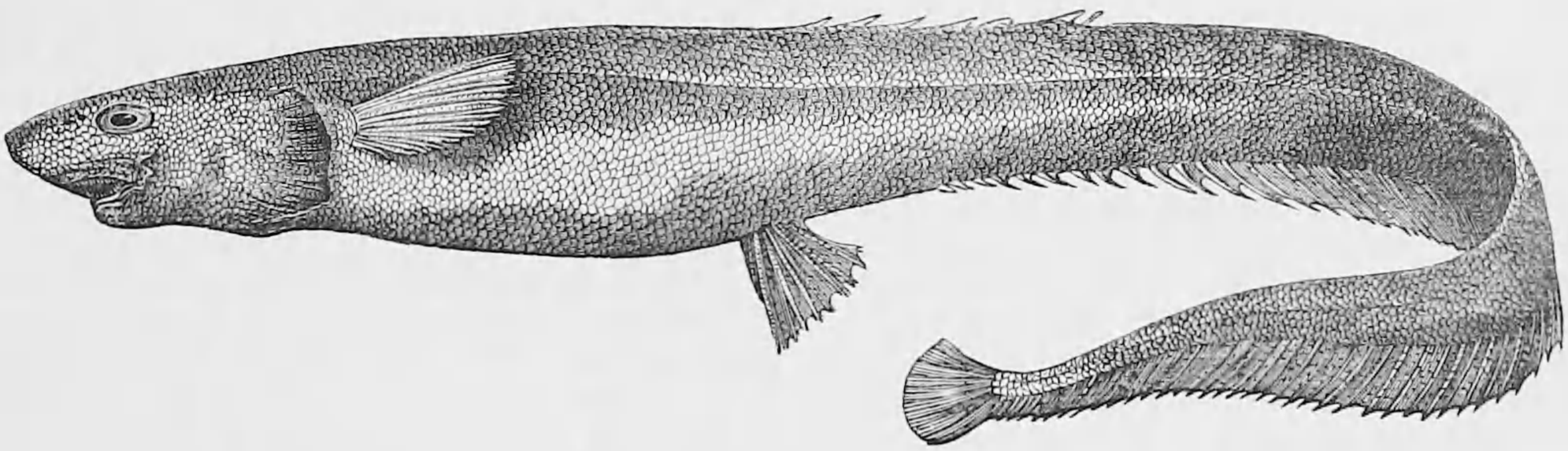
Many fish of this sub-order are among the most active swimmers of their class, and frequent the surface of the wide ocean, keeping at a distance from rocky coasts and surf, with which their delicate scales are ill-fitted to contend.

Family XXVII.—NOTACANTHS (*Notacanthidæ*).

This may be considered as an aberrant group of the sub-order, and consists of elongated, compressed fishes, which have the scapulo-coracoid arch suspended to the back-bone, as in the cartilaginous fishes, and not to the skull, as in most osseous fishes. They are either destitute of ventrals, or have these fins situated on the belly, and joined together by membrane stretching across. Their dorsal spines are isolated, and the soft dorsal is sometimes wholly absent; sometimes represented by only two minute rays in the axilla of the last spine; while in other members of the group, the soft rays are numerous. When the ventrals are present, they are each composed of a spine, and seven or eight jointed rays; but the membrane which connects the rays, and also the two fins to each other, does not, as in the Gobies, form a funnel. Cycloid scales cover the head and body, and partially the fins also. A tapering or conical snout projects beyond the mouth, which is cleft horizontally to a moderate extent. Only slight armature exists on the head, the opercular pieces being hidden under the scaly integument. The tolerably wide gill-openings are situated towards the ventral aspect, being closed above and behind by the scaly integument. The stomach is cæcal; the pancreatic cæca are few; and the bones contain no osseous corpuscles.

The genera are—*Notacanthus*; *Mastacembelus*, and *Rhynchobdella*.

Fig. 35.



Australian Spine-back (Notacanthus sex-spinis).

The first-named genus is represented by one species in the Greenland seas, and by another on the coasts of Australia, but none of the family have been detected in the British seas.

Family XXVIII.—SCABBARD-FISHES (*Gempylidæ*).—Plate 11, fig. 56.

The Scabbard-fishes, or Gempylids, are known by their greatly elongated, compressed bodies, combined with more or less of the mackerel aspect; but they have no corselet on the thorax, neither keel nor armature on the lateral line, and no caudal crests. Their heads are low, and their jaw-teeth compressed, acute, or lancet-shaped, resembling those of the *Sphyræna*. Palatine and vomerine teeth are present in some of the genera, but absent in others. The ventrals are small and rudimentary, or wholly absent. The skin is smooth and nacry, without evident scales, like the belly of a mackerel. Six or seven branchiostegals serve to extend the gill-membrane; and the stomach is a long, pointed sac—the air-bladder being also long and narrow.

Most of the members of this family were grouped by Cuvier in an appendix to his first tribe of Scomberoids, named *Trichiurini* by Bonaparte.

The genera are—*Thyrsites*; *Gempylus*; *Lepidopus*; *Trichiurus*; *Epinnula* (Poey); *Dicrotus* (Günther); *Aphanopus* (Lowe); and *Ruvettus* (Valenc).

The Scabbard-fish (*Lepidopus argyreus*) has been taken on the Devonshire coast, and is the only British member of the family. Young ones not more than ten inches in length have been seen, but the old fish exceeds five feet. One of the latter was in the act of swimming in Salcombe harbour with amazing velocity, with its head raised out of the water, when it was killed by a blow from a fisherman's oar. *Ruvettus pretiosus* of Cocco is studded with bony spines on the body.

FAMILY XXIX.—SCOMBRIDES (*Scombridæ*).

Plate 10, figs. 51, 52.

The Scomberoid or Mackerel aspect of this family is easily recognizable, proving the assemblage to be a natural one. The Tunnies, which are its most active and powerful members, have bone-corpuscles in their skeletons, and thus form a transition to the *Physostomes*, whose bony framework is generally built up of true bone, and not merely of osteoid structure, like those of the *Teleostomi*, or Acanthopteres in general.

The texture of the bones of the Scombrides is for the most part loosely fibrous, penetrated by an oily secretion, but with a small quantity of earthy matter compared to their extent of surface. This gives great lightness to the skeleton, and accords with the habits of the mackerel tribe, which live on the surface of the ocean, and delight in skipping into the air, such motions being effected by their strong caudal muscles, coloured in part with red blood. The tail at the setting on of the caudal fin, is much more slender than in other fishes, but tapers gradually from the fusiform or compressed body; and the crescentic or swallow-tailed manner in which the fin expands, gives it much power as a propeller. In many species the sides of the tail are keeled, and they are also frequently protected by a ridge of scutiform pointed plates.

The scales are in this family generally small, tender, and smooth; sometimes lost in a shining nacry surface, as in the common mackerel.

In most Scombrides the jointed portion of the dorsal fin is separated from the spines by a notch, or by a naked space, and the membranes are generally delicate, disappearing partially with age. Sometimes the spines of the dorsal stand singly, each with a small triangular membrane behind it, or without a membrane at all; and not unfrequently the posterior tufted rays of the soft dorsal and anal are similarly isolated, in which case they receive the appellation of "pinnules" (*fausses pinnules* of Cuvier). In the majority of the genera, at least two of the anal spines are detached in front of that fin. Most generally the ventrals are situated under the pectorals, but in some rare instances they are absent. Some species have a short oblique cutaneous crest on the base of each side of each lobe of the caudal fin. No armature exists on the opercular pieces of these fishes. The branchiostegals commonly number seven; sometimes, however, there are no more than six, and in other instances they amount to eight.

In the structure of the jaws, the Scombrides resemble the other Acanthopteres, in having the upper lip bordered wholly by the generally dentiferous premaxillaries. The edentulous maxillaries lie in the membrane behind, and approach the corner of the mouth only when the jaws are widely extended. They are not serrated; and a similar smoothness and absence of projecting angular points prevails in the heads of these fishes, which have very generally the form of compressed cones, adapted to swift motion through the water.

The numerous pancreatic cæca are often so conjoined as to form a tolerably compact glandular mass. Most of the Scombrides have a larger and more complicated brain than the generality of fishes. The stomach is large and cæcal, with folds of the internal membrane that greatly extend the surface. Some species have an air-bladder; others, even in the same genus, want that organ.

All these characters cannot be found in every member of the family, being variously combined in varying numbers in the different groups. The family as here restricted is less extensive, but more natural than it was as propounded by Cuvier, having been made so by the separation of some of his sections of genera.

The genera are—*Scomber*; *Thynnus*; *Auxis*; *Pelamys*, *Cybium*; *Naucrates*; *Elecate*; *Hypsiptera*; *Trachurus*; *Carangichthys*; *Caranx*; * *Argyreiosus*; *Micropteryx* (Agassiz); *Seriola* (Cuv.); *Seriolella* (Guichenot); *Seriolichthys* (Bleeker); *Nauclerus*; *Porthmeus*; *Chorinemus*; *Lichia*; *Temnodon*; *Trachinotus*; *Palinurus* (Dekay or *Pammelus*, Günther); *Paropsis* (Jenyns); *Olistes*; *Scyris*; *Lactarius*; *Pseres*; *Nomeus*; *Gasterochisma* (Richardson); *Cubiceps* (Lowe); *Neptomenus* (Günther); *Platystethus* (id.)

The British species are—the Mackerel (*Scomber scombrus*); the Spanish Mackerel (*Sc. colias*); the Dotted Mackerel (*Sc. punctatus*); the Tunny (*Thynnus vulgaris*); the Bonito (*Th. pelamis*); the Belted Bonito (*Th. brachypterus*); the Germon (*Th. alalonga*); the Plain Bonito (*Auxis vulgaris*); the Pilot-fish (*Naucrates ductor*); the Derbio (*Lichia glaucus*); and the Scad (*Trachurus vulgaris*).

The Scombrides are objects of fisheries, in the Mediterranean and other seas, as extensive and important to the maritime populations there as the herring fisheries are in the north. The Tunny is one of the largest of marine fishes, since it attains the weight of one thousand pounds or more; when under three hundred pounds, it is termed by the Sards *mezzo-tonno* or "half-tunny." Aristotle mentions one that weighed twelve hundredweight. The abundance of these fishes in the Bosphorus, is said to have been the origin of the name of Golden Horn applied to the port of Byzantium. The Tunny fishery was established in a very early age by the Phœnicians on the coasts of Spain, both on the Mediterranean and Atlantic sides of the peninsula, and the fish is represented on the medals of Carteja and Tartessus.

The Tunny fishery of Sicily has been described in a spirited manner by Brydone and Dumas, to whose

* *Megalaspis*, *Decapterus*, *Selar*, *Carangioides*, *Leioglossus*, *Uraspis Selaroides*, *Leptaspis*, and *Gnathonodon*, are dismemberments of *Caranx*, which are not adopted in the catalogues of the British Museum by Dr. Günther.

alluded to by Brydone, and found that they were not Greek, but a mere jargon not traceable to any known language. It would be well to compare them with Hebrew, as they may be a remnant of the ancient Phœnician tongue. Strabo describes this fishery, which he believes was as ancient as the days of Ulysses. The flesh of the Sword-fish is excellent, resembles beef, and is generally dressed in form of steaks. It is preserved by salting, and the fins are prepared in Sicily, and sold under the name of *Callo*. The highly-esteemed *Uræon* of the ancients was cut from the tail.

The great strength of the Sword-fish renders it a formidable enemy, and it is able to use its beak with fatal effect. It sometimes drives this weapon through the planks of a ship, and specimens of beams so transfixed are not unfrequent in museums.*

FAMILY XXXIII.—TÆNIOIDS (*Tæniædæ*).
Plate 11, fig. 57.

These are sword-shaped or tape-like fishes, with a smooth nacry skin, containing delicate microscopical scales, and bands of soft or hard tubercles imbedded in the thickness of the skin. Some have rows of superficial bony shields. The dorsal fin extends nearly the whole length of the back, and its front rays, standing on the head or nape, are generally tall. The caudal varies with the genus. The anal is absent. The ventrals are sub-brachial, and in some are small, and composed of six rays; in others very long, and consisting of only one or two rays. The jointed rays are not branched, and the rays of all the fins are so fragile that a complete specimen has scarcely ever been obtained. The mouth is small and protractile. The skeleton is fibrous, but has little compactness, and is easily injured. The stomach is prolonged below the pylorus in form of a conical bag, and the pancreatic cæca are very numerous. There is no air-bladder.

The genera are—*Trachypterus*; *Regalecus*; *Gymnetrus*; and *Stylephorus*.

The unusual forms of these fishes render them interesting. They are well named Tænioids or Ribbon-fishes, because of their thinness and length, which in some extends to between twenty and thirty feet. The tenderness of their fins, and the brittleness of their bones, unfit them for contending with a rough sea, and it is probable that their habitual residence is in the still waters of considerable depths; yet their colours are brilliant and beautiful. They are obtained chiefly after storms, by which they are thrown disabled on the shore. The British species are the Vaagmær (*Trachypterus bogmarus*), and Bank's Oar-fish (*Regalecus Banksii*).

ORDER V.—MALACOPTERES OR PHYSOSTOMES.

MALACOPTEROUS fishes have their fins supported by jointed or branching rays, not associated with spines as in the preceding order; though in some cases, and more especially in the Cyprinoid family, one or more of the dorsal rays are stout, round, tapering, and stiff, losing by age their joints, which are visible in the young fish; but in these instances the characteristic ventral spine of the Acanthopteres is absent. Another important character of this order, is *the presence of a pneumatic tube*, leading from the cavity of the air-bladder to the œsophagus or stomach—hence the appellation of Physostomes. The gills are free, with a single operculated external opening on each side, these openings being in one or two groups only; approximated on the throat so as to appear like one; the arterial bulb is valvular at its origin only; the scales are cycloid or absent; and in general the bones contain radiated, osseous corpuscles, these organisms being absent merely in a few minor groups of this order.

The Malacopteres have been divided into two sub-orders by the presence or absence of ventral fins, namely, into SERPENTIFORM APODALS (*Apodes*) and MALACOPTEROUS ABDOMINALS; the ventrals when present in this order being situated on the belly.

FAMILY I.—OPHISUROIDS (*Ophisuridæ*).
Plate 2, fig. 8; Plate 1, fig. 5.

This family belongs to the SERPENTIFORM APODALS, a group of fish in which the predominant aspect is that of a long thick worm, covered with a slimy skin, for the most part scaleless, but in two or three families producing small imbedded scales. The fins, generally long and low, are supported by simple rays, not jointed, but of a very soft texture. Some groups want the pectorals as well as the ventrals, and are therefore termed both abrachial and apodal. A few genera are destitute not only of these lateral limbs, but also of vertical fins, and therefore exhibit examples of fish wholly without fins. Ribs are not developed in any of the Serpentiform Apodals, except in the Congeroids, which have an extraordinary number of these processes.

The Ophisuroids have cæcal stomachs, that is, a bag-like protuberance beneath the pylorus of that viscus, but they have no pyloric cæca. Dr. Kaup, in his recent very complete review of the Apodal sub-order,* divides it into two sections, one having the posterior openings of the nostril-tubes exterior to the mouth, and clearly visible on the side of the face; the other having the

* The most recent instance that has come to our knowledge is that of the barque *Maud* of Tynemouth, which sprung a leak on her voyage homewards from Ceylon. She arrived in the Tyne towards the close of May, 1860, and being put into the middle dock for repairs, one of the planks under the bilge was found to have been perforated by the beak of a Sword-fish, a piece of the beak, nine and a half inches long, having been found still sticking in the wood.—*Newspaper paragraph.*

* Catalogue of Apodal Fish in the British Museum, 1856.

posterior nostrils concealed by a fold of white integument within the edge of the lip. These divisions are named respectively *phaneromycteres* or "exposed nostrils," and *cryptomycteres*, "concealed nostrils." The latter division is conterminous with the single family of Ophisuroids, which, in addition to the character derived from the position of the nostril-tube, has another in the naked tip of the tail, projecting between the upper and lower vertical fins. In some of the genera the pectorals are very small, but they are not wholly absent in any Ophisuroid. Though the gill-openings are lateral, yet as they are frequently larger in the Ophisuroids than in other members of the Serpentiform Apodal group, and are moreover placed low on the side of the neck, there is often but a very narrow interval between them on the throat. The Ophisuroids have a smooth mucoid skin, destitute of scales. In some of them small cutaneons tags fringe the upper lip, and in several the proximal ends of the nostril-tubes protrude like barbels on the side of the snout.

This family belongs to the warmer parts of both oceans. A few members of it inhabit the Mediterranean, and one species passes northwards along the Spanish coasts to the Bay of Biscay.

The genera are—*Leiuranus*; *Centrurophis*; *Pœcilocephalus*; *Microdonophis*; *Cœcilophis*; *Ophisurus*; *Herpetoichthys*; *Brachysomophis*; *Elapsopsis*; *Mystriophis*; *Murænopsis*; *Echiopsis*; *Leptorhinophis*; *Pisodonophis*; *Lamnostoma*; *Anguisurus*; *Sphagebranchus*; *Cirrhimuræna*; *Callechelys*; *Ichthyopus*; *Ophisuraphis*; *Myrophis*; *Muræniehthys*; and *Myrus* (Kaup. Cat.)

FAMILY II.—ANGUILLIDS (*Eel Family*).

Plate 1, fig. 6.

This group contains but one genus (*Anguilla*), and its members, the Eels, are anadromous fishes, some of them living and dying in fresh water, and migrating merely from river to lake and back again after spawning; but generally they descend in autumn from the upper streams to the estuaries, where the mixture of fresh and salt water raises the temperature, and there deposit their spawn. In the ensuing spring the young may be observed ascending rivers, in dense columns, close to the banks, swarming up the moist gates of weirs and locks, and overcoming other obstacles to their upward course. This movement is called the Eel-fare.

Lateral gill-openings, with opercula and branchiostegals; conspicuous pectorals; the end of the tail encompassed by the union of the dorsal and anal; and longish, oval, cycloid scales imbedded in the mucoid skin, transversely and obliquely, so as to resemble lattice-work—are characters of the family, and of the single genus it contains. Card-like or villiform teeth arm the jaws. Dr. Kaup has described, in his Catalogue, forty-five species, which are generally diffused in the fresh waters of both the northern and southern hemispheres, and doubtless the numbers will be greatly augmented by future ichthyologists, since hitherto collectors have given but little attention to the foreign members of the genus.

As furnishing a nourishing food, Eels are in much request, though the Celtic races generally, and some other nations, entertain a prejudice against them because of their resemblance to serpents. *Anguilla*, the Latin name for the Eel, is retained in modern Italian, and means in fact a little serpent. In the time of Juvenal Eels were consumed by the populace at Rome, but were despised by the wealthy classes on account of their feeding in the sewers. No such dislike appears to have been entertained in England in after-times; and the cellaress of Barking Abbey is ordered by the statutes of that religious house to provide "Russ aulx" (Russelet pears?) "in Lenten, to bake with Eles on Shrove Tuesday," and to have "Stubbe Eles and Nine-shaft Eles."*

In London at the present day Eels are a favourite delicacy of the working classes. Vast quantities are consumed in making a rich soup or stew, which is sold in pennyworths near coach-stands, being cooked on the spot over portable furnaces. Eel-pie houses are also numerous on the banks of the Thames, wherein this fish is served up to a higher class of customers. In Mayhew's work on London Labour, ten millions of Eels are stated to be sold annually in the metropolitan fish-markets, weighing, at six Eels to the pound, nearly one million six hundred thousand pounds. Dutch fishermen are the chief suppliers of this article of food; but considerable quantities are imported from Ireland, Eel fisheries being established on the Shannon and elsewhere in that island.† A great consumption of Eels also takes place in the manufacturing districts of England, so that altogether, though they cannot be classed as an important item in the staple food of the nation, they are useful as a variety of diet, and a cheap luxury. Eels are taken in the fenny districts by barbed spears of several prongs, which are plunged into the mud and withdrawn again, often with one or more Eels impaled on the barbs. In rivers a more regular fishery is carried on by fixing a barrier of wicker baskets across the stream. Many are also caught by hooks, baited with worms or fish, and set over-night. Frost or bright moonshine are adverse to success in this kind of fishery. The New York market, according to Dr. Mitchill, is supplied with Eels at all seasons, the fishery being carried on in summer by eel-pots, nets, or by bobbing in the evenings with a bunch of tough bait; in winter Eels are procured by spearing in the mud.

Charlevoix in his "History of Canada," iii. 170, gives the following notice of a productive Eel-fishery established above a century ago on the Saint Lawrence. In the course of the river between Quebec and Trois Rivieres a prodigious quantity of large Eels are taken in this manner. On the wet beach, exposed to the atmosphere by the ebb-tide, boxes are built at certain distances ranged opposite an inclosure of hurdles, through which the Eels cannot pass. Hedges of interlaced willows diverge from the mouth of each box and run to the line of hurdles, tufts of grass being attached to them at intervals. When the flood-tide has covered

* By Stubbe Eels were meant probably thick, short ones, and if the term nine-shaft be equivalent to "nine-eyes," the second kind of Eels were Lampreys. A *shaft monde* was a measure of length equal to about half a foot, but four and a half feet would be a very extraordinary length for eels.

† The amount of Eels brought annually by sea to London has been stated at seven hundred tons!—(Simmons' *Cur. of Food*).

the whole erection, the Eels, which always follow the edge of the stream, and are attracted by the verdure, crowd along the hurdle-palisade in vast numbers, enter between the willow-hedges, and are by them guided into the box-traps that are often filled in a single tide. These Eels, Charlevoix says, are larger than the European ones, are very oily, and whatever be the care bestowed in cooking them, always retain a wild flavour. They are supposed, he informs us, to descend from Lake Ontario, and to return thither again because of the persecution they encounter from the White Porpoises when they reach the tide-way. The descent of Eels to estuaries for the purpose of spawning was unknown to Charlevoix.

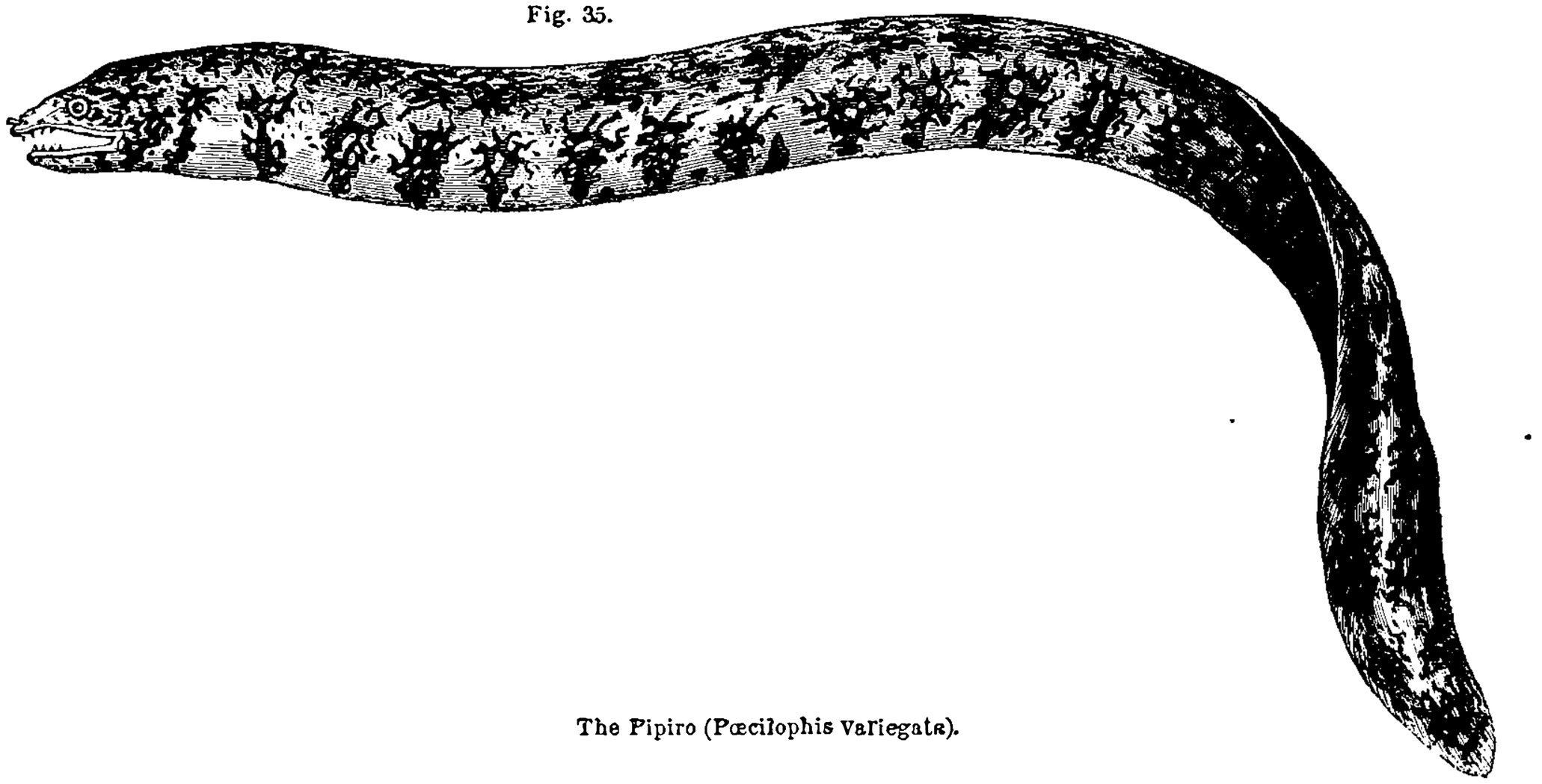
FAMILY III.—MURÆNOIDS (*Muræniæ*).
Plate 1, fig 4.

This family, like the preceding one, belongs to that division of the Serpentiform Apodals in which the posterior nasal orifices are exterior to the lips, and are exposed to view. In its members also the gill-openings are lateral, one on each side, with a considerable intermediate space below; their smooth and slippery skin is destitute of scales, and their haunts are almost exclusively marine. They are abrachial as well as apodal, and some forms, being also destitute of vertical fins, are wholly *apterous* (finless).

The dentition varies with the genus. The genera are—*Muræna*; *Sidera*; *Enchelynassa*; *Eurymyctera*; *Enchelycore*; *Thyrsoidea*; *Limamuræna*; *Polyuranodon*; *Channomuræna*; *Murænoblenna*; *Pœcilophis*; *Gymnomuræna*; *Aphthalmichthys*; *Uropterygius*; *Apterichthys*; *Primnothonus*; and *Moringua*; for an account of which the student is referred to Dr. Kaup's Catalogue.

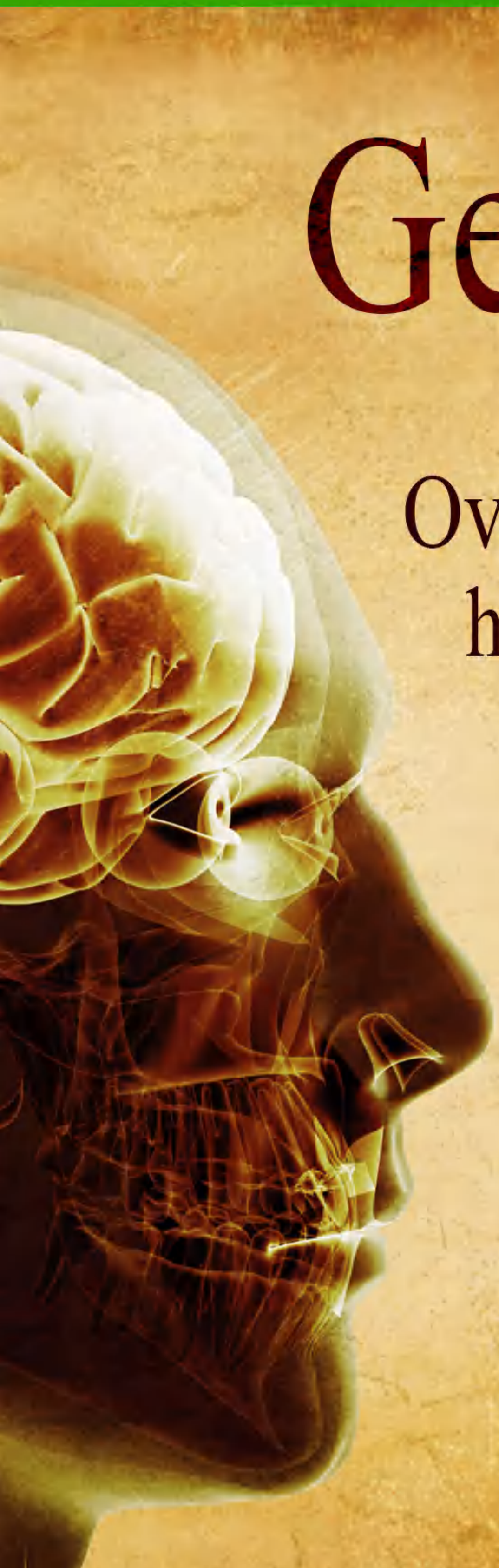
No special fishery has been established, as far as we know, for the capture of the numerous fish of this family, commonly called Murries; and we know little of their habits beyond their being bold and voracious animals. One called *Pipiro* by the natives is mentioned in the narrative of Cook's third voyage as inhabiting the reefs of Palmerston Island, and instead of shunning its pursuers, coming fiercely towards them, raising its head out of the water and attempting to bite.

Fig. 35.



The Pipiro (Pœcilophis variegata).

A Murry, which is not uncommon on both sides of the Atlantic, as well as in the Australian seas, occasionally appears off the coast of Cornwall, and is abundant in the Mediterranean; it bears the scientific appellation of *Muræna helena*. During the Empire the Romans, taking advantage of its ability to live in fresh water, kept this fish in stews; and Pliny relates in his "Natural History" that Vedius Pollio, a Roman knight, one of the intimate friends of Augustus Cæsar, proved the fierceness of these fish by throwing condemned slaves into his fish-ponds to be devoured by them; not, says Pliny, that he lacked wild animals wherewith to feed his fish, but because he was of too tender a nature to behold an entire man torn to pieces in any other way!! Caius Hirrcus, who kept stews for Murries, presented the public with six thousand of these fish when Cæsar triumphed as dictator. Licinius Crassus trained his Murries to be obedient to his voice; Hortensius Orator is said to have formed so strong an attachment to a Murry that he wept when it died; and Antonius Drusus adorned one that he loved with earrings. The Murries brought from Tartessus, which were much esteemed by the Romans, were also of the species named *Muræna helena*, which still abounds at Cadiz and the Straits of Gibraltar. Brydone says that the Murries of the Faro di Messina were the finest fish he ever ate, so that it was probably merely the greater cost of those which were obtained beyond the Pillars of Hercules that gave them so much favour in the eyes of the Romans. Pliny attributes to the Muræna the habit of leaving its ponds and travelling overland, which the common eel is known also to do. *Gymnomuræna* is entirely destitute of fins, and in *Aphthalmichthys* the only vestiges of a fin are a few soft rays at the tip of the tail. *Apterichthys cæcus* has merely rudimentary eye-balls covered with skin, and cannot possess distinct vision.



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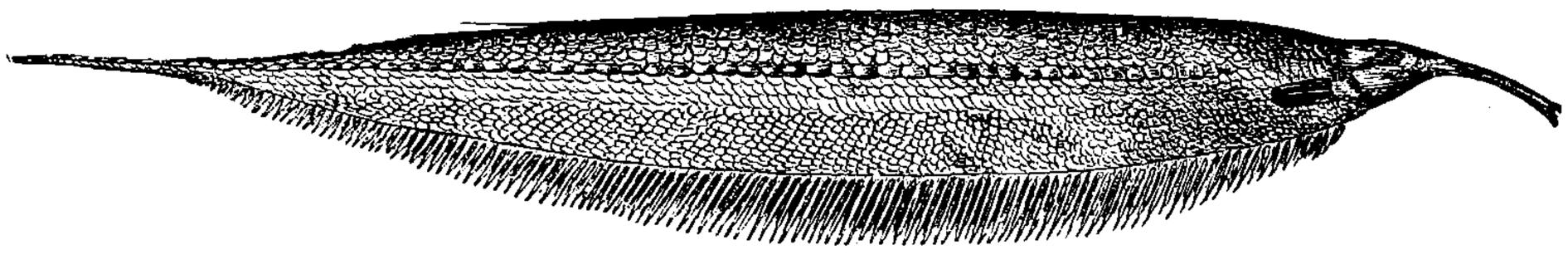
down by mucus. In the woodcut it is shown partially disengaged.

Professor Hyrtl has shown that *Gymnarchus* resembles Mormyrus in possessing a side-chamber in the bulb of the gill-artery; it has moreover a serpentiform complication of the air-bladder.

Gymnotus is the only genus of the family which is scaleless, and it is furnished with a powerful galvanic apparatus, an organ not hitherto found in scaly fishes. In the *Gymnotus*, or Electric Eel, the galvanic organ occupies about half the thickness of the tail, and is divisible into four longitudinal bundles; a thicker

Fig. 36.



Sharp-nosed Thong-fish (Sternarchus oxyrhinchus).

upper pair and a slender lower pair laid along the base of the anal fin. Each bundle is constructed of parallel membranes and horizontal discs, close to each other, including multitudes of transverse prismatic cells filled with gelatinous matter, and largely supplied with nervous filaments. Humboldt's description of the way in which the Gymnotes use their batteries is highly interesting. These fish abound, he says, in the vicinity of Calaboza in South America, and the Indians well aware of the danger of encountering them when their powers are in vigour, collect from twenty to thirty horses, drive them into the pools, and when the Gymnotes have exhausted their electric batteries on the poor horses, they can be taken without risk. Time and repose are needed before the batteries are ready to act again. The horses at first exhibit much agitation and terror, but are prevented from leaving the ponds by an encircling band of Indians who strike them with bamboos. "The eels," says Humboldt, "stunned and confused by the rush of the horses, defended themselves by reiterated electric discharges, and for some time seemed likely to gain the victory; for every now and then a horse overcome by the violence of the shocks he received, was observed to disappear under the surface of the water. Some horses, however, rose again, and though exhausted by fatigue gained the shore in spite of the exertions of the Indians, where they stretched themselves out on the ground. I remember a superb picture of a horse entering a cavern and terrified at the sight of a lion. The expression of terror there depicted was not greater than that which we witnessed in this unequal conflict; in less than five minutes two horses had succumbed, and were drowned. The eel, more than five feet long, glides under the belly of the horse and by a discharge of its electric organs attacks at once the heart, the viscera, and the gastric nerves. After such a commencement I was afraid that the fishing would end very tragically indeed; but the Indians assured me that it would soon terminate, and that the first assault of the Gymnotes was chiefly to be dreaded. In fact after a time, the eels resembled discharged batteries. Their muscular motion continued active, but they had lost the power of giving energetic shocks. When the combat had endured for a quarter of an hour the horses appeared to be less in fear; they no longer bristled up their manes, and their eyes became less expressive of suffering and terror. They were no longer seen to fall backwards, and the Gymnotes swimming with their bodies half out of the water, were now flying from the horses and making for the shore. The Indians now began to use their harpoons, and by means of long cords attached to them drew the fish out of the water, without receiving any shock so long as the cords were dry." Professor Faraday made experiments on two Electric Eels that were brought to London and kept in the Adelaide Gallery. By the galvanic currents of the fish, needles were magnetized, heat was evolved, an electric spark was obtained, and chemical decompositions effected; in short, the absolute identity of the nervous currents of the Gymnote with those of a galvanic battery or Leyden jar was completely established. Professor Owen says that when he grasped the head of the Gymnote with one hand and the tail with the other, he received a stroke which was most painfully felt at the wrists, the elbows, and across the back; but Professor Faraday showed that the nearer the hands were together within certain limits the less powerful was the shock, which was given by the parts of the fish only that intervened between the hands: the current was always from the head towards the tail. When the two examples of this fish were brought to England in 1842, neither of them weighed above a pound, but in 1848 one of them had attained to forty, and the other to fifty pounds, so that each of them had gone on nearly doubling its weight in each succeeding year. So common is the Gymnote in the neighbourhood of Uritucu, that a route at one time much frequented had been abandoued in consequence of the number of mules killed by these fishes every year in fording a stream that crossed the way.

FAMILY VII.—HETEROPYGIANS.

With this family we commence the second sub-order of Malacopteres, or that which has ventrals; and as these fins are when present in this order always situated on the belly and are not closely connected to the scapulo-coracoid arch, the sub-division has been named *Abdominales*, or *Abdominal Malacopteres*. The very forward position of the vent, on the throat, is a character which the Heteropygians possess in common with the Gymnotids, and from which they derive their appel-

lation. These fishes have also minute or rudimentary eyes, whose optical powers are very low; a simple air-bladder, communicating with the intestinal canal; a cæcal stomach; pancreatic cæca; and neither pseudo-branchiæ, nor an adipose dorsal. Agassiz is inclined to consider the group as an aberrant Cyprinoid form, but reserves his final decision on its position until he has had an opportunity of investigating the embryology of the species composing it.

In the recesses of the great cave of Kentucky, miles under ground, there are waters which no ray of sunlight ever reaches, and which are inhabited by blind insects and blind fishes. Dr. Wyman examined fourteen of these fishes (*Amblyopsis spelæus*), and in three or four of them only was he able to detect an eye-ball beneath the skin. These he dissected and found that the eye was wholly covered by areolar tissue, and was not organized to receive images of external objects. Slender optic nerves were detected, but he could not trace them to the optic lobes of the brain, though they doubtless proceeded from thence. The family comprises two genera, *Amblyopsis* and *Chologaster*, the latter having like the former a guttural vent, but possessing eyes, and wanting ventrals. It is therefore an apodal, and furnishes one of many instances in zoology of the way in which nature oversteps our artificial classification.

The Malacopteres with abdominal ventrals which follow, belong mostly to the great Linnæan genera, *Clupea*, *Salmo*, and *Cyprinus*, and are treated of in much detail in the xvii., xviii., xx., and subsequent volumes of the *Histoire des Poissons*. They have cycloid scales, a few only being scaleless; and the bones of the head, cheeks, gill-covers, and shoulder, are generally destitute of serratures and spinous points.

FAMILY VIII.—CLUPEOIDS OR HALECOIDS (*Clupeædæ*).—Plate 3, figs. 13, 17.

This, which includes the Herrings, may be considered as the most important, or at least as one of the most important families of fish, viewed in respect of the quantity of wholesome food they furnish to man. It may be characterized as follows:—Scaly abdominal Malacopteres having generally elongated and greatly compressed bodies, with thin, trenchant bellies most generally denticulated by a series of small dermal bones interposed between the points of each pair of ribs. Dorsal fin always solitary; ventrals situated near the middle of the body; no spinous rays in any of the fins. In common with the Salmonoids they have moderately long premaxillaries which join with the maxillaries to form the upper border of the mouth; the maxillaries are composed of three pieces, which separate readily. Gill-openings are on each side, large, joining the isthmus far forward between the limbs of the mandible; branchial rakers long and narrow, projecting towards the mouth; no pseudo-branchiæ. Ribs long and slender, with thread-like epipleural spines diverging from them and from the vertebral apophyses. Stomach cæcal, often fleshy; pyloric cæca numerous and long. Ova very numerous, and like the milts towards spawning time, occupying much space in the belly. Air-bladder always large and communicating through a slender tube with the point of the cæcal cone of the stomach, or in some species with the dorsal side of that viscus or of the œsophagus; rarely does the air-bladder divide posteriorly into long conical processes; its anterior end is always simple, generally pointed, and does not pass farther forward than the first spinal vertebra; neither are there any ossicles connecting it with the acoustic capsules, as in the Cyprinoids, nor has it any communication with the cavity of the skull.

The Clupeoid or Halecoid family contains the following genera—*Clupea*; *Sardinella*; *Harengula*; *Pellona*; *Pristigaster*; *Rogenia*; *Clupeonia*; *Spratella*; *Kowala*; *Meletta*; *Alausa*; *Engraulis*; *Coilia*; *Odontognathus* or *Gnathobolus*; *Chatöessus*; *Amblogaster* (Bleeker); *Clupëichthys* (id.).

This family is of great importance to man in all quarters of the world; and, of its members, the Herring (*Clupea harengus*) merits the first place. For many centuries it has been the object of a great fishery in the English seas, but the records of it go no farther back than to Anglo-Saxon times, and the Welsh appellations of the fish, *Pennog* and *Ysgaden*, or the Gaelic, *Syaden* (pronounced Scatten) have not found a place in the commercial vocabulary. Neither have the Scandinavian terms, *Sill* or *Sild*, obtained general currency. Artedi derives the Latin name *Harengus* from the German *Häring* (in Dutch *Haring*). M. Valenciennes thinks that the origin of this German word may have been the Latin *aresco*, to dry, while Pennant attributes it to the German *heer*, a host, but neither etymology is satisfactory. The Roman word, *Alec* or *Halec*, denoting any small marine fishes that are salted, as well as a *garum* made from them, could, as used by Horace, Martial, and Pliny, have no reference to the northern Herring, which does not enter the Mediterranean, yet it was the ecclesiastical name for the latter at the time of the Norman conquest. In Doomsday Book, Dunwich is taxed at *sexaginta millia alectum* (sixty thousand Herrings), and the same word, *Alec*, occurs in the work on natural history written about the year 1180 by the Abbess of Hildegard de Pinguia. The Anglo-Saxon *Hæring*, probably even more ancient than the German *Häring*, since it belongs to a maritime people, has kept its ground in England, with slightly modified spelling, and the Herring fishery can be traced to an earlier date in England than on the continent.

In the charter of foundation granted to the monastery of Barking by Erkenwald, bishop of London, circa A.D. 680, allusion is made to the salting and smoking of Herrings; the barrel is ordered to contain five hundred of them, and the levy of these fishes for the use of the monks in Lent is called herring-silver. Mention is likewise made of the Herring in the instructions for managing the revenues of the monastery of Evesham in Worcestershire, founded in 700 by Bishop Edwin. Edward the Confessor bestowed on the Abbey of Fécamp a Cheshire salt-work to provide the monks with salt for their Herrings; and at the time of the Conquest very numerous salt-pans in the Isle of Wight, and along the eastern coasts, were allotted to those who carried on the Herring fishery. Even at that early date, Yarmouth in Norfolk was the rendezvous of Herring fishers from various parts of England, France,

and Flanders. Laws were made for the regulation of the fishery, and its commencement fixed to be on the feast of St. Michael (September 29), and its close on that of St. Martin (July 4). In 1128 Henry I. appointed a mayor to govern the burgh and the fishery, and to pay over to the crown a royalty of ten thousand Herrings. Dunwich, then a strong walled town, paid twelve thousand to the monks of Ely, and twelve thousand to those of Eye; but this tax was remitted by King John, owing to the town having gone to decay through the encroachments of the sea, which now flows over its site. An act called the "Statute of Herrings" was passed in the reign of Edward III. Red Herrings and Bloaters seem to have been cured chiefly at Yarmouth, and the German commercial designation of them was "English Red Herrings in straw." King John granted a charter to Yarmouth, of which one of the conditions was the presentation of twenty-four Herring-pies to the king through the sheriff of Norwich. Red Herrings are mentioned in an inquisition held in the reign of Henry III.; and in the time of Edward I. they were sent from Yarmouth to London by the last. The best pickled Herrings were then sold at twenty the penny, fifteen Eels brought the same price, and Soles were threepence a dozen. Edward II. wrote three letters to Haco VI. complaining of the arrest and oppression of certain English merchants trading to Norway with Herrings and other commodities. The Earl of Northumberland's household book, kept in the reign of Henry VII., mentions Whyt Herring, Rede Herring, Stockfish, Saltfish, Salt Salmon, Salt Sturgeon, Salt Eels, &c., among the articles of diet to be provided for his family.

The Scotch Herring fishery was, according to Anderson, in a flourishing state in the days of Gregory the Great, contemporary with Alfred. Many acts of the Scottish parliament were passed between 1148 and 1284 for its encouragement, and for providing salt for the same; and ever since the Herring fishery has been considered to be of great national importance. The curing of Red Herrings does not appear, however, to have been at any time carried on with success in Scotland, though attempts were made to introduce it. In the reign of James VI., A.D. 1613, Archibald Campbell was privileged to bring in strangers to make Red Herrings.

Brill is the first port from whence the Dutch carried on a regular Herring fishery, and its records go no farther back than 1164. The art of salting the fish was greatly improved by William Buckelz or Beukelen of Biervliet, who died in 1397. His process gave a pre-eminence to the Dutch-cured Herrings, which they still retain, and he was considered to be so great a benefactor to his country that the Emperor Charles V. honoured his memory by visiting his tomb.

The earliest documents relating to the Herring fisheries of France are dated in 1030. The charter of the abbey of St. Catherine, near Rouen, mentions the existence in the valley of Dieppe of five salt-pans and five sheds (*salines et masures*) wherein five thousand Herrings were cured, and Robert, Duke of Normandy, granted to the abbey of Fécamp, in 1088, permission to hold a fair during the Herring season. These Norman fisheries then, and for more than a century afterwards, supplied Herrings to Paris and the country drained by the Seine. In the year 1859 the Herring fishery carried on from Boulogne employed fifteen hundred men, one hundred and nine boats, and produced four thousand five hundred and fourteen lasts of fish,* valued at £118,000.

In 1855 Scotland cured seven hundred and sixty-six thousand barrels of pickled Herrings, and exported half of that quantity—employing in the business forty thousand seaman, eleven thousand boats, and twenty-eight thousand curers and labourers. The average annual produce of the Scotch Herring fishery for forty-three years is four hundred and sixteen thousand barrels. The general sea-fisheries of Ireland, when most flourishing, employ about ninety-three thousand people; but in 1856 the number so engaged was only forty-seven thousand, and of the boats, twelve thousand. London receives annually, at Billingsgate, two hundred and seventy-eight millions of Bloaters,† and fifty millions of Red Herrings.

As the Herring has not been observed to pass Rochelle in the Bay of Biscay, the southern limit of its range may be stated at about the forty-sixth parallel of latitude, and some minor sculls only go so far; few of any consequence passing the capes of Normandy on the forty-eighth parallel. Its chief haunts are the seas encircling the British isles, or washing the coasts of Denmark, Sweden, and Norway, including the Baltic. It is comparatively a scarce fish on the coasts of Iceland, and though Herrings occur in the Arctic seas, they are of small size, and their specific identity with the true Herring has not been established by a careful comparison of specimens. The Halecoid called the Herring on the Atlantic coasts of North America, is, according to M. Valenciennes, a different species from the European one. The notion formerly entertained of the Herring descending from under the Polar ice in vast columns to the localities we have named, and then retiring again to the north to breed, was not founded on exact observation, and has been abandoned. On the contrary, it is certain that these fishes do spawn in the Channel, and in the bays and fiords that they enter; the eggs having often been found by fishermen adhering to sea-weeds, oyster-shells abandoned by the molluscs, and other substances lying at the bottom of the water; and the Herrings themselves have been occasionally observed, in shallow water, within half a mile of the shore, rubbing their bodies against stones with such vivacity, to promote the expulsion of the roe, as to detach part of their scales, while towards sun-rise the quantity of milky secretion from the milt gave a tinge to a great extent of sea. After the Herrings have deposited their eggs, they put out to sea, and do not return again towards the shore except in small sculls. A few stray ones sometimes ascend a river to the fresh-water, and instances of such occurrences

* A last of Herrings contains twenty cades, or a thousand, every thousand ten hundred, and every hundred six score. Of unpacked Herrings, eighteen barrels make a last.—(Mortimer's *Dictionary of Commerce.*)

† "Blote," according to Hallowel, means "dried;" and "bloat," "dried in smoke."

the names of Common Shad, Menhaden, Hardheads, Marshbankers, Spring-herrings or Alewives, Summer-herrings, Shadines, &c. (*Alausa tyrannus*, *præstabilis*, *teres*, *menhaden*, *shadina*, &c.), some of which are largely consumed in the fresh state, and are said by Dr. Mitchill to take salt well and to be highly prized as an article of food by the people.

The Pilchard of Cornwall, which is the Sardine of commerce (*Alausa pilchardus*), is of much greater economical importance than the Shad. It is known on the coasts of Normandy and Picardy by the names of *Célérin* and *Célan*, at Bordeaux by that of *Royan*, and in the markets of Paris by that of *Harengs de Bergues*. On the coasts of Spain and Portugal and in the Mediterranean, where it is an abundant fish, it is generally termed the *Sardine*, *Sarda*, *Sardella*, &c. The best fishery for the Sardines on the French coast, is stated by M. Valenciennes to be between Belleisle and the peninsula of Quiberon. The chasse-marées in which the fishery is carried on are of eight or ten tons burthen, and have a crew of from six to ten fishermen, including a master and a brigadier or mate; the rest being working men, not sailors by profession, but Breton husbandmen who become fishers for the time. The nets are from fifteen to twenty fathoms long and two and a half deep, with meshes under an inch in diameter. Nets with small meshes are named *carabins;* and those which have meshes approaching an inch, *folles*. The head-rope is buoyed up with corks, and leads are affixed to the foot-rope to preserve the erect position of the net in the water; some fishermen, however, preferring to balance the net with the weight of a stout cable as a foot-rope. Salted fish-roe is used for bait to allure the fish to the spot, and is named *resure*, *rave*, or more commonly *rogue*. The roe of the cod is most in request for this purpose; but the roe of mackerel mixed with the pounded flesh of that fish is frequently employed—this kind of bait being brought from Norway, more especially from Drontheim. *Gueldres* and *Chevrons* are other sorts of baits formed of small crabs and fish-fry salted, but they are forbidden by law because of the great quantities of fish-fry that their employment consumes. The chasse-marée equipped and manned, stands out to sea for two or three leagues, and then the sail being lowered and the mast struck, it is kept head to wind by the action of the oars alone. After unshipping the rudder the net is payed over the stern by the master; and while the boatmen put it on the stretch by plying their oars, he throws the bait, reduced to a proper consistence, to the right and left as far as he can cast it. When the master, judging by the movements of the corks and a quantity of silvery scales appearing on the top of the water, that the net is pretty full of fish, he loosens its end from the boat to attach it to a buoy that he had fastened to the other end, and so quits it for a time. Then, having cast out in the same manner five or six nets in succession, he waits until he thinks the meshes are charged with fish, when he proceeds to take up the first net, and then the others in succession. The fish which are caught in the meshes by the neck are next disengaged and covered with salt, and the boat returns to port, where the Sardines are expeditiously landed by the aid of Breton women, who run with baskets of them on their heads. The produce of the fishery that does not find a ready market when fresh, is either salted anew, or is preserved in olive oil or melted butter, to form an article of export to all parts of Europe. The Sardines that are too large to enter the meshes of the Breton nets, proceed onwards into the Channel, increase still farther in size, and acquire the name of *Célan*, but are often confounded in the Paris markets with the common herring. On the coast of Portugal the Sardine fishery is carried on in lateen-sailed boats named bean-cods, from their shape, by English sailors. The plan of fishing is much like the French one described above, and the fish salted in bulk and carried to Lisbon, and other markets of the peninsula, where they are in great request. The Cornish fishery is described in detail in Yarrell's "History of British Fishes," and in the publications of Jonathan Couch, Esq., of Polperro, who for many years has studied the ichthyology of that coast. Three stations are particularly mentioned as points of assemblage for these fishes; one between the Lizard and the Start in Devonshire, eastward of which no regular Pilchard fishery is prosecuted; a second station lies between the Lizard and the Land's-end; and the third is off St. Ives. From five to ten thousand is considered a moderate capture in one night for a single boat, fishing with drift-nets, but the take often amounts to twenty thousand; and the quantities inclosed in sean nets are frequently such as to be scarcely credible. Borlase records the capture of three thousand hogsheads at one time, each hogshead containing from two thousand five hundred to three thousand fish; and an instance is mentioned in Yarrell where ten thousand hogsheads, amounting to twenty-five millions of fish, were carried into one port in a single day. The outfit of a sean costs about £800; of a string of drift-nets about £6 a net, and the value of the boat is from £100 to £150; and the whole capital invested in the Pilchard fishery is estimated at £450,000. The wages of the fishermen depend on the success of their labours. A pilchard or star-gazing pie, with the heads of the fish protruding through the crust, is a dish peculiarly Cornish. Camden tells us that in his day the "Pylchard" fishery was prosecuted from July to November with great success on the Cornish sea; and that the fish, when salted, smoked, and pressed, were exported in vast quantities to France, Spain, and Italy, under the name of *Fumados*.

The *Ikan-tamban* of the Malay peninsula (*Dussumicra acuta*) and *Támban nepis* or *bátul* (*Clupeonia perforata*) of the Straits of Malacca are prepared like Sardines in oil. The latter bears a close resemblance to another Clupeoid of the same seas which is very poisonous, and is itself said to be poisonous when its usually silvery eyes become red. In 1822, 1823, and 1825, many natives of Bencoolen having eaten of these red-eyed fish, were suddenly seized with violent vomiting, which, except when remedies were immediately resorted to, ended fatally in an hour. It was surmised that the poisonous fishes had fed on a gelatinous substance which at that season exudes from the beautifully-coloured coral reefs; but Dr. Cantor, who relates this circumstance, thinks that the *Támban*

was confounded with the *Meletta venenosa*. In the Straits of Malacca the *Támban nepis* has not been known to produce injurious effects.

The *Trubu* of the Malays (*Alausa toli*) is called Shad or Sable-fish by the English settlers, and is valued for its flavour; it is rich, though oily and full of bones. In the Indian Archipelago it is the object of an important fishery, principally for the sake of its roe. It is the Shad which Mr. Crawfurd mentions as frequenting the great river Siak in Sumatra, and of which the roe, that grows to an enormous size, constitutes when dried an article of commerce. The Sumatran Shad is described in Moor's "Notices of the Indian Archipelago" in the following passage:—"At Bukit Batu, opposite Malacca, within the strait formed by the island of Bankalis, exists an extensive fishery well known in this part of the world. The fish which is the object of it is called in the Malayan language *Trubu*, and is sufficiently common in the neighbouring seas, but is found in roe only here. The *Trubu*, about a cubit long, is taken in three or four fathoms of water on a mud bank. About three hundred boats are engaged at all seasons in the fishery, with the exception of four days during dead neap-tides. The roes are an article of trade seaward, and the dried fishes are sent into the interior of Sumatra. The rajah of Siak draws a revenue of seventy-two thousand guilders yearly from a fixed duty on the quantity taken. From the amount of this duty the quantity of fish caught is ascertained to be between fourteen and fifteen millions. It seems a little remarkable that the spirit of European monopoly never should have fastened upon so promising an object of gain. The fishery, from its peculiar nature, is probably quite inexhaustible, and might unquestionably be prodigiously improved by European skill and industry, and this, too, not only without detriment but to the great improvement of the revenue of the native prince, as well as the essential benefit of the surrounding population." "The roe, called *Telur ikan* in the Malayan markets, is, like the preparation of fermented fish and molluscs named *Balachan*, largely used by the Malays and Chinese to render their food palatable, and it is no less a favourite relish with Europeans. In Sumatra the roe is prepared as follows:—It is thoroughly salted when fresh, and next dried until only a slight moisture remains, in which state it is pressed closely by hundreds in a cask for exportation, the price in the European Malayan settlements being from three to four Spanish dollars for the hundred roes. For export to China it is repacked between layers of salt and sprinkled with arrack. The roes are fried for use, being first soaked in water for half an hour.—(Cantor, *Malay Fish.*) The *ngapwee* of the Birmans is a strong-smelling condiment, prepared of fish like the Balachan.

The Moss-bonker (*Alausa menhaden*) is taken in vast numbers on the coasts of New Jersey, and a valuable oil being obtained from them by pressure, the residue is used for manure. Sometimes a fresh fish is placed in each maize hillock, with the certainty of producing a luxuriant crop.—(*Baird.*)

The Anchovy (*Engraulis encrasicholus*), a well-known fish in commerce, is an inhabitant of the British seas, and was formerly more abundant there than it is at the present time. Several statutes were passed in the reign of William and Mary for the regulation of its fisheries, but enough is not at present caught to affect the home market, either from inattention, or because the species has become too scarce to repay the cost of a proper fishery. It was plentiful on the coasts of Brittany a century ago, though no longer so; but it is still an inhabitant of all the northern seas, from Greenland and Norway southwards, and is so abundant in the Mediterranean that the whole world is supplied from thence. In Sweden it goes by the name of *Ansjovis;* in Denmark of *Bykling* and *Moderlöse;* the Catalonians call it *Roqueron* and *Anchoa;* at Nice it is named *Anchoa;* and in the Crimea *Chanisa*. The greatest quantities are taken on the coast of Dalmatia, and the fisheries of it are very productive in the seas of Sicily, Corsica, Elba, and Antibes. The nets, which are like those used in the Sardine fishery, are shot in the night, and all the boats carry lanterns.

To prepare the Anchovies they are thrown into great tubs full of pickle, from whence the workmen take them one by one, with much dexterity decapitate them with the thumb nail and pass them to the packers, who with equal adroitness lay them side by side in small kegs, alternating with layers of salt. In a few days they are sufficiently impregnated with the salt, and the kegs are then headed in for exportation. The Anchovy sauce so indispensable for English tables seems to be nearly the same with the *garum* of the Romans. Pliny says that this liquor, which he calls "precious" and "exquisite," was the putrid exudations of the intestines and other ejected parts of the fish, called by the Greeks *garon*. A garum made on the African coast from the Tunny or some other Scomheroid, was prized in noble families next to the dearest ointments.

Alex was an inferior garum imperfectly strained from the dregs, and was frequently made clandestinely from small fishes of little price, and also from oysters, echinoderms, crabs, and the refuse of mullets, being of more or less value according to its mode of preparation. Some kinds of alex were so soft and pleasant that they could be drank.

A delicious condiment, famed in our Indian possessions under the name of "Red-fish," the *Ikan mérah* of the Malays, is prepared at Bencoolen in the following manner from another species of Anchovy (*Engraulis brownii*, *commersonianus* or *fasciata*) termed *Bádah* or *Búnga ayer* by the Malay fishermen. Middle-sized fishes are preferred, and after the heads have been removed they are deposited in flat, glazed, earthen vessels, with salt in the proportion of one part to eight of fish. They are then covered with plantain leaves or thin boards, upon which stones are laid, and this pressure is continued for three days; after which the fishes are taken out and soaked in vinegar made from cocoa palm-toddy, with an addition of ginger powder, and bruised or entire black pepper, some brandy, and powdered "red rice." After three days more the fishes are placed in bottles or jars, a little more vinegar is added, and the air carefully excluded. The condiment should be kept five months before it is used. It

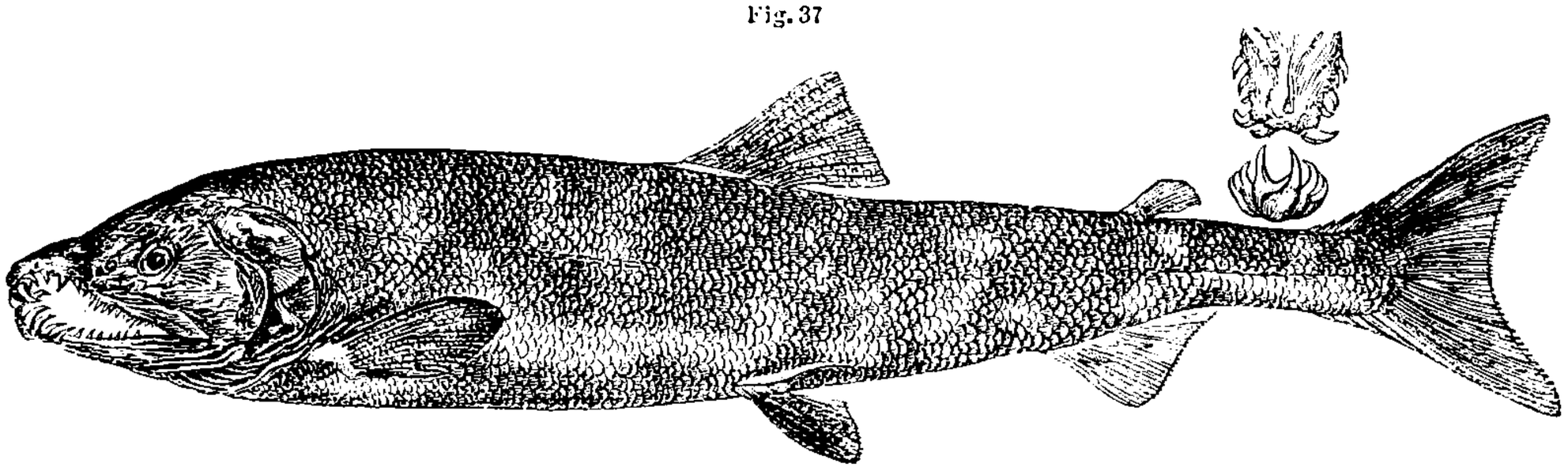
is retailed at a Spanish dollar per quart bottle. Red rice is a glutinous variety of the common rice steeped in an infusion of cochineal, and is imported from China at an expense of a quarter of a dollar per pound. The Chinese settled in the Straits of Malacca prepare a similar condiment from other fishes (*Polynemi*) cut in slices, and from prawns.

FAMILY IX.—SALMONOIDS (*Salmonidæ*).

Plate 3, figs. 14, 15.

A family composed of Malacopterous Cycloid Abdominals, with a soft rayless second dorsal called an adipose fin; the upper border of the mouth formed by the premaxillaries and maxillaries conjointly; large and simple air-bladder, without contractions; numerous pyloric cæca; pseudobranchiæ on the gill-cover; a moderate number of branchiostegals; and bony gill-rakers. The genera are—*Salmo*, *Fario*, *Salar*, *Osmerus*, *Mallotus*, *Argentina*, *Thymallus*, *Coregonus*, and *Stenodus*, comprising the Salmons, Trouts, Graylings, Gwyniads, and other well-known fishes of our rivers and lakes. So much has been published on their natural history, and on angling and other modes of taking them, in popular works, that we may be excused from entering into detail here on these subjects. They are natives of the northern hemisphere, and scarcely go southwards beyond the 30th parallel of latitude, not having been detected beyond the northern slope of the Himalayas and of Mount Atlas in the eastern hemisphere, or the high lands of Mexico in the western, but they are exceedingly numerous in the temperate and

Fig. 37



Scouler s Salmon (Salmo scouleri).

colder regions to the north. Many of them which resemble the Clupeoids in external form, may be readily distinguished by the presence of the adipose fin, and the absence of serratures on the belly.

Large Indian populations are supported in Rupert's Land and on the west coast of America by the fisheries of Salmon and Gwyniads, and the species of the latter known in Arctic America as the White-fish, is scarcely equalled, certainly not excelled, by any other fish as an article of diet. The great St. Lawrence lakes yield vast quantities to the commerce of the United States; and similar species, nearly as much prized, inhabit the waters of Northern Asia. Mr. Atkinson speaks of the Omul (*Coregonus*) as being caught in enormous quantities in Lake Baikal, from whence it is sent preserved by salt to all parts of Siberia. He says that it is a delicions fish when fresh, and when pickled is equal to the best Dutch herring.

FAMILY X.—CHARACINOIDS (*Characinidæ*).

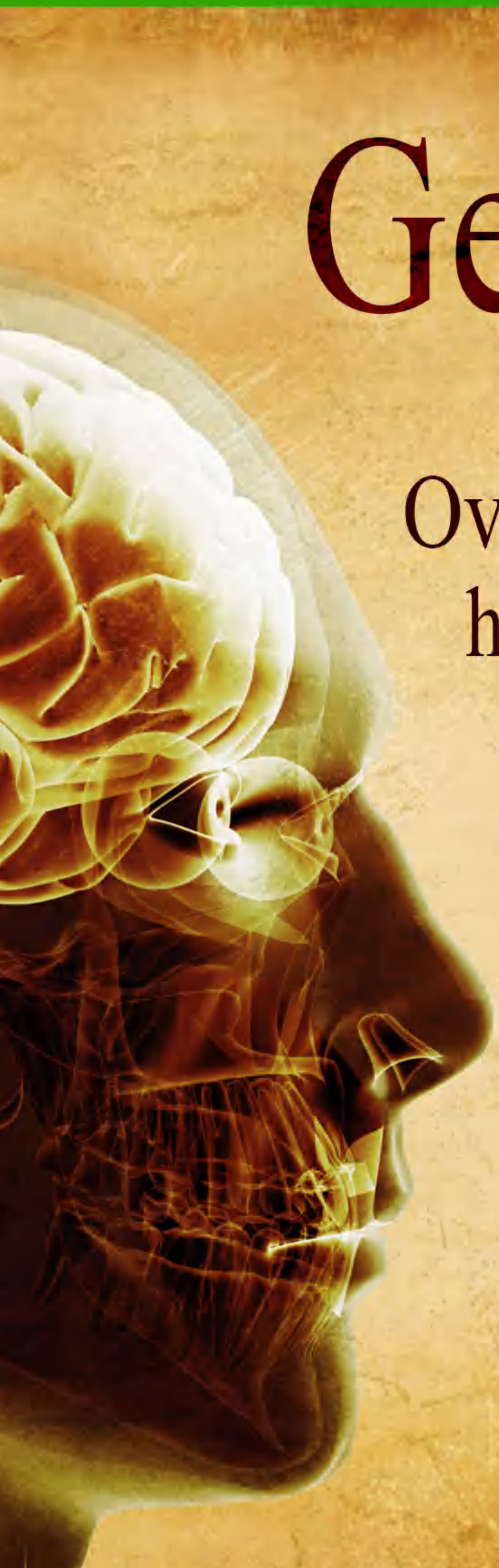
This family group was by Linnæus included in his comprehensive genus *Salmo*, but Müller and Troschel separated them, expounding their reasons for doing so in an able monagraph published in their "Horæ Ichthyologicæ." Most of the family are South American, African, or Asiatic fluviatile fishes, comparatively few being oceanic.

They are characterized as Abdominal Malacopteres, with scaleless heads, but covered on their bodies with cycloid scales (a few only having naked bodies); possessing no pseudobranchiæ; having the orifice of the mouth formed of the premaxillaries, maxillaries, and mandible; villiform pharyngeal teeth; a cæcal stomach; numerous pancreatic cæca; and an air-bladder divided into two chambers by a transverse constriction, its fore-chamber being connected to the acoustic organ by a chain of ossicles. There are a few instances among these fish of an air-bladder with one chamber only. The pneumatic tube issues from the posterior chamber, or much more rarely from the constriction between the chambers. Branchiostegals four or five in number. These fishes generally have smooth bellies, in which they differ from the Halecoids; but some, as *Tometes*, have the keel of the belly serrated like the herrings. Like the typical Salmonoids they have an adipose posterior dorsal fin.

The genera are—*Curimatus*; *Anodus* (Spix); *Prochilodus*; *Stevardia* (Gill); *Microdus* (Kner); *Leporinus*; *Chilodus* (Mll. u. Fr.); *Epicyrtus*; *Parodon*; *Salminus*; *Hemiodus*; *Citharinus*; *Schizodon* (Agassiz); *Rhytiodus* (Kner); *Piabuca*; *Distichodus*; *Nematopoma* (Gill); *Pœcilurichthys* (id.); *Corynopoma* (id.); *Plecoglossus*; *Tetragonopterus*; *Bryconops* (Kner); *Brycinus*; *Piabucina*; *Gastropelecus*; *Alestes*; *Myletes*; *Tometes*; *Myleus*; *Mylesinus*; *Chalceus*; *Chalcinus*; *Serrasalmo*; *Pygocentrus*; *Pygopristis*; *Catoprion*; *Hydrocyon*; *Cynopotamus*; *Cynodon*; *Agoniates*; *Xiphorhamphus* or *Xiphorhynchus*; *Xiphostoma*; *Salanx*; *Hydropardus*; *Gonostoma*; *Chauliodus*; *Astronesthes* (Richardson); *Aplochiton*.*

The Characinoids may be considered as the tropical

* *Erythrinus* and *Macrodon* placed in this family by Müller are, in consequence of wanting the adipose fin, ranged by Agassiz after the Halecoids. *Malacosteus* of Ayres also wants the fin.



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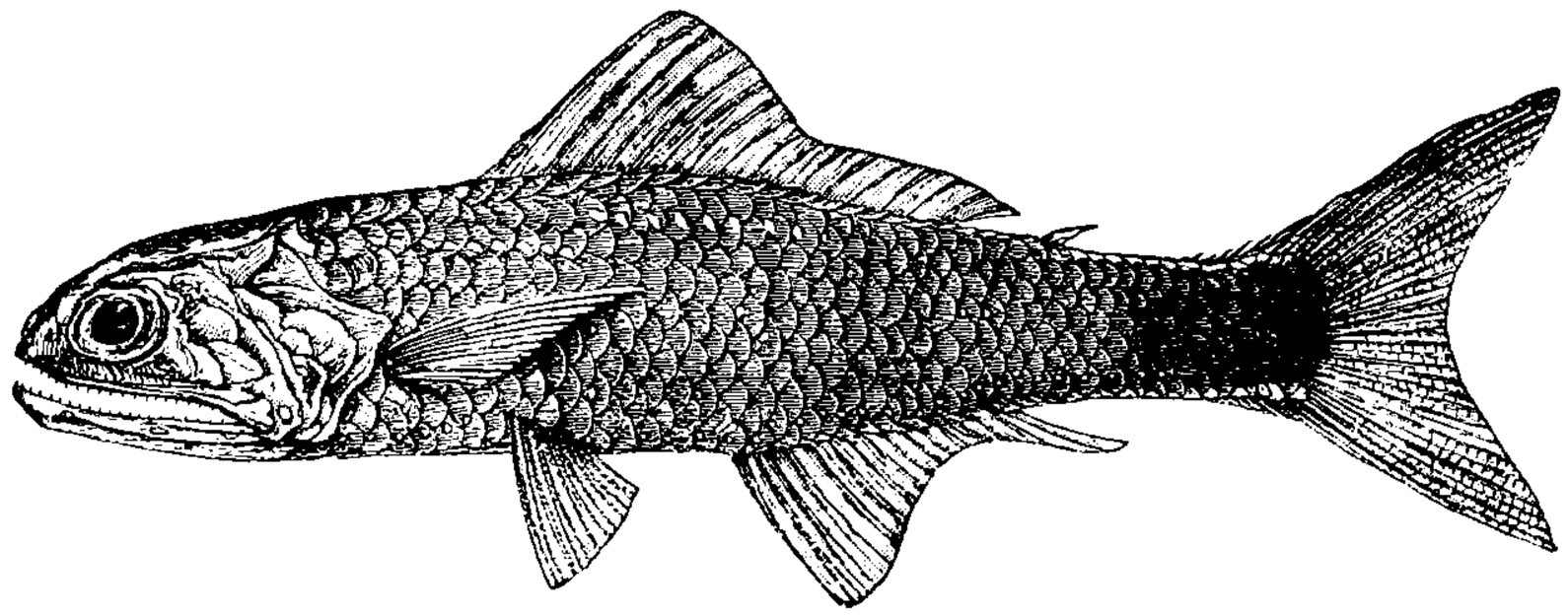
the tables of the European residents under the appellation of "Bombay Ducks," and may be procured by that name in London.

The genus *Saurus* has evidently received its name in allusion to the wide, threatening mouths of the species, well furnished with lizard-like teeth, which are

Fig 38.



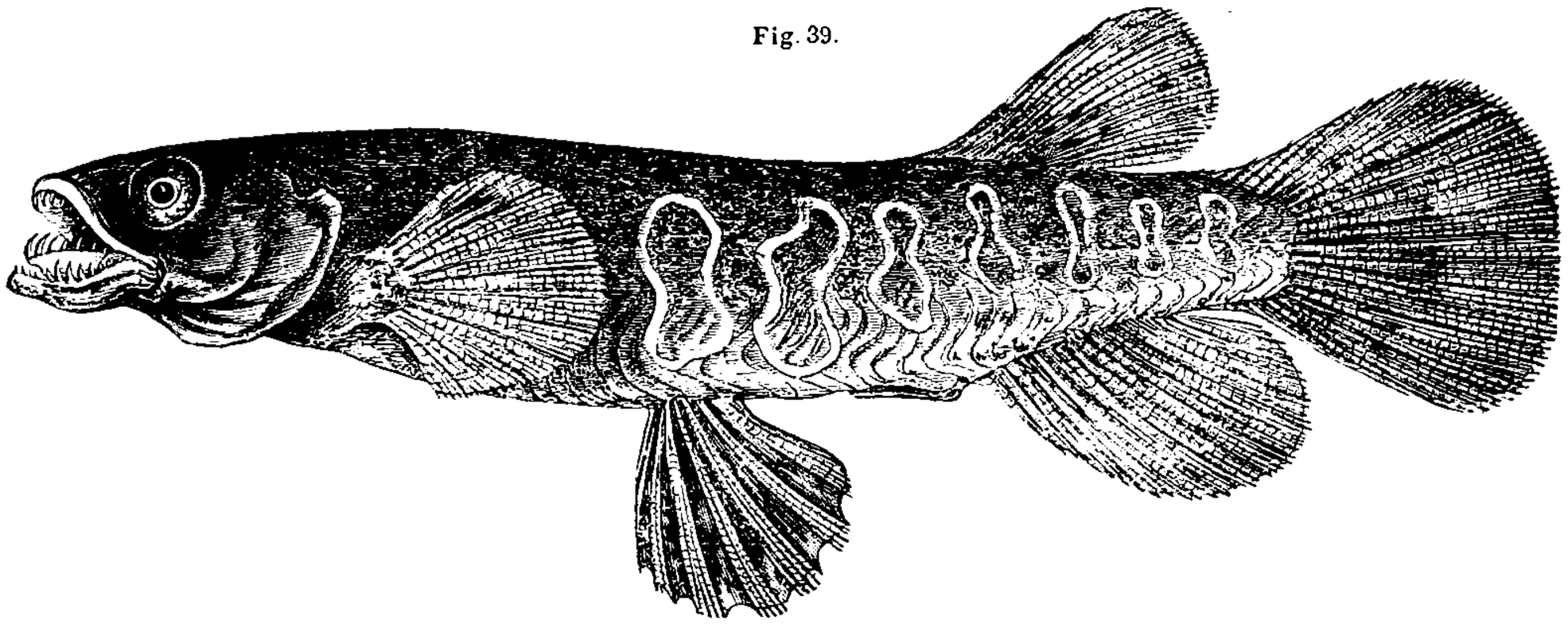
Brilliant Lamp-fish (Scopelus resplendens)

long, slender, and often barbed. Its members inhabit the Mediterranean and the tropical and subtropical districts of both oceans. The *Golpin* of Madeira (*Alepisaurus* of Lowe) has a wide gape, armed with long lancet-shaped, exceedingly sharp teeth. One small but interesting fish is the only member of the family known on the British coasts. It is the Pearl-side (*Scopelus pennanti*), and belongs to a genus of nocturnal fishes which have soft prominences on the head that shine by night like a glow-worm. Since naturalists have begun to investigate marine animals with more ardour, and the practice of towing small nets after ships has become frequent, the Scopeles have been discovered in all parts of the ocean. They are very brilliant little fishes, ornamented by rows of enchased spots on the sides, that look like strings of pearls.

FAMILY XII.—GALAXIDANS (*Galaxidæ*).

This small family belongs to the fresh waters of Australia, Tasmania, New Zealand, the Falklands, and Patagonia, and has received from Europeans visiting or settling in those countries the name of Trouts. The Galaxidans have in fact to the uninstructed eye the aspect of the river trout, being similarly spotted on the sides; but they have no scales, and want the adipose fin. The premaxillaries do not reach the corner of the mouth, but neither does the maxillary form that part of the margin of the orifice, a thick fold of the upper lip interposing. Strong teeth arm the jaws, some of them so much more prominent than the others as to obtain the name of canines; and strong curved ones

Fig. 39.



Gag-toothed Galaxias (Galaxias brocchus).

exist on the roof of the mouth and on the tongue. All the members of the family are comprised in the genus *Galaxias*.

FAMILY XIII.—HYODONTS (*Hyodontidæ*).

This is a group of three genera which Linnæus would have merged in his great genus *Clupea*, and which, together with the family that immediately succeeds it, is still a part of the Clupeoids of some more modern ichthyologists. The Hyodonts have compressed bodies; acutely-keeled bellies; without serratures; and pancreatic cæca, though few in number. Their stomachs are siphonal; and their mouths are particularly well armed with teeth on the jaws, vomer, palatines, presphenoids, lingual and hyoid bones. They

are handsome small fishes, of comparatively little economic value.

The genera are—*Osteoglossum; Ischnosoma;* and *Hyodon;* such species as inhabit the waters of the United States being called Gold-eyes, Toothed Herrings, Moon-eyed Herrings, and Shiners.

FAMILY XIV.—ERYTHRINOIDS (*Erythrinidæ*).

This small group, named *Erythröides* by Valenciennes, contains some genera whose true affinities have not yet been ascertained by ichthyologists. The Erythrinoids have moderately thick bodies, with rounded backs and bellies. The upper arch of the mouth is formed by the premaxillaries, and the maxillaries, articulated to their extremities, are both, together with the mandible, crowded with small conical teeth. The vomerine mesial line is smooth, but on each side of it an arched plate of villiform teeth lines the vault of the mouth. The entire cheek is covered by bony suborbitar scales, followed by two *temporal plates* which are characteristic of the family. The stomach is conical and siphonal, and the pancreatic cæca are numerous. The ovisacs do not communicate with the cavity of the belly, and the air-bladder is double; the roundish anterior chamber being clothed with a thick, exterior, loosely-adhering capsule, which is inserted into the processes of the third and fourth vertebræ, but does not communicate with the labyrinth of the ear; the second chamber is cellular anteriorly, without extensive partitions, but with recesses formed by longitudinal and transverse bridles and folds of the interior coat. A pneumatic tube leads from the second chamber to the top of the œsophagus. They are *Characini* without adipose fins.

The genera are—*Erythrinus; Macrodon; Lebiasina; Pyrrhulina; Umbra; Melanura* (Agassiz); *Dussumiera;* and *Etrumeus.*

Of these *Umbra* and *Macrodon* want cells in their simple air-bladder. Valenciennes remarks that *Erythrinus* agrees with the Salmonoids in the structure of the face; with the Cyprinoids in the size of the lateral occipital openings; with the Clupeoids in the parieto-occipital foramina, and in the form of the basilar occipito-sphenoid bone; with the Cyprinoids again in the confluence of the anterior vertebræ, and in the existence of a chain of ossicles connected with the first chamber of the air-bladder, but not reaching to the vestibule of the ear, as in the Cyprinoids. Most of the family inhabit tropical or subtropical countries. *Erythrinus cinereus* is the "Waubeen" of Trinidad. The Macrodons bear the native names of *Tareira, Guavina,* and *Häimara* in South America; and one species (*Macrodon ferox*) is called Yarrow in the island of Trinidad (Gill); *Umbra* is the *Hundfisch* of the Austrians.

FAMILY XV.—ELOPIANS (*Elopidæ*).

This family group is distinguished from others by the presence of a sublingual bone between the limbs of the mandible and behind the branchiostegal membrane; also by an unusual number of branchiostegals. The mouth is like that of the Clupeoids, bordered above by small premaxillaries, and flanked by long, free maxillaries. Teeth exist on all the dentiferous bones, but so fine as to appear merely a roughness. Body long and rounded, without serratures on the belly. Dorsal fin situated in the middle of the length. At the base of the deeply-forked caudal, above and below, there is a large indurated scale; and long scaly appendages are seated in the axillæ of the pectorals and ventrals. The head is naked, and the eyes furnished with a waxy-looking membrane. Stomach conical; numerous pyloric cæca; air-bladder large, forked anteriorly, and communicating with the digestive caudal, but not entering the cranium.

The genera are—*Elops* and *Megalops.*

These fish have a variety of local names in the United States and West Indies, such as Silver-fish, Round-fish, Herrings, Pounders, Pond King-fish, Caffum, Lisa-francesa, Banana, Caballero, Saballo, and Savale. In the Red Sea they are termed Machnat; in Hindostan, Inagore; and in China, Chuh-Keaou. They attain a considerable size, and most of the species, though sea-fish, thrive in fresh-water ponds, where they fatten on the guts of fowls and other garbage thrown to them.

FAMILY XVI.—AMIDANS (*Amiœdæ*).

The Mud-fish of the United States have attracted much attention from ichthyologists on account of the structure of their air-bladders, and M. Valenciennes remarks that the single genus *Amia* of ten or twelve species constitutes of itself a small family of fishes. The air-bladder is very large, enveloping the œsophagus and stomach, and communicating with the digestive canal near the pharynx. It is forked anteriorly, and its horns, as well as its lateral and superior parts, are divided into numerous cells, which expand towards their bottoms, forming bags. This congeries of cells is provided with a dense net-work of delicate bloodvessels, and is therefore believed to act a part in the oxygenation of the blood. The pneumatic tube is very short, but at the same time very wide, and issuing from near the anterior fork of the air-bladder, enters the œsophagus by an oblong cleft which has two tumid lips like those of a glottis. Another characteristic of the Amidans, is a sublingual bone like that of the Elopians. The naked cranium, supratemporals, suborbitars, and operculum are sculptured, but the interior of the mouth is like that of a trout, except that there are no lingual teeth. The ova drop into the cavity of the abdomen like those of a salmon. The caudal comes farther forward above than below.

These fish can live for some length of time out of water, and travel from one piece of water to another. They have a spiral valve in the cæcum, but otherwise resemble the Cyprinoids in the simplicity of the intestinal canal without cæca. They have been considered to be Ganoids, but the latest observations are against such an arrangement.

FAMILY XVII.—MORMYRIANS (*Mormyridæ*).

These are longish, compressed fishes, with slender tails, having a slight expansion at the attachment of the caudal fin. A thick, scaleless skin envelopes the head, gill-cover, and the six branchiostegals, leaving merely a slit to serve as a gill-opening on each side. Premaxillaries that coalesce on the mesial line, like those of the *Diodon* bound the upper part of the small mouth, the sides being edged by the maxillaries. The temporal bones are simpler than those of other fishes, and a peculiar cranial canal conducts to the acoustic labyrinth. No pseudobranchiæ have been found; the stomach is globular; there are two pyloric cæca and a long slender intestine. The air-bladder is simple. The arterial bulb has a lateral recess or *diverticulum*, and Professor Hyrtl has found an inner muscular coat corresponding to the outer ones of the Ganoids. Living among the mud like the Gymnotids, the Mormyrians resemble them in some parts of their arterial system.

The genera are—*Mormyrus* and *Mormyrops*.

The species are numerous in the Nile, Senegal, and Congo, and several were objects of worship by the ancient Egyptians. They are timid, nocturnal fishes, extremely difficult to catch, but being of high value, the fishermen pursue them assiduously and bring a few to the markets of Cairo. They are taken with lines, furnished with many hooks baited with worms. The *Mormyrus anguillaris* is carnivorous, but the other species are more or less exclusively phytophagous, which accounts for the small success of fishermen using the hook and line.

The most noted of the fish held to be sacred by the ancient Egyptians were the *Oxyrhinchus*, *Phagrus*, and *Lepidotus*. The two latter have been noticed in page 149, under the generic names of *Citharinus* and *Hydrocyon*, and their dentition corresponds to the reputation they have obtained as devourers of a part of Osiris; but the slender tubular faces of the Mormyrians show that they scarcely could deserve to be ranked with the bloodthirsty Characinoids. The *Mormyrus oxyrhinchus*, however, is considered to be one of the fishes placed under the ban of the priests of Osiris. It is well represented by a small bronze figure that was brought from Egypt by Mr. Salt, and is now preserved in the museum of the Louvre. A cut of it is also given in Sir Gardner Wilkinson's "Ancient Egypt."* We are there told that the Oxyrhinchus is very commonly represented in the paintings of Thebes, Beni-Hassan, and Memphis, and that it was the object of special worship in the city and nome of Oxyrhinchus. The citizens of that city were so scrupulous that they would eat of no fish taken with a hook, fearing that the hook might at some time have been employed in the capture of the object of their worship; and when a net was used the draught was carefully scrutinized, and should a single Oxyrhinchus be found among the fishes taken, the whole were returned into the river. Plutarch relates that the Cynopolites having insulted the Oxyrhinchians by eating of their sacred fish, the latter in revenge killed and consumed the holy dogs of the Cynopolites, and thus a religious war ensued between the communities.

* See Series ii. page 250.

FAMILY XVIII.—HERRING-PIKES (*Clupesocidæ*).

The fish here grouped under this family designation were either associated with the Pikes by M. Valenciennes, or considered to be types of other small sections. Müller at one time thought that he had found a distinctive character between them and the true Clupeoids in the absence of pseudobranchiæ; but having afterwards discovered these organs in the Odontognath, a close ally of Notopterus, he was led to restore the group to a place among the Clupeoids. We have thought it expedient, however, to retain the Odontognath with its strongly serrated belly among the Clupeoids, and to distinguish the Herring-pikes as a family, by the want of ventral serratures, the absence of an adipose fin, and of pseudobranchiæ. Their upper jaws are formed laterally by the maxillaries; a few of them have a simple swim-bladder; in some one or two pyloric cæca are present, while in others these appendages are wholly absent.

The genera are—*Stomias*; *Microstoma*; *Chirocentrus*; *Notopterus*; *Arapaima* or *Sudis*; *Heterotis*; and *Butirinus*.

These genera are interesting to ichthyologists from peculiarities of structure. The Butirins are known in the West Indies by the names of Banana-fish, Ten-pounders, and Kakamby; and on the Gold Coast of Western Africa by that of *Kio-kio*. In Tahiti their appellation is *Mohée*.

Sudis, *Vastres*, or *Arapaima*, is a genus of fishes remarkable for their bulk of body and for the size and strength of their scales. One species discovered by Sir Robert Schomburgh is appropriately named the Giant Sudis, and has a skeleton surpassing that of most other fishes in the strength and firmness of its bones. Its scales are almost bony, and are sculptured on the discs in dendritic and mosaic patterns; the thinly-covered bones of the skull also presenting similar appearances. These fish abound in Guiana and South America, and other species inhabit the Senegal and Niger. Skeletons preserved in our museums measure from three to five feet in length, and the hyoid-bone, which is used as a file by the natives of the countries where the genus exists, is often brought to Europe as a curiosity. The hyoid-bones from the Amazon are named *Lingua de Paes*, and those from the Rio Negra de Para are called *Kuare*. As some of these bones belong to species not yet described, the attention of travellers should be turned to finding and preparing the fish which produce them. Castelneau says that the fishermen of South America often mentioned the singular affection of the female Pirarucu (*Sudis*) for its progeny. It defends its eggs with vigour against the male fish, which seeks to devour them, and affords shelter in its mouth to the young fish when they are in danger. The fishermen ascribe the same habits to the large Siluroids.

small bones; the second air-chamber communicates with the gullet by a long tube.

The Cyprinoid genera are divided by Heckel into three tribes:—

1st. The THICK-LIPPERS (*Pachychili*)—*Cyprinus*; *Osteobrama*; *Carpio*; *Carassius*; *Tinca*; *Barbus*; *Gobio*; *Aulopyge*; *Rhodius* (Agassiz); *Abramis*; *Blicca*; *Bliccopsis*; *Pelecus*; *Alburnus*; *Aspius* (Agassiz); *Leucaspius*; *Idus*; *Scardinius*; *Leucos*; *Leuciscus*; *Squalius*; *Telestes*; *Phoxinus*; and *Phoxinellus*. These are European genera, some of which embrace also Asiatic species, and a purely Asiatic genus, *Epalzeorhynchus* of Bleeker, is to be added to them.

2nd. PRONE-MOUTHERS (*Catastomi*), having thick, papillose, or furrowed lips; and incorporated with the pharyngeal bone a crescentic series of pharyngeal teeth, whose crowns adapted for grinding are compressed yet broader than their stems—*Catastomus*; *Moxostoma*; *Cycleptus*; *Ptychostomus*; *Hylomyzon*; *Rhinichthys*; *Carpioides*; *Ichthyobus*; *Crossocheilos* (Bleeker); *Lobocheilos* (id.); and *Bubalichthys* (id.). These are American genera, including comparatively very few European or Asiatic representatives.

3rd. CUTTING-LIPPERS (*Chondrostomi*), in which the mandible is sheathed by an almost cartilaginous lip, whose edge is thin and incisorial. They are numerous in Asia, and perhaps still more so in America, but Europe nourishes only one representative of the group—*Chondrostoma*; *Acrocheilus*; *Exoglossum*; *Campylostoma*; *Pimephales*; *Hyloborhynchus*; *Hylobognathus*; *Ptychocheilus*; *Mylocheilus*; *Aspidoparia*; and *Catla*.

Many genera of Asiatic Cyprinoids proposed by Dr. M'Clelland and others, require to be more fully described before their correct position can be ascertained. Such are—*Pelecus*; *Mola* (Blyth); *Oreinus* (M'Clelland); *Systomus* (id.); *Perilampus* (id.); *Opsarius* (id.); *Capöeta* (id.); *Nuria* (id.); *Dangila* (Valenciennes); *Chela*; *Bengala*; *Potia*; *Cirrhinus*; *Psilorhynchus*; *Schisothorax*; *Racoma*; *Devario* (Heckel); *Schisopyge* (Bleeker); *Labio*; *Rohita*; *Pylognathus* (Heckel); *Discognathus* (id.); *Cyrene* (id.); and *Platycara* (M'Clelland). *Labio* and the four following genera form the group called *Pennochitæ* by Heckel.

The Cyprinoids are, more exclusively than almost any other large family, fresh-water fishes, though some species descend the rivers into the brackish waters of estuaries or inland seas. Most of them flourish and multiply in ponds. Their cultivation has been much attended to in China, whose teeming populations derive great quantities of food from this family of fishes.

In America the *Catastomi*, or Sucking-carps, are most abundant, and yield wholesome supplies to the natives all the year round, up to the northern extremity of the continent.

The British species are—The Common Carp (*Cyprinus carpio*); the Crucian Carp (*Carassius linnæi*); the Prussian Carp (*C. gibelio*); the Gold Carp (*C. auratus*); the Barbel (*Barbus fluviatilis*); the Gudgeon (*Gobio fluviatilis*); the Tench (*Tinca vulgaris*); the Bream (*Abramis brama*); the Bream-flat (*Blicca argyroleuca*); the Pomeranian Bream (*Bliccopsis buggenhagii*); the Rudd (*Scardinius erythrophtalmus*); the Azurine (*Sc. cæruleus*); the Ide (*Idus idbarus*); the Chub (*Id. melanotus*); the Dobule (*Squalius dobula*); the Dace (*Sq. leuciscus*); the Graining (*Sq. lancastriensis*); the Roach (*Leuciscus rutilus*); the Bleak (*Alburnus lucidus*); the Minnow (*Phoxinus lævis*).

Cuvier remarks that the name of the Carp, though mentioned by Aristotle and Pliny, does not occur in Ausonius, and thence infers that at the end of the fourth century, when the Bordeaux poet wrote, the Carp, which came from the East, had not reached the Moselle. It is not included in the ample list of fish served up at the feast held in 1466 at the enthronization of the Archbishop of York; but fifteen years later the prioress of St. Alban's, Dame Juliana Berners, in her "Boke of St. Alban's," printed in 1481, calls it "a deyntous fisshe." This passage was doubtless unknown to Leonard Mascall, who claims to have introduced Carp and Pippins into England in the year 1600. The suppression of the monasteries had probably caused the Carp ponds to be neglected.

FAMILY XXII.—ACANTHOPSIDES (*Acanthopsidæ*).

Plate 4, fig. 21.

Fishes of this small family have generally a fusiform body, with thickish tails and a small head, covered with smooth skin as far back as the gill-openings. The preorbital scale-bone, and frequently the bony operculum, emit one or more spines, in which respect they differ from the Cyprinoids. Suctorial lips and barbels surround the orifice of the small toothless mouth. A short dorsal, destitute of bony rays, stands over the ventrals. Small scales clothe the body; the gill-openings are short vertical slits; and the branchiostegals are three in number. No pseudobranchiæ are developed. A globular bony cell, constructed in processes of the large anterior vertebra, receives the swim-bladder, from whence chains of bones extend towards the acoustic organs.

The genera are—*Cobitis*; *Botia*; *Acanthopsis*; *Apua* (Blyth); *Prostheacanthus* (Blyth); *Pangio* (id.); *Syncrossus* (id.); *Schistura* (M'Clelland); *Homoloptera* (Kuhl et Van Hasselt); and *Balitora* (Gray).

This last form is depressed, is furnished with large spreading ventrals and pectorals, and has no air-bladder. The Loach or Beardie (*Cobitis*) and the Groundling (*Acanthopsis*) are British representatives of these genera.

ORDER VI.—SILUROIDS.

FISHES of this order have either a smooth naked skin or a lateral line protected by keeled scales, which are sometimes so expanded as to encase the whole body, each side being protected by one row above, and another below the lateral line. In the second family of the order the scales are disposed in more numerous rows. The cranial and humeral bones often appear on the surface, forming with some of the interspinous bones shields of various forms; and the skeletons differ considerably from those of the common osseous fishes. The sub-operculum is wanting, and the epicoracoid is reduced to the condition of a mere process of the cora-

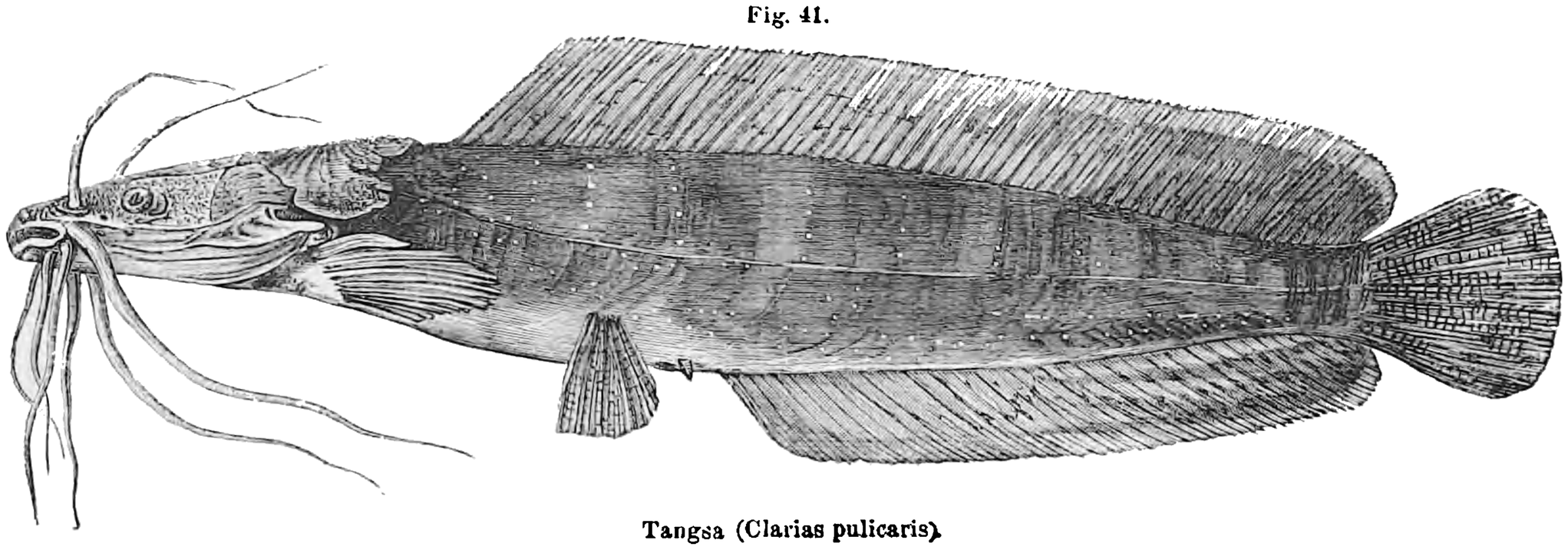
coid. There are no pancreatic cæca. There is sometimes only one dorsal, but more commonly two; the second being adipose, or in a few species only supported in front by a bony ray; the caudal is forked, crescentic, or rounded at the end. In almost all cases the first pectoral is a strong, bony serrated ray, which is sustained by a stout scapulo-coracoid arch; and a similar strong ray often stands in front of the dorsal, and is not unfrequently furnished with a trigger-like apparatus for fixing and releasing it at the pleasure of the fish. Fossil bones of this kind are abundant in some strata, and are known by the name of Ichthyodorulites. When the air-bladder is present, it is furnished with a pneumatic tube; hence those who consider the Siluroids to be merely a family group, place it among the *Physostomi* of Müller.

FAMILY I.—GLANIDIANS (*Siluridæ*).

Plate 4, figs. 22, 23.

To avoid using the same designation for the family that Agassiz has applied to the order, we have borrowed an epithet from Aristotle. The Glanidians are a very large family, and resemble the Malacopteres and also the Ganoids, in having a pneumatic tube to the air-bladder. Their skins are either naked, or encased in the expanded plates of the lateral line; the mouth is bordered above by the premaxillaries, the maxillaries being reduced to mere vestiges, or elongated into soft, flexible barbels: all have barbels either at the nostrils, or on the borders of the mouth. The swim-bladder is connected to the acoustic organs by

Fig. 41.



Tangsa (Clarias pulicaris).

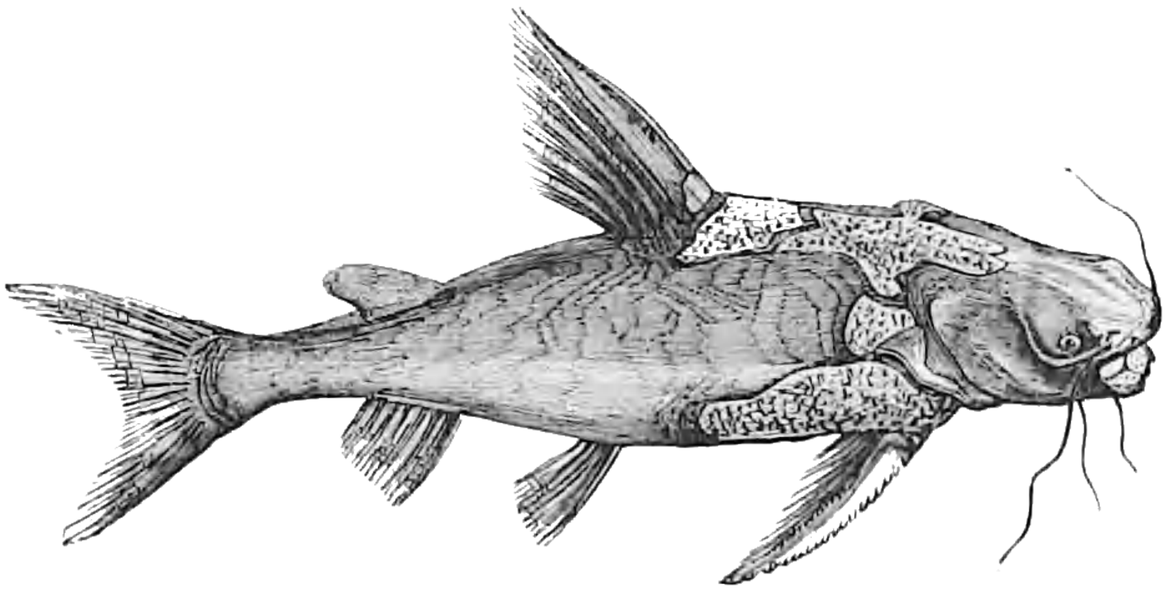
chains of ossicles; the cavity of the cranium is closed laterally, as in the Cyprinoids; and the posterior bones of the skull are generally prolonged to furnish sutures with the first vertebral spines. The stomach has a sac-like protuberance below the pylorus; and the branchiostegals vary in number from nine to eighteen.

The genera are—*Silurus*; *Glanis* (Agassiz); *Schilbes*; *Cetopsis*; *Bagrus*; *Cephalocassis* (Bleeker); *Gargota* (id.); *Hara* (Blyth); *Platystoma*; *Galëichthys*; *Pangasius*; *Silundia*; *Sciades* (Müll. und Trosch.); *Ariodes* (id.); *Eutropius* (id.); *Osteogeneiosus* (Bleeker); *Arius*; *Asterophysus* (Kuer); *Batrachocephalus* (Bleeker); *Clarotes* (Kner); *Pimelodus*; *Hemipimelodus* (Blyth); *Pimelonotus* (Gill); *Synechoglanis* (id.); *Amblyceps*; *Rita* (Bleeker); *Bagarius* (id.); *Euanemus* (Müll. und Trosch.); *Erethistes* (id.); *Auchenipterus*; *Ketengus* (Bleeker); *Callophysus* (Müll. und Tr.); *Centromochlus* (Kner); *Trachylopterus*; *Hypopthalmus*; *Ageneiosus*; *Glyptosternon* (Blyth); *Glyptothorax* (id.); *Pseudecheneis* (id.); *Exostoma* (id.); *Synodontis*; *Doras*; *Callichthys*; *Hoplosternum* (Gill); *Hoplosoma* (Swains.); *Arges*; *Brontes*; *Astroblepus*; *Clarias*; *Heterobranchus*; *Saccobranchus*; *Plotosus*; *Trychomycterus*; *Stegophilus* (Rheinhardt); *Pareiodon* (Kner); *Bunocephalus* (id.); *Aspredo*; *Chaca*; *Sisor*; *Malapterurus*; *Ailia*; *Eremophilus*.

The Rita represented by the woodcut is very strongly mailed, and is a fish of a disagreeable aspect, common in the mouths of the Ganges, but few of the natives venture to eat it. It grows to the length of four feet.

The Sheat-fish (*Silurus glanis*) is considered to be the largest of European fresh-water fishes. Pliny describes it as second in size to the marine Tunny alone, as devouring all animals that it meets with, and as frequently drowning horses that attempt to swim across the rivers that it inhabits. The "Histoire des Poissons" mentions that in modern times one was taken in the Bug which measured sixteen feet in length; and, quotes Grossinger, who relates that, on the confines of Turkey, a poor fisherman captured one of those omnivorous fishes which had in its stomach the entire corpse of a woman, with a ring and a purse filled with money! Sibbald mentions the Sheat-fish in his list of Scottish

Fig. 42.



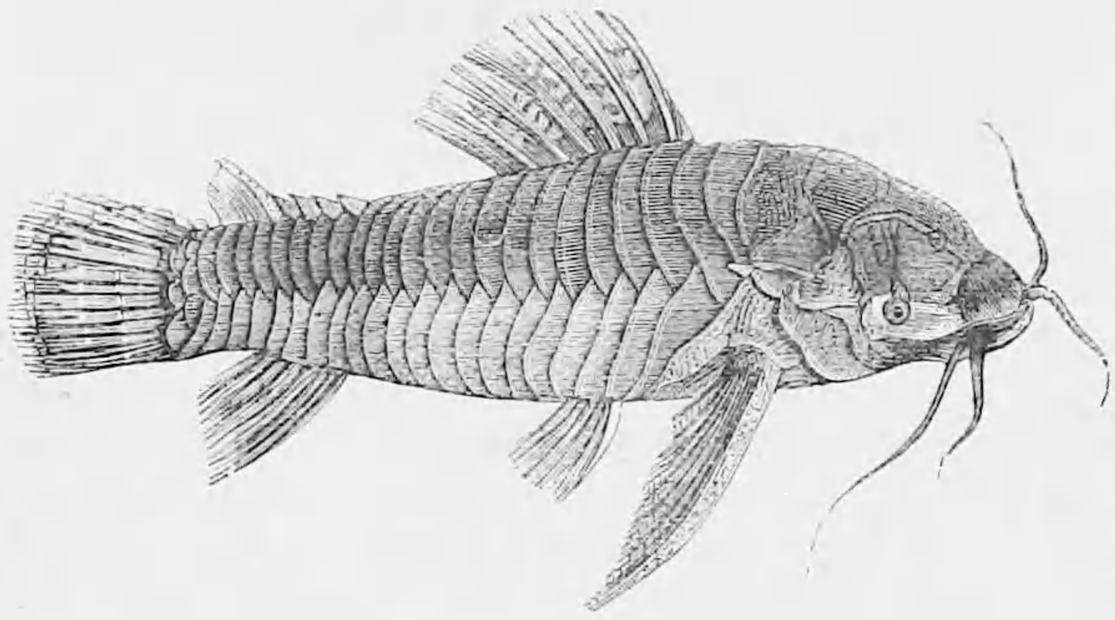
The Rita (Arius rita).

fishes, but gives no details, and no other ichthyologist has seen a British example.

The *Glanis* of the ancient Greeks, which inhabits the river Achelous in Acarnania, and at this day bears

the name of *Glanidi* (in the plural *Glanidia*), is of a nearly allied genus. Aristotle says that the Glanis is conspicuous among river fishes for the care that it takes of its young; for the female having discharged its eggs and departed, the male sets himself to watch the precious deposit, and keeps off other fishes for forty or fifty days, by which time the young have grown sufficiently to escape from their enemies. Agassiz, speaking of another member of the family, says, Who can see the Cat-fish (*Pimelodus catus*) move about with its young, like a hen with her brood, or the Sun-fish (*Pomotis vulgaris*) hovering over its eggs, and protecting them for weeks, without remaining satisfied that the feeling which prompts these acts is of the same kind with that which attaches the cow to its calf? The fishermen of South America report that many of the large Siluroids open their mouths for the reception of their young brood when danger presses, and return them to the water in safety when no longer threatened. This report is sustained by the observations of several travellers, who have observed multitudes of young fishes dropping alive from the mouth of an old one of the same species that has been speared.

Fig. 43.



Atipa (Callichthys thoracatus).

According to Mr. Hancock, the Hassars (*Doras* and *Callichthys*), locally named Yarrow, Atipa, Tamoata, and Mana, travel in the dry season overland in search of water, moving over the meadows in dense columns, and when the ponds dry up, burrowing into the mud. In the rainy season they make regular nests of leaves, and carefully cover up their eggs, which, during the process of hatching, are assiduously watched and courageously defended, by both males and females. The *Callichthys* wants the air-bladder.

Aristotle mentions a fish by the name of *Choiros*, or Pig, as inhabiting the river Clitor in the Mediterranean, and as being one of the fishes that have the power of emitting sounds. The Choiros is enumerated by Strabo among the fishes of the Nile; and it is said that the spines on its head prevent the Crocodiles from attacking it. It is admitted by authors to be a Glanidian, but the species has not yet been determined. M. Valenciennes ascribes the sounds which some fishes produce to the escape of air from their large swim-bladders, acted upon by strong muscles. This, if considered to be the only cause of such sounds, would confine their production to the *Physostomi*, which have the power of expelling air; but we have already mentioned the Gurnards, whose swim-bladders are closed, as being remarkable for grunting.

The following extract may be compared with what has been said on the subject of sounds uttered by fishes at page 125:—

On occasion of a visit to Batticaloa, on the north coast of Ceylon, in September, 1848, Sir Emerson Tennent made inquiries relative to the musical sounds alleged to issue from the bottom of the lake. The fishermen vouched for the truth of the story, stating that the sounds are heard only during the dry season, and cease when the lake is swollen by the freshes after rain.

"In the evening," says Sir Emerson, "when the moon had risen, I took a boat, and accompanied the fishermen to the spot. We rowed about two hundred yards north-east of the jetty, by the fort gate. There was not a breath of wind, and not a ripple, but that caused by the dip of our oars; and on coming to the point already mentioned, I distinctly heard the sounds in question. They came up from the water like the gentle thrills of a musical chord, or the faint vibrations of a wine-glass when its rim is rubbed by a wet finger. It was not one sustained note, but a multitude of tiny sounds, each clear and distinct in itself; the sweetest treble mingling with the lowest bass. On applying the ear to the woodwork of the boat, the sound was greatly increased in volume by its conduction. They varied considerably at different points as we moved across the lake, as if the number of animals from which they proceeded was greater in particular spots; and occasionally we rowed out of hearing of them altogether, until on returning to the original locality, the sounds were at once renewed.

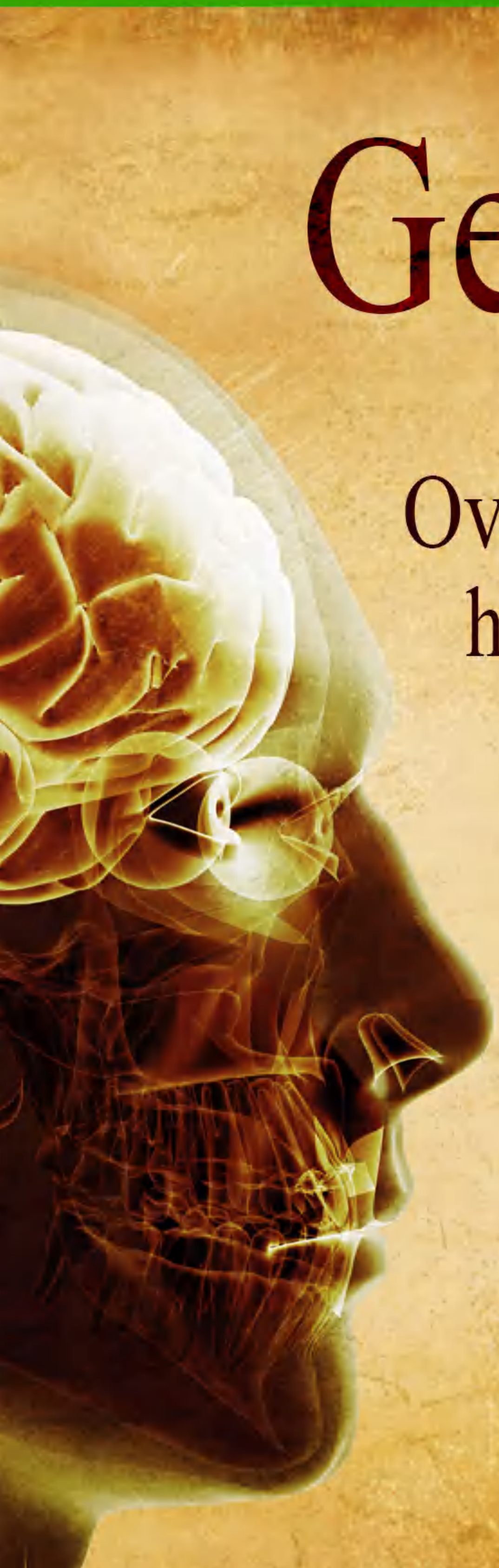
This fact seems to indicate that the causes of the sound, whatever they may be, are stationary at their several points; and this agrees with the statement of the natives, that they are produced by mollusca, and not by fish."*

Prenadillas (*Arges cyclopum*—Plate 4, fig. 23—and *Brontes prenadilla*) are small fishes which issue from the bowels of the earth in torrents of muddy and smoking water flowing from crevices in the sides of South American volcanoes, elevated sixteen or seventeen thousand feet above the sea. Near Ibarra, and at other places, such vast quantities of these fish have at various times been cast on the land as to cause very fatal epidemic fevers. The eyes of these subterranean Glanidians are very small, like those of other fishes inhabiting caverns.

The *Clarias*, *Hales*, or *Heterobranchus*, and *Saccobranchus*, have branching supplementary leaflets springing from their gills, which spread in shrub-like tufts over the superior pharyngeals.

The *Stegophilus insidiosus* of Reinhardt has the operculum set with curved spines, which most probably serve the same purpose with similar organs in a group of Hypostomes, namely, to enable the fish to attach

* Ed. Rev., Oct., 1859.



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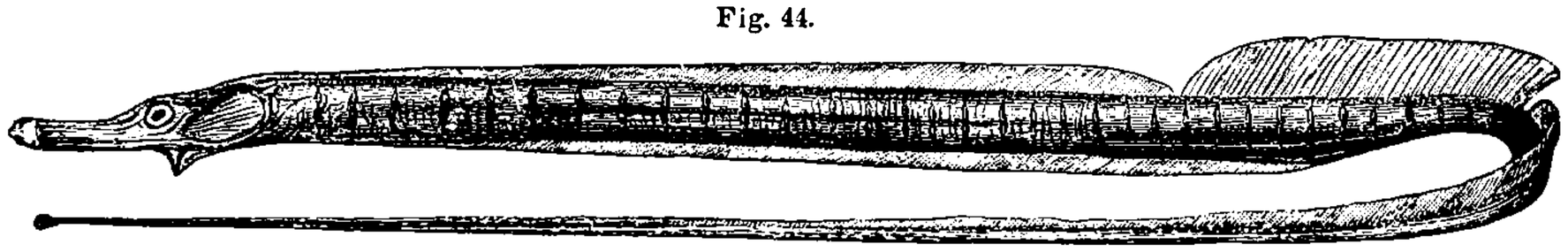
hensile tails. The rings are numerous, and various knobs on the cranial bones, with the elongated face, produce a resemblance to the head of a horse, which was recognized in ancient times, as it is now by the present inhabitants of the Mediterranean, by the appellation of Sea-horses. Pliny, referring to these fishes, says—"As, according to the common opinion, everything that is produced on land has its marine repre-

Fig. 44.



Falkland Island Nerophis (Nerophis hymenolomus).

sentative, our wonder ought to be the less on beholding the heads of horses springing from such tiny shells."

The genera are—*Hippocampus*; *Acentronura*; *Gasterotokeus*; *Solenognathus*; *Phyllopteryx*; *Halicampus*; *Trachyrhamphus*; *Corythöichthys*; *Ichthyocampus*; *Syngnathus*; *Leptonotus*; *Siphonostomus*; *Leptöichthys*; *Stigmatophora*; *Doryrhamphus*; *Doryichthys*; *Chöeroichthys*; *Hemithylacus*; *Microphis*; and *Nerophis*.

These, distributed into four subfamilies or tribes, are described by Dr. Kaup in his Catalogue of Fish in the British Museum. The following are British species—The Short-nosed Hippocampus (*Hippocampus brevirostris*); the Needle-fish (*Syngnathus acus*); the Deep-nosed Pipe-fish (*Siphonostomus typhle*); the Æquoreal Pipe-fish (*Nerophis æquoreus*); the Snake Pipe-fish (*Nerophis anguineus*); the Straight-nosed Pipe-fish (*Nerophis ophidion*); the Worm Pipe-fish (*Nerophis lumbriciformis*).

In the *Edinburgh New Philosophical Journal* for April, 1855, there is a statement of the ship *Harbinger* having sailed for several *hundreds of miles* in the North Atlantic among shoals of dead fishes, supposed to have been killed by submarine volcanic action. One of these dead fish being sent to Sir William Jardine, was determined by him to be the common Snake Pipe-fish (*Nerophis anguineus*).

ORDER VIII.—PLECTOGNATHS.

IN this order the maxillary bone is soldered to or coalescent with the premaxillary of the same side, and in some groups the conjoined bones of the one side are blended on the mesial line with those of the other, forming a solid upper jaw in which the teeth are incorporated, and which is opposed to a mandible of similar form and dentition, having its limbs also coalescent at the symphysis. In other groups the mesial junction of the lateral halves of the jaws is in form of a serrated suture. The internal skeleton is partially ossified, and has a fibrous osteoid structure, without any bone corpuscles. The pieces of the skeleton are fewer than in the Osseous fishes, having only rudimentary ribs, as well as wanting some other bones; and the dermal skeleton differing much in aspect from the ordinary scales, is considered to approach ganoid scales in texture. The spines of the fins also, when present, are studded with ganoid grains. Agassiz, because of the structure of the dermal bony scales, is inclined to range the order provisionally among his Ganoids; but Müller, who relies more on the forms of the central organ of circulation, does not separate the group from the Osseous fishes, with which its members agree in having merely two valves at the origin of the arterial stem, without the succeeding rows that exist in the Ganoids. The swim-bladder of these fishes is closed, having no air-duct, and there are no pancreatic cæca. The gills are biserial, and the processes of one series alternate with those of the other instead of being in opposite pairs. There are no distinctly-developed ventrals, but their place is supplied in some groups by a projection of the pubic bones, sometimes followed by a longitudinal series of short slender spines.

FAMILY I.—BALISTIDS (*Balistidæ*).

Plate 13, fig. 65.

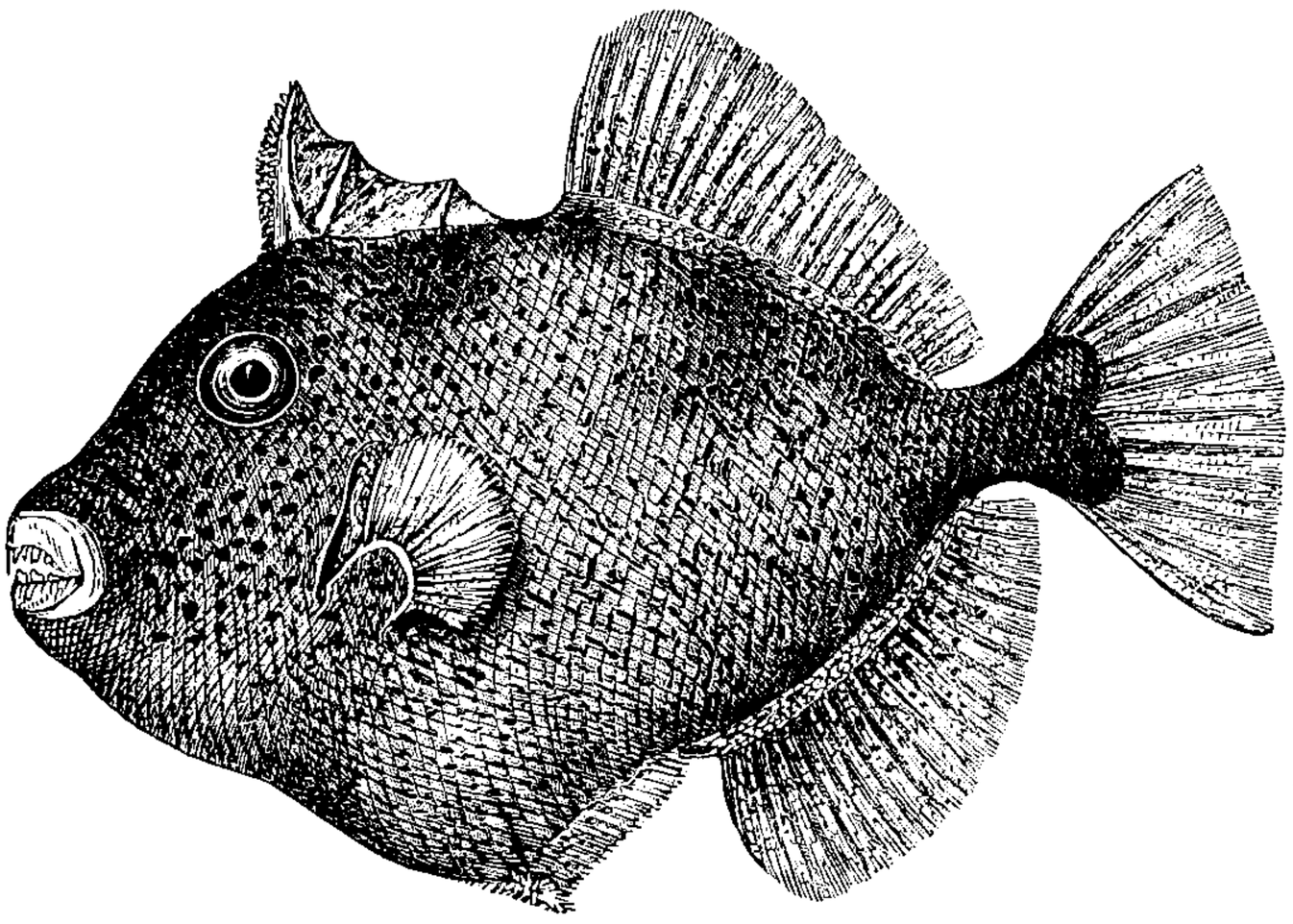
The characters of this group are a conical face with a small mouth at its apex, armed with a few more or less tapering incisorial teeth. The skin is protected by shield-like, ganoid scales, or by small rough points. The branchiæ are three only. These are most generally considerably compressed fishes, with a profile often approaching to oval or orbicular, but sometimes much elongated. In one group, the *Balistini* of authors, the ganoid mail is divided by diagonal intersecting lines into small rhomboidal discs; the stout anterior ray of the first dorsal is followed by one or two small ones, which act as triggers to fix it in an erect position, and when disengaged, allow it to fall back into a groove. In the other group (the *Monacanthini*) the dermal mail is in form of small, thickly-set spines, of forms varying with the species, and occasionally resembling in fineness and closeness the pile of velvet.

The genera are—*Pyrodon*; *Melichthys*; *Xanthichthys*; *Canthidermis*; *Balistes*; *Balistapus*; *Monacanthus*; *Aluterius*; and *Priacanthus*.—(See Kaup, *Cat. Brit. Mus.*)

The Pig-faced Trigger-fish or File-fish (*Balistes capriscus*) is a British species, though very seldom cap-

tured. It is an inhabitant also of the Mediterranean, Atlantic, and Indian Ocean.—Plate 13, fig. 65.

Fig. 45.



Gilded Trigger-fish (Xanthichthys curassavicus).

The Balistids and Coffer-fishes, or Ostracionids, constitute the family of *Sclerodérmes* of Cuvier.

FAMILY II.—OSTRACIONIDS (*Ostracionidæ*).
Plate 13, fig. 66.

These COFFER-FISHES have the body inclosed in a tesselated cuirass of scales arranged quincuncially, forming a box of little or no flexibility, from out of which the lips, teeth, pectorals, and tail with its three vertical fins protrude. The pelvic bones and ventrals are wanting. The vertebræ of the belly are mostly coalescent, and the body has but little muscular substance, its motions being limited. Exteriorly the gill-opening is only a short slit, bordered by a skinny edge, but interiorly it has an operculum and six branchiostegals. The box-like mail is in some species rectangular; in others triangular in section, or it is oval or orbicular. The liver is large and oily; the stomach capacious and membranaceous.

The genera are—*Cibotion*; *Doryophrys*; *Ostracion*; *Aracana*; and *Centaurus*.—(See Kaup, *Cat. Brit. Mus.*)

FAMILY III.—GYMNODONTS (*Gymnodontidæ*).
Plate 13, figs. 67, 68.

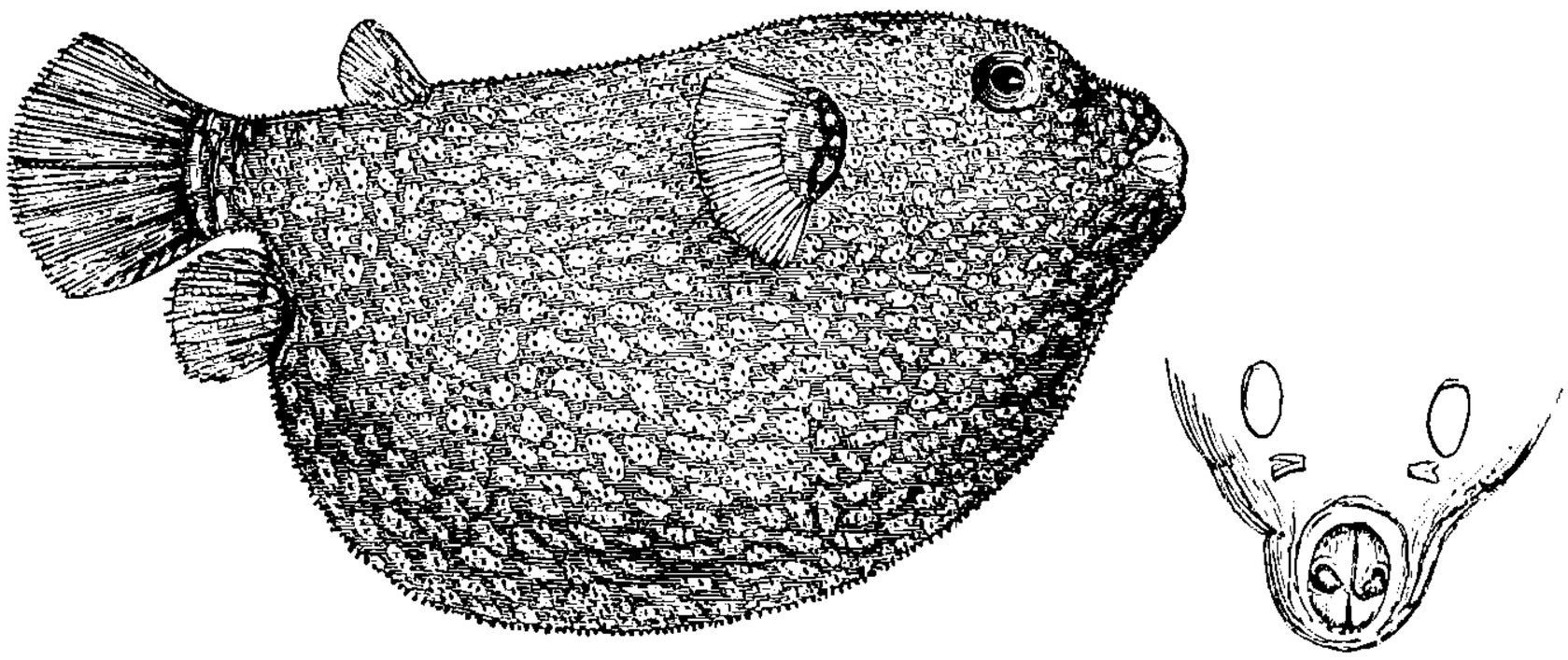
This family, characterized by Cuvier under the name of *Gymnodonts*, comprises his *Diodonts*, *Tetrodonts*, *Triodonts*, and *Moles* or Sun-fish. Its members have the teeth incorporated in the gorget-shaped jaws, forming a bill like that of a parrot. Cuvier's genera have been described by Dr. Kaup as families or sub-families.

The DIODONTS have a flexible skin which, in most species, is inflatible so as to give a globular shape to the fish, and is armed with spines which diverge every way when the skin is distended. No mesial division exists in either the upper or under jaw, each having the form of a horse's hoof, with the teeth incorporated in their bony substance.

The genera are—*Diodon*; *Dicotylichthys*; *Cheilomycterus*; *Cyclichthys*; and *Cyanichthys*; none of which are British.

The MOLEBUTS or SUN-FISHES (*Orthagoriscini*) have jaws like the Diodonts, and are compressed fishes incapable of inflation, and a tail so short and high as to seem as if docked off. The dorsal is high and pointed,

Fig. 46.



Turkey-fish (Tetraodon meleagris).

and is united at the base to the caudal. No air-bladder is present, and the small stomach is entered directly by the bile-duct. The arterial stem is provided at its origin with four semilunar valves. The skin is smooth in some species, and in others is armed by scattered spines. The myelon is greatly abbreviated. The

only genus is *Orthagoriscus* or *Orthrugoriscus*, of which two species frequent our seas, viz., the Short and the Oblong Molebut (*Orth. mola* and *oblongus*).

The TETRODONTS, forming a family or sub-family of some ichthyologists, is equivalent to the genus *Tetraodon* of Linnæus and Cuvier. They have their gorget-shaped jaws, in which the teeth are incorporated, divided above and below by serrated, mesial sutures, forming four dental masses, whence the name. The skin is partially and variously armed by spines, which are smaller than those of the Diodonts, and in an electric species are wholly absent. Some genera have inflatible bodies; others do not possess the power of inflation, and have a moderately elongated form.

The genera are—*Tetraodon*; *Physogaster* (Müller); *Chelonodon* (id.); *Cheilichthys* (id.); and *Arothron* (id.).

Some of these groups have no olfactory sac, or even depression, the nerve of smell being expended on a solid, imperforate barbel.

In the TRIODONTS the mandible is undivided, as in the Diodonts, while the upper jaw has a mesial suture as in the Tetrodonts. An immense dewlap is sustained in front by a very large bone representing the pubics, and resembling the same parts in some Balistids. The fins are like those of the Diodonts, and the asperities of the body and dewlap resemble those of the Tetrodonts. A single species from the Indian seas is called *Triodon bursarius*, and is described by Lesson and Garnot in their ichthyology of the voyage of Duperrey.

GANOIDS.

TYPICAL ganoid scales have generally a rhomboid or quadrangular outline, with a smooth, shining coating of enamel. They are seldom rounded, and rarely imbricated, being more commonly arranged in oblique rows whose edges touch; but each scale is secured to the one that precedes it by a hinge-like process of its anterior corner. Like ordinary scales, the ganoid plates are developed in follicles, but their epidermal coating is so very thin and so closely adherent as to be nearly imperceptible. Müller sums up his view of the ganoid character in the following terms:—Fishes provided with tabular and angular or roundish enamelled scales, or with bony plates, or with a perfectly naked skin; having fins frequently, but not always, sustained in front by a single or double row of spiny plates, technically named *fulcra;* and a caudal fin involving in its upper fold the extremity of the vertebral column, which may continue to the end of the fold. The free gills are placed in an operculated cavity, like those of the true osseous fishes. Several Ganoids have an accessory branchial organ in form of an opercular gill, which differs from a pseudobranchia, and may co-exist with it. Many have spout-holes (*spiracula* or blowing-holes) like the Plagiostomes. In the arterial bulb or stem there are several rows of valves. The eggs are generated in ovisacs and discharged through oviducts. No decussation (*chiasma*) exists between the optic lobes, but merely a lateral cohesion. The swim-bladders have pneumatic tubes; the skeleton is bony, or partly cartilaginous; and the ventral fins are situated on the abdomen. According to the researches of Kölliker, the skeletons of the Plectognaths and Lophobranchs are destitute of bone corpuscles, but those of the other orders enumerated as Ganoids by Agassiz contain these organisms. All the above characters do not exist in every Ganoid; and the essential parts of structure are, according to Müller, *several rows of valves in the arterial bulb, free operculated gills, and abdominal ventral fins.*

ORDER IX.—STURIONIDANS.

FAMILY I.—ACIPENSEROIDS.

(Plate 14, fig. 72; Plate 15, figs. 73, 74.)

THIS order containing but one family may be characterized as a single group of Ganoids, whether these be termed with Agassiz a class of Vertebrals, or with Müller an order of Fishes. The distinctive characters of the Acipenseroids (*Sturiones*, Cuvier) are, according to Heckel and Kner, an elongated body, protected and made more or less pentagonal by five rows of bony shields; a protractile, toothless mouth on the ventral aspect; a blowing-hole and a single operculated gill-opening on each side, but no branchiostegals in the membrane; a cartilaginous internal skeleton; a heterocercal caudal, densely bordered with short bony rays in the upper lobe; and a long spiral valve in the great intestine. In the genus *Scaphirhynchus* the tail is depressed at the root of the caudal, which is not the ease in the members of the more populous genus, *Acipenser* (Sturgeon) nor in that of *Planirostra* or *Polyodon*. Of these forms the family and order consist.* The species are numerous in the temperate parts of the northern hemisphere, both in the Old and New Worlds, but they do not enter the arctic regions, and are unknown in the South Seas.

Among the ancients, says Pliny, the *Acipenser* was considered to be the noblest of fishes; but it had ceased to be esteemed in his time, at which he expresses his surprise, since it was rare. The *Attilus* of the Po, which is considered by modern ichthyologists to be of the same genus, is stated by Pliny to be sluggish and

* *Dinectes* and *Proceros* are two genera of this family, named but not sufficiently characterized by Rafinesque-Smaltz.

ing parts of Canada, wherein about ten species have been detected by Agassiz, and they are considered to be the nearest representatives now living of the extinct ganoid fishes.

In this family the upper jaw, which is elongated in the axis of the fish, is composed of several pieces; and the mandible is also composed of many pieces, as in the reptiles. The vomer is of two pieces, separated by a median cleft. Instead of the first vertebra being united to the occipital bone by opposing cups filled with an elastic gelatinous fluid as in ordinary fishes, that joint is formed by a ball and socket, so that the head has a nodding movement. The olfactory organ, situated at the tip of the upper jaw, contains the ordinary nasal folds arranged simply. The gills, on four arches, have a perfect bifoliate structure, and behind the last arch there is the ordinary fissure; a respiratory gill lines the operculum, and a pseudobranchia is also present. The branchiostegous membrane passes without division evenly across the throat, and is sustained on each side by three branchiostegals. The swim-bladder is divided into cells, the partitions being provided with muscles; and the pneumatic opening is a long slit in the upper wall of the throat. The stomach has no cæcal expansion; there are several pancreatic cæca; and there is no spiral valve in the large intestine. All the fins are protected on their proximal edges by two rows of spinous scales, and are supported by jointed rays only. The heterocercal caudal is abruptly truncate, its rays being inserted partly at the extremity of the vertebral column, partly beneath it. The upper jaw and mandible are closely set with raduliform teeth, bordered by a row of larger pointed ones. The Lepidostids have no blowing-holes like those of the Sturgeons and Polypteres.

FAMILY II.—POLYPTERIDS (*Polypteridæ*).

Plate 14, fig. 71.

This is an African family hitherto detected only in the Nile, Senegal, and Tchadda or Niger. It is equivalent to Müller's group of *Polypterini*, and is not considered to be a less characteristic representative of the Ganoids than the Lepidostids. *Polypterus*, the only genus, consists of three species closely resembling each other. They are elongated fishes, with blunt depressed snouts, having their heads protected by bony plates—somewhat similar to the cephalic plates of the Sturgeons—and their backs furnished with an even row of detached finlets, each having a strong spine in front, followed by four or five soft branching rays. The caudal, bluntly rounded, embraces the acutely conical end of the tail, and comes farther forward on the dorsal aspect than it does below. The anal is situated immediately before the lower lobe of the caudal, and the ventrals are behind the middle of the fish. These are supported in front by scaly bases, and the pectorals have still more conspicuous scaly bases resembling short arms. The scales which closely envelope the body are very strongly adherent, stout, and very hard.

In this family the upper jaw is not divided by a longitudinal cleft as in the Lepidostids; and the mandible and skull generally, are constructed as in the osseous fishes. A labial cartilage situated at the corner of the mouth supports the upper and lower lips. The nostrils are more complicated than in other fishes, as they consist of a large labyrinth of five passages, each having a gill-like folding of the lining membrane. The anterior nostril is prolonged into a membranous tube; the posterior opening is a small cleft before the eye. The fourth gill is unifoliate only; there is no opercular gill; no pseudobranchia; and no inferior pharyngeal bones. The stomach is cæcal; there is a pancreatic cæcum; and the large intestine is furnished with a spiral valve. The air-bladder consists of two sacs of different lengths, opening into a short common chamber, which communicates by a long glottoid fissure with the ventral floor of the gullet. A single gill-opening on each side, has the common branchiostegous membrane covered with a bony plate; and there is also a blowing hole on each side, furnished with an osseous valve.

The *Gymnarchus* or *del-el-far* of the Nile has a lung-like air-bladder supplied with venous blood.

ORDER XI.—HOLOCEPHALIDS.

(Plate 15, figs. 75, 76.)

PASSING by the Cœlocanth order as being wholly fossil, we come to the Holocephali, containing the single family group of CHIMÆRIDS. These form a passage to the Chondropterygians by the arrangement of their gill-openings. Like the Sturionidans, they have only one external operculated opening on each side; but under the integument there is a common canal proceeding from it, and receiving the four branchial slits. The complete biserial gills are attached by their margins, and are only three in number; but the inferior pharyngeal or fourth arch supports an uniserial gill, and there is an accessory one on the inner side of the operculum. There is a spiral valve in the intestine, and there is no swim-bladder. The long, muscular, arterial stem is provided with three rows of valves. Placoid granules exist in the integument, but the internal skeleton is cartilaginous, with partial and scanty bony deposits. Most of the fins are supported in front by a strong spine, and the ventrals are situated on the belly.

The upper jaw is represented by the vomer, palatines, and tympanals, in a rudimentary state, on the sides of the snout; and the function of teeth is performed by four hard, bony plates above and three below. The males are provided with trifid appendages named "claspers;" and the eggs of the females are large and leathery or horny, with flat velvety borders.

The genera are—*Chimæra* (British) and *Callorhynchus*.

SELACHIANS.

(Plate 16, the six figures; Plate 17, figs. F and G.)

THIS term, as employed by Cuvier (*Sélaciens*), includes the Sharks and Rays, and was equivalent with him to his second order of Chondropterygians, comprising those which have *fixed gills*, by which they are distinguished from his first order of cartilaginous fishes, which have movable gills. These have been noticed above under the denominations of Acipenseroids and Holocephalids. The group is equivalent to the *Plagiostomi* of Müller and Owen. By Agassiz the Holocephalids are associated with the Galeodes (or Sharks) and the Batides (or Rays), the three groups being considered to be orders of a class of vertebrals called by him SELACHIANS. This arrangement is, as has been already intimated, merely provisional, and dependent for final adoption on the issue of researches not yet completed by the illustrious naturalist who suggested it. The Selachians so constituted are nearly identical with the same author's PLACOIDS defined in his treatises on Fossil Ichthyology, and the student ought therefore to be told that placoid scales are hard osseous productions of the skin, sometimes in form of plates of large size, sometimes in shape of small points (forming when the skin is prepared for use in the arts the substance known by the name of "shagreen"), and at other times in form of thorns or prickles. All these differ from ganoid scales in the absence of enamel, as well as in their less regular shapes; and Kölliker states that the spines of the Selachians are formed of dentine. The author just named says that the internal skeleton of the Selachians differs in type from that of the Ganoids, and from that of all other fishes except the Dermopteres, in being merely common cartilage, or cartilage indurated by the deposition of earthy matter, but having no real bone-cells. In structure, therefore, the dermal skeleton of the Selachians is in advance of the internal one.

The heart of the Selachians consists, as in other fishes, of a single series of chambers, the first of which named the "venous sinus" is a mere receptacle of the venous blood coming from all parts; the auricle and ventricle which succeed it are considered to be the more essential parts of the central propelling organ, and beyond the last named is the stem of the arterial system, named generally the arterial bulb, but which in the Selachians is cylindrical. In these fishes the bag or pericardium in which the heart moves communicates with the cavity of the abdomen by a canal, which is single in the Holocephalids, but which in the Sharks and Rays bifurcates after leaving the pericardium. The venous sinus lies within the pericardium, and is bivalvular at its entrance into the auricle; and there are from two to six rows of transverse valves within the long muscular arterial stem.

The gills of the Sharks and Rays are fixed or adherent to the walls of the branchial chambers, each chamber having an interior pharyngo-branchial slit to admit the water of respiration from the mouth, and a peripheral orifice to allow it to escape. In the Sharks these external orifices are situated laterally, and are generally five, but in a few cases six or seven; in the Rays they are on the ventral aspect, and are always five in number. The gills of the Selachians are, together with the scapulo-coracoid arch, farther back than in the osseous fishes, being behind the skull; and the heart, which occupies the triangular space between the gills and the chevron of the coracoids, has consequently a similar more backward position. The ventrals are abdominal, and there is no swim-bladder. All have the inner membrane of the intestine expanded near its termination at the vent into a valve, which exhibits one of two types of form. In one type the intestinal valve is screw-formed or scalariform, making a spiral slope; in the other the valve is rolled longitudinally on itself, and attached lengthwise to the wall of the intestine; both forms serving to augment the surface of the comparatively short intestine.

The Sharks and Rays received from Duméril the name of PLAGIOSTOMES, and this appellation being equivalent to the Sélaciens of Cuvier, was adopted by Müller and Henle in their comprehensive *Beschreibung der Plagiostomen*, which is our chief guide to a knowledge of these fishes. The arrangement of these ichthyologists is as follows:—

The SQUALI or SHARKS (*Galeodes* of Agassiz) are Plagiostomes with lateral gill-openings (*Stigmata*); free supplementary eyelids; an incomplete scapulo-coracoid girdle suspended to the soft parts behind the gills, but having no articulations either with the skull or spine. These fishes do not possess a cephalopterous cartilage.

A. *First division.*—Sharks having one anal fin and two dorsals placed far back, the first dorsal being over or behind the ventrals. This division is comprised in the family of SCYLLIIDÆ.

B. *Second division.*—Sharks having two dorsals and an anal; the first dorsal being situated over the space intervening between the pectorals and ventrals.

1. *First subdivision.*—Sharks of B group having a blinker (or nictitating membrane), but no spout-holes; and the last or last two stigmata situated over the base of the pectoral. It includes the families CARCHARIÆDÆ; SPYHNÆDÆ; and PRIÆNODONTIDÆ.
2. *Second Subdivision*—Sharks of B group which have spout-holes and blinkers; also the last or last two stigmata situated over the base of the pectoral. To it belong the families GALEIDÆ; SCYLLIODONTIDÆ; and MUSTELIDÆ.
3. *Third subdivision.*—Sharks of B group with spout-holes but no blinkers. It embraces the families LAMNÆDÆ; ODONTASPIDÆ; ALOPECIÆDÆ; CESTRACIONTIDÆ; and RHINODONTIDÆ.

C. *Third division.*—Sharks having but one dorsal and one anal fin, forming one family, the NOTIDANIDÆ.

D. *Fourth division.*—Sharks furnished with spout-holes and two dorsals, but having neither blinkers nor an anal fin. The five stigmata are all situated before the pectorals; and the intestinal valve is spiral. It embraces the families of SPINACIDÆ; SCYMNIDÆ; and SQUATINÆDÆ.

ORDER XII.—GALEODS OR SHARKS.

SQUALI.—(*Characterized above.*)

FAMILY I.—SCYLLIDS (*Scylliidæ*).

In this family there is one dorsal fin standing over or behind the ventrals, another farther back, and one anal. The eye is not provided with a nictitating membrane, but spout-holes exist behind the eyes. Of the five stigmata the last one is over the base of the broad pectorals; at the corner of the mouth there is a furrow in the integuments, and also a labial cartilage above and below. The teeth have a pointed mesial cusp, and from one to four denticles on each side of it. The caudal fin is extended longitudinally, with a truncated or r unded tip, and without an under lobe or merely with the traces of one, but with a notch near the end, beneath.

The family includes the following genera—*Scyllium*; *Pristiurus*; *Hemiscyllium*; *Chiloscyllium*; *Crossorhinus*; *Ginglymostoma*; and *Stegostoma*.

In the British seas there have been detected the Small-spotted Dog-fish (*Scyllium canicula*); the Large-spotted Dog-fish (*Scyllium catulus*); and the Black-mouthed Dog-fish (*Pristiurus melanostomus*).

FAMILY II.—CARCHARIÆDANS (*Carchariædæ*).

In these Sharks the first dorsal is situated over the space between the pectorals and ventrals, and they have also a second dorsal and an anal; the eyes are furnished with nictitating membranes, but spout-holes do not exist in a pervious state in the adults; each nostril is generally provided with a small three-sided flap on its upper border; the mouth has a boldly convex outline, with small folds of skin at its corners; the anal fin is placed directly under or close behind the second dorsal; and the caudal fin has always a short under lobe, with a notch on the inferior edge of the elongated upper lobe, close to its obliquely truncated end; the intestinal valve is rolled longitudinally, and is not scalariform; the scales are small, and the skin smoothish. The family consists of the genera *Carcharias* and *Prionodon*, and includes some of the Sharks that are most numerous in the tropical seas, and most dangerous to mariners. The Blue Shark (*Carcharia sglaucus*) frequents the Cornish coasts, and does much injury to the fishermen by cutting their lines and nets, for which its serrated teeth are well adapted.

FAMILY III.—SPHYRNÆDANS (*Sphyrnædæ*).

Sharks resembling the Carcharidans in the number and position of the fins, in having nictitating membranes, and wanting spout-holes, but having the eyes stilted out by a great lateral prolongation of the orbits, giving a form to the skull from whence comes the popular name of Hammer-headed Sharks. The only genus is *Sphyrna*, also called *Zygæna*.

The great lateral breadth of the skull, arising from the projection of the orbits, gives a very strange aspect to these Sharks, one of whom, *Sphyrna zygæna*, or the Hammer-headed Shark, is an occasional visitant of the British seas.

FAMILY IV.—TRIÆNODONTS (*Triænodontes*).

In this family the head is flat, and the snout is sometimes pointed, sometimes blunt; the nostril-valve is broad, or less commonly lengthened out into a barbel; the orifice of the eye longitudinal, and the fold at the corner of the mouth is very small; the teeth resemble those of the Scyllids, but with a longer middle cusp, and not more than one or two lateral denticles; the second dorsal fin and the anal are opposed to one another, or nearly so, and the scales have three, five, or seven keels.

The only genus is *Triænodon*, an inhabitant of the Indian Ocean and Red Sea.

FAMILY V.—GALEIDANS (*Galeidæ*).

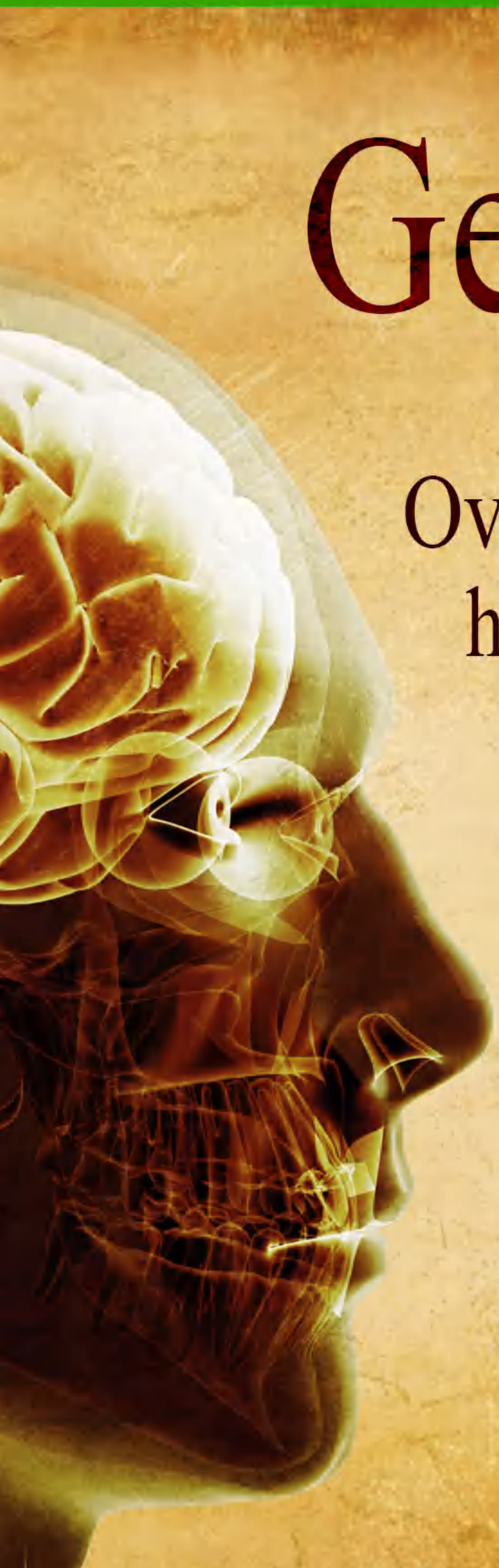
In this family there are also two dorsal fins and an anal, as in the four preceding ones, but the first dorsal is farther forward than the ventrals. Nictitating membranes and spout-holes are both present, and the last stigma is over the base of the pectoral. Nostrils, orbits, and corner folds of the mouth as in the Carcharidans, and the small labial cartilages are always present. Teeth of both jaws alike, flat, oblique, and with entire or serrated cutting edges. The scales are small and three-keeled, with a mesial cusp. In the upper lobe of the caudal there are one or two notches.

The genera are—*Galeus*; *Galeocerdo*; *Loxodon*; *Thalassorhinus*.

The only British species is the Common Tope (*Galeus canis*). *Galeocerdo arcticus* is not uncommon in the North sea, but has not been taken among the British isles, unless it should be the White Shark of the Orkneys, which has not been examined by a competent ichthyologist.

FAMILY VI.—SCYLLIODONTS (*Scylliodontidæ*).

The members of this family are characterized by a flat head, blunt snout, and a moderately broad and long nasal flap. The depressions at the corners of the mouth and the labial cartilages are large, and the spout-holes are of medium size. The dentition and form of the fins are those of the proper Scyllids, the under lobe of the



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membranes. The single dorsal stands behind the ventrals, and partly before the front of the anal. The long caudal is notched near the obliquely docked end, and has a small under lobe. The teeth are strongly serrated. One genus, *Hexanchus*, has six stigmata; the other, *Heptanchus*, has seven. One species, the Gray Notidanus (*Hexanchus griseus*), has been taken off the Isle of Wight and also on the Cornish coast.

FAMILY XIV.—SPINACIDS (*Spinacidæ*).

This family and the two which immediately succeed it form a division of the Sharks which is characterized by Müller and Henle as having spout-holes and two dorsals, but neither anal nor nictitating membrane. All the five stigmata are before the pectorals, and the intestinal valve is scalariform. The Spinacids are distinguished from the other two families by having a stout spine in front of each dorsal.

The genera are—*Acanthias*; *Spinax*; *Centrina*; *Centrophorus*; and *Centroscyllium*.

The Picked Dog-fish (*Acanthias vulgaris*) is very common on our coasts, so abundant, that Mr. Couch says he has known twenty thousand to have been taken at one cast of the seau. At one time these Dog-fishes committed such ravages on the fisheries of Finmark that eight vessels were fitted out expressly for their capture, and though many thousands were taken there was no sensible diminution of their numbers.

This species would appear to be extremely prolific periodically, and to have been no less annoying to the fishermen formerly than in later times. In the "Domestic Annals of Scotland" by Robert Chalmers, we find the following quotation from the Journal of Spalding, the Town-clerk of Aberdeen:—"1642. From the beginning of this year up to June there was a scarcity of white-fish along the east coast, to the hurt and hunger of the poor, and beggaring of the fishermen. It was reported that when the fishers had laid their lines and taken fishes abundantly, there came ane beast called the Sea-dog to the lines, and ate and destroyed the haill bodies, and left nothing on the lines but the heads. A judgment surely from God Almighty, for the like scarcity of fishes to continue so long has scarcely been seen in Scotland; whilk bred great dearth of meal and malt, at aught, nine, or ten pounds the boll, and all other meats also very dear."

FAMILY XV.—SCYMNIDS (*Scymnidæ*).

With the same number of fins and spout-holes as the Spinacids, this family is recognized by the absence of spines in the dorsals. The upper teeth are pointed; the lower ones trenchant and not denticulated.

The genera are—*Scymnus*; *Læmargus*; *Echinorhinus*; and *Pristiophorus*.

Valentine's Sea-hound (*Scymnus lichia*) is reported to have been taken on the British coasts, but details are wanting. The Greenland Shark (*Læmargus borealis*) has been several times captured in the Scottish seas; and the Spinous Shark (*Echinorhinus spinosus*) has been caught off Yorkshire and on the Cornish coasts.

Pristiophorus is a genus differing remarkably from the rest of the group in having the snout elongated like a flat sword-blade, set on each side with sharp slender teeth of different lengths.

FAMILY XVI.—SQUATINIDS (*Squatinidæ*).

Head and body depressed; the broad pectorals and ventrals laterally spread out so as to resemble the Rays; the stigmata ensconced in the deep slit that separates the pectorals from the head, but not opening on the ventral aspect as in the Rays. The large spout-holes are behind the eyes, which are on the dorsal aspect, and the mouth transversely cleft is at the extremity of the snout. There is no anal fin. The family is represented by a single genus and species called the Angel-fish (*Squatina angelus*), which occurs in considerable numbers on our coasts and is very voracious, devouring ground-fishes greedily.

A shark caught at Bermuda measured eighteen feet in length, and its jaws, when extended to the utmost, admitted three grown-up persons to stand upright between them; and the *Rangoon Chronicle* of the 3rd March, 1854, mentions the capture of a shark of those seas which had a length of thirty-five feet—(Simmons, *Cur. of Food*). Dr. Barclay describes some fragments of an enormous shark.

ORDER XII.—BATIDES (RAYS or SKATES).

THIS order, named ROCHEN or RAIÆ by Müller and Henle, is composed of flatly-depressed Plagiostomes, having spout-holes, five stigmata of a side opening on the ventral aspect under the pectorals; a complete scapulo-coracoid girdle soldered above to the vertebræ adjoining the skull; a cephalopterous cartilage, and the upper eyelids either closely adherent to the eye or altogether absent. Müller and Henle group them in the following way:—

A. *First division.*—SQUATINORAIÆ.—Batides having the head elongated into a flat snout; and a robust, fleshy tail with lateral keels; two dorsals and a terminal fin supported by rays. The teeth are flat, resembling a mosaic pavement; and the upper eyelids are adnate. The families are—PRISTIDÆ and RHINOBATIDÆ.

B. *Second division.*—TORPEDINES.—Disc rounded; very blunt in front. An electrical apparatus encompassed by the pectoral fins. One family, the TORPEDINIDÆ.

C. *Third division.*—RALÆ.—Pectorals cohering to the snout, the attachment reaching backwards to the ventrals, forming an oval or rhomboidal disc, terminated by a more slender tail than the preceding groups. In the group are the following families:—RAIÆDÆ; TRYGONIDÆ; MYLIOBATIDÆ; and CEPHALOPTERIDÆ.

FAMILY I.—PRISTIDANS (*Pristidæ*).

The members of this family have nearly the form of those sharks whose pectoral fins are distinctly separated from the head and do not reach to the ventrals. The snout is elongated and uniform, with stout lateral teeth which convert it into a double saw. The true jaw teeth resemble those of the Mustelidans, and form a mosaic pavement. The first dorsal stands close behind or partly over the ventrals. The lateral cuticular keels are not continued on the sides of the caudal. Very small, flat, roundish, or hexagonal scales clothe the smooth sleek skin. The family consists of a single genus (*Pristis*) of about six species called saw-fishes, whose beaks are often seen in museums, but complete specimens are rare.

FAMILY II.—RHINÆDANS (*Rhinædæ*).

In these a disc is formed anteriorly by the conjunction of the pectorals with the snout. The four-cornered pectorals do not reach the ventrals, and are separated by a notch from the cephalic part of the disc. The lateral caudal keels are continued on the sides of the bilobate caudal, whose upper lobe is rather the largest. The margins of the jaws are undulated, three eminences of the lower one corresponding to as many hollows in the upper one. The nostrils are longitudinal slits near the mouth, with a flap above and below.

The genera are—*Rhina* and *Rhinchobatus*.

FAMILY III.—RHINOBATIDS (*Rhinobatidæ*).

The ventrals in this group are close behind the pectorals, which pass imperceptibly into the snout, without the notch of the Rhinædans. The two dorsals situated on the hinder part of the tail are equal in size, and the caudal has no under lobe. The keels commencing behind the ventrals converge towards the upper edge to the caudal. The transverse mouth is straight or gently arched. The flat quincuncial teeth are traversed by a cross ridge. The spout-holes are close beneath the eyes, and there is a row of pores beneath the scapulo-coracoid girdle.

The genera are—*Rhinobatus*; *Syrrhina*; *Trygonorhina*; and *Platyrhina*; all of them foreign to our seas.

A "Snow-fish" of great rarity, whose skin is prized greatly in Assam as a valued medicine, was recognized by Mr. Blyth as a *Rhinobatus*. The *Gungball* or Snow-fish of Kunàwar is thought by some naturalists to be a burrowing lizard. It is described by the natives as having four legs and a human face.

FAMILY IV.—TORPEDINIDS (*Torpedinidæ*).

In the members of this family a galvanic battery occupies the spaces between the skull and the pectoral fins on each side, and as usual in electrical fishes the skin is quite smooth, developing neither ordinary scales nor acute spines. The disc is rounded, very obtuse anteriorly, and terminates posteriorly in a tail, which is less fleshy than that of the two preceding species, and is provided with a sub-triangular caudal. The dorsals are either absent, or there is one or two situated in the tail, and the ventrals are close behind the pectorals. A longer or shorter keel exists on the side of the tail.

The following genera enter the family—*Torpedo*; *Narcine*; *Astrape*; *Temera*; *Discopyge*; and *Hemigaleus*. Two species of Torpedo are natives of the British seas.

FAMILY V.—RAIANS (*Raiædæ*).

In this numerous family the disc is rhomboidal, the lateral angles being formed by the meeting of the proximal and distal margins of the pectoral fin of each side; the snout being a third angle of the rhomb, and the origin of the tail the fourth. The attachments of the pectorals extend from the roots of the ventrals to the snout. The orbits are separated from the spout-holes by slender cutaneous bridges; and each of the nostrils, which are on the ventral aspect, is protected by a free rounded lobe of the nasal flap, as it projects laterally from the even surface of the upper lip. The flat teeth acquire a central cusp in the adult fish in the season of reproduction. Two small dorsals are situated towards the end of the tail; and the caudal is either absent or exists merely in form of a cuticular seam. The skin is smooth or prickly.

The genera are—*Raiæ*; *Sympterygia*; and *Uraptera*.

Eight different species of Skates (*Raiæ*) inhabit the British seas, and furnish much wholesome nourishment to the population.

FAMILY VI.—TRYGONIDS (*Trygonidæ*).

In this family the nasal flaps are not lost in the upper lip so as to form one even surface between the nostrils, but have a common free ledge with short fringes, which is attached to the upper jaw by a mesial bridle only, while the rounded lateral ends project over the nostrils. Under the flap the nostrils approach each other, and there is no valvular lobe on their exterior sides. The large spout-holes are close behind the eyes, which have adnate eyelids. The teeth are transversely elliptical, and have a rounded cross ridge, with either an acute root or one divided into points. The ventrals are simple. The tail is thin and often taper-pointed, without lateral cutaneous keels. It has no caudal or other kind of fin either before or behind a barbed spine, or spines, which it sometimes bears, sometimes wants.

The genera which enter the family are—*Anacanthus*; *Urogymnus*; *Trygon*; *Pteroplatea*; *Hypolophus*; *Tæniura*; *Urolophus*; *Trygonoptera*; and *Ætoplatea*.

The Sting-ray or Fire-flaire (*Trygon pastinaca*) is a British species.

FAMILY VII.—MYLIOBATIDS (*Myliobatidæ*).

In this family the pectorals are interrupted on the sides of the head, which is more prominent than other members of the Raian order; but at the proximal extremity of the disc the pectoral rays are developed anew, constituting a kind of cephalic fin. The nasal lappets of each side coalesce mesiad into a quadrilateral fringed flap, which reaches to the mouth. Nostrils approximating to the mesial plane, where they are separated by a thin bridle, which has a lateral connection with each corner of the transverse mouth. Teeth broad and flat in geometrical polygonal figures, forming plates which extend far back into the mouth, and are bounded posteriorly in both jaws by membranous folds. Eyes separated from the spout-holes by broad bridges of integument, and situated on the sides of the skull. Tail long and whip-like, with a dorsal fin at its root and a spine behind it.

The genera are—*Myliobatis*; *Ætobatis*; and *Rhinoptera*.

The Eagle-ray (*Myliobatis aquila*) frequents the British seas.

FAMILY VIII.—CEPHALOPTERIDS (*Cephalopteridæ*).

In this family the proximal end of the head is straight transversely, but with an ear-like appendix on each side, curving towards the ventral aspect, and formed by a procephalic detachment of the pectoral fin. Mouth in front or beneath, reaching nearly from one of these ear-like fins to the other. Nostrils widely apart. Eyes lateral, situated immediately before the beginning of the proper pectorals, which have a great lateral expansion. Spout-holes on the dorsal aspect and rather distant from the eyes. Tail as long as the body or longer, with a spine behind the dorsal fin.

The genera are—*Cephaloptera* and *Ceratoptera*.

The Horned-Ray (*Cephaloptera Giorna*) has been captured on the coast of Ireland. *Ceratopteræ* of great size, exceeding twenty feet in length, have been taken in the West Indies; and traditions of some that were seen having a still vaster spread of the pectorals are current in Barbadoes.

ORDER XIII.—PROTOPTERES (*Protopteri*).

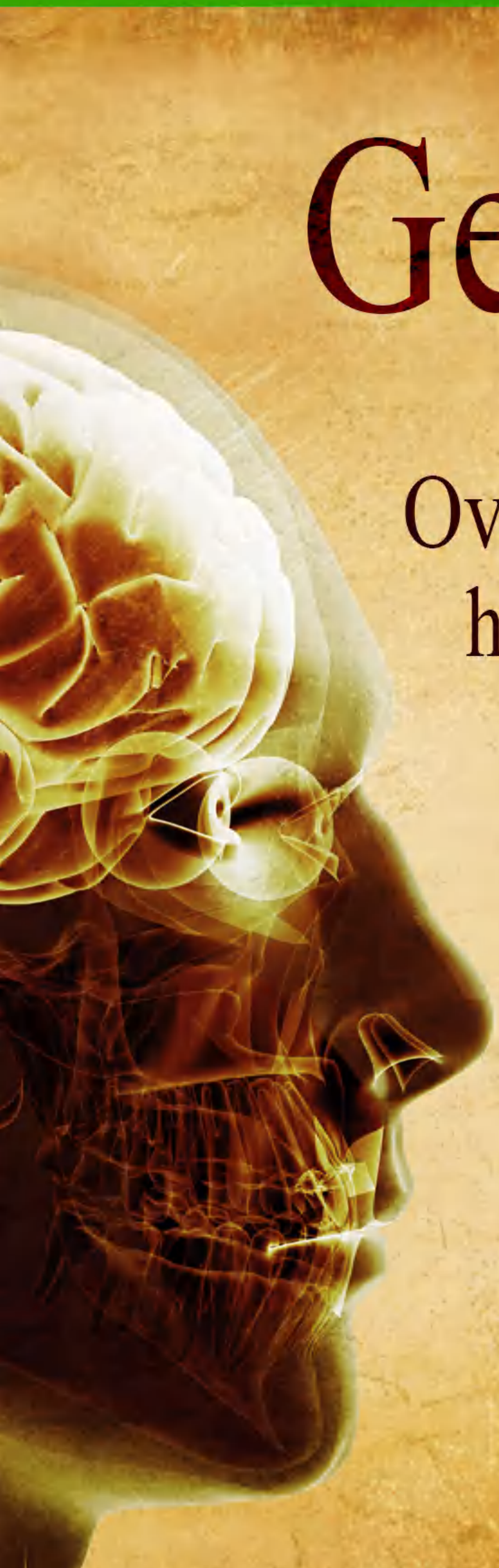
THIS order was named by Professor Owen from the embryonic condition of the vertical fins, which, like those of the tadpole of a frog, are developed on the upper and under edges of the animal from a continuous fold of the integument, and, as in the order of Dermopteres, are persistent in the Protopteres and Lepidosirens. Müller in allusion to the resemblance of these fishes to another tribe of Batrachians, named the order Sirenoids. The characters that have been assigned to this group, are the internal skeleton in part ossified, in part cartilaginous; vertebral column retaining the embryonic form of a "notochord," and the dermal skeleton existing in form of cycloid scales; the pectorals and ventrals, which are situated on the abdomen, each in form of a single tapering, flexible filament or barbel, supported internally by a soft cartilaginous ray. The gills are filamentary and free; there is no pancreas; the swim-bladder appears as a cellular lung with an air-duct; and there is a spiral valve in the intestines. The *Protopterus annectens* of the Gambia, and the *Lepidosirens paradoxa* of the Amazon, are the representatives of the order.

The Gambia Protoptere inhabits districts which are flooded by tropical rains, and leads an active piscine life as long as the waters prevail; but when the flood is passing off, this curious animal burrows into the mud, which a vertical sun soon bakes into a hard crust. An aperture, however, is left in this clayey cell by which some air is admitted, and therein the fish, besmeared by a thick layer of mucus passes, the dry season, rolled up in a torpid condition. Protopteres have been brought to this country imbedded in the clay, and when placed in a stove and well watered, have come forth in a vigorous condition. The air-bladder is supposed to perform the function of a lung during the time that the Protoptere is secluded from the water; and the communication of the air-tube with the œsophagus is fortified by a tracheal cartilage. The disposition of the gills is peculiar. In front there is a uniserial or half gill, but the first branchial arch is united to the second, and is not furnished with gills; the gills of the second arch are biserial, long, and thread-like; the third arch is merely fringed or denticulated on the edge; the fourth arch is united by membrane to the third, and has no gills; but the fifth, or pharyngeal arch, supports a uniserial gill. There are only three passages between the gills, and only a portion of the blood is oxygenated, the blood in the arteries that supply the gill-less arches joining the circulation without undergoing that process.

Naturalists are divided in opinion as to these animals being fishes or reptiles. Professor Owen's reasons for ranking them in the first of these classes are—the gelatinous condition of its notochord, the form of the transverse processes of that column, the attachment of the scapulo-coracoid arch to the skull, the branchiostegous membrane and the operculum covering the permanent gills, the absence of a pancreas, the presence of a spiral intestinal valve, the position of the vent, the muciferous pores on the head and lateral line, and the nasal sacs shut off from the interior of the mouth.

The Protoptere is much like an Ophidium with an acute tadpole-like tail.

END OF FISHES.



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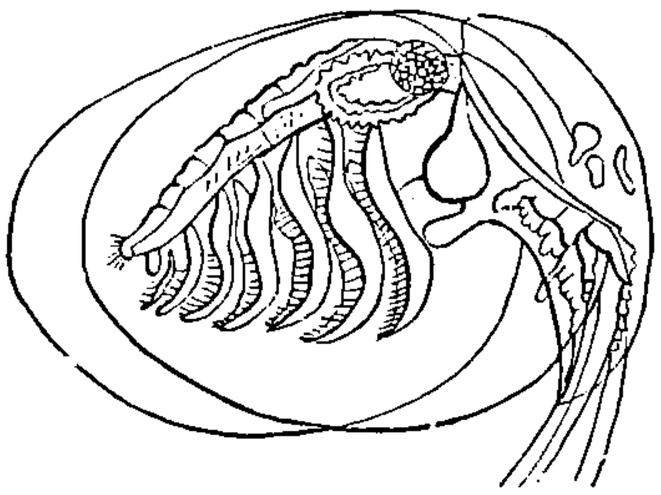
Class V.—INSECTS (Insecta).

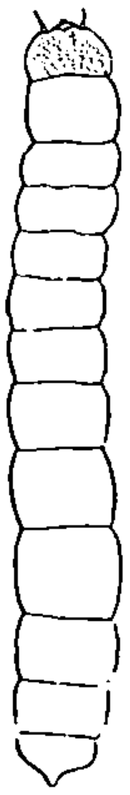
In the following pages I intend to give, as far as space and other circumstances admit, a general view of the various orders of *true* Insects. By *true* is meant Insects, as distinguished from Crustacea (such as Lobsters, Shrimps, Crabs), Spiders (including Mites), Centipedes (or Myriapoda), and such like, which are all *insects* in the strict sense of the term; that is, all

Fig. 47.



One of the Entomostracous crustacea, showing very clearly annulose structure.

Fig. 48.

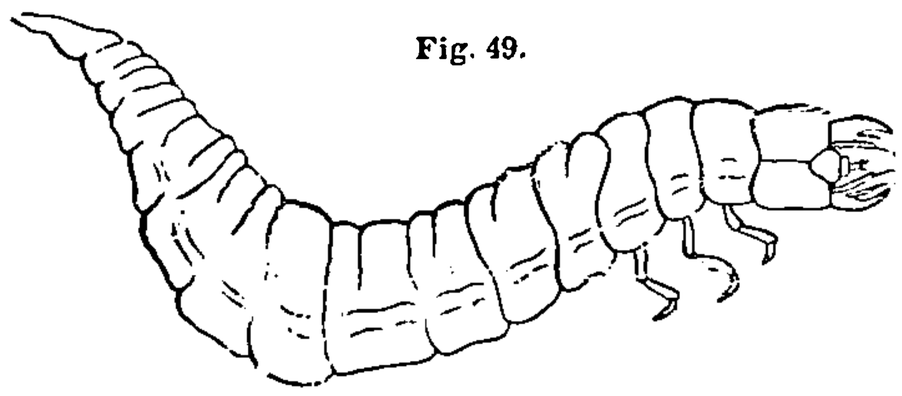


Larva of a Beetle, showing the annulose structure.

these classes have the body composed of many segments or rings (*annuli*)—hence their general name of Annulosa: while their various parts, such as the antennæ, organs of the mouth and head, thorax and its appendages, are all formed of various parts or joints, as may be seen by looking at a Lobster, a Centipede, or at any Beetle—even the "black beetle" of the kitchen, the Cockroach, which, however, we find belongs to a different order to that containing the "great army" of Beetles—see figs. 47, 48, and 49.

Jointed feet are strikingly indicative of annulose structure, and, hence, many naturalists call them Condylopa, or *creatures with jointed feet*. In dividing the invertebrated classes (those, namely, which have no *real* skeleton), we must hardly compare them with the vertebrated animals. Insects are organized on a totally different plan. Most vertebrated animals have their

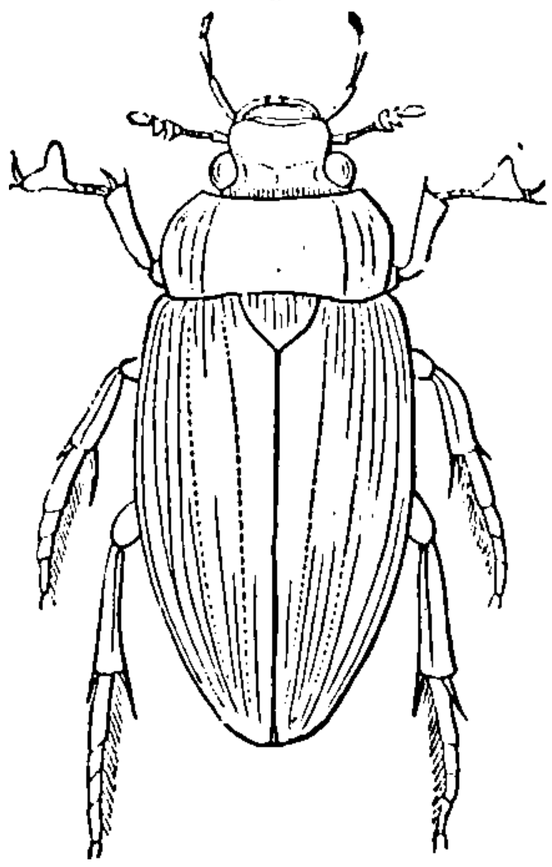
Fig. 49.



Larva of Hydrous piceus.

nervous system deranged, or destroyed by any injury to the spine; but insects, or rather annulose animals like insects—Spiders, Crabs, and Centipedes—are very little, if at all, seriously injured in this way. The nervous matter in Annulosa is collected in ganglia *all along* the body, and I might enter on this ganglionic

Fig. 50.



Imago of large Water Beetle.

structure were animal anatomy my object. Most of the Annulosa undergo great changes in their course of

life—changes nearly as strange, as any read of in the Metamorphoses of Ovid.

These changes are, indeed, well called "metamorphoses," from a Greek word. An insect deposits an egg, as indeed birds, reptiles, and fish do; but the egg, when hatched, generally turns out a creature little, if at all, resembling the parents. This creature is named a grub, or caterpillar, or better still, a *larva*, from the Latin name for "a mask." The silk-worm is a complete "mask of the moth," and is totally unlike the soft, scaly, winged creature, which deposits the egg. The larvæ eat unceasingly, but change their skins a certain number of times, and at those periods cease to feed. At last they attain their full size, and they change, are metamorphosed—at least most of them, such as Moths and Butterflies, and Beetles, and Bees, and Flies are changed—into what is called the *pupa*, as unlike the *larva* as the larva is unlike the mother. These pupæ are often inclosed in cocoons. In this state they are quiet, at least generally so, and do not eat; and it is from this *pupa* that the perfect insect escapes,—a splendid Butterfly, an active Beetle, a busy Bee, a bustling, humming Fly, called the *Imago*—see fig. 50.

Insects are divided into various c*lasses* and or*ders*. The *classes* and *orders* are important, and stand for, or represent, many great points of structure.

From the space at his disposal, the author cannot go into this part of the work so minutely as he could wish. His object will be to present such views of the subject as may at once interest the general reader, and serve to guide the course of those who desire to study it more in detail.

There are two great and important divisions of insects, and yet at times they imperceptibly run into each other—Mandibulated and Haustellated Insects—according as they have distinct and transverse jaws, or a short or long, straight or bent, proboscis or haustellum.*

DIVISION I.—MANDIBULATA (*Mandibulated Insects.*)

I PREFER to begin with the HYMENOPTERA, the order which contains the Ant, the Bee, and the Wasp. They are certainly at the head of the insect world. In a strict scientific classification I would begin with the Ants; would go on from them to the Wasps, the Fossores, and the Bees; and so by Scolia to Chrysis, and then Chalcididæ, Ichneumonidæ, Siricidæ, and Tenthredinidæ.

ORDER I.—HYMENOPTERA.

THE first great order of insects is that of HYMENOPTERA, so called from their four transparent wings, ὑμην (hymen) being the Greek word for a membrane, and πτερα (ptera) for wings. They have jaws, though the tongue usually exceeds the jaws in dimension. The most highly developed instincts are observable in some of the insects of this order.

Wasps make a kind of whitey-brown paper; but, some of the foreign species construct nests of pasteboard-like material.

How regularly, how methodically, does the bee visit each flower! Among the Pentland and Braid Hills, on the slopes of lovely Arthur's Seat, on Hampstead and Weybridge or Walton Heaths, how pleasant to wander while

"The wilderness bee gangs floatin' awa."

Its hum, its motion, seem as much part of the scene, as the spring or summer day.

TRIBE—TEREBRANTIA:

So named from the singular, boring ovipositor of the female in this tribe. By some naturalists this tribe has been made an order. Their caterpillars are very like those of Lepidoptera, and somewhat resemble those of some Lamellicorn coleoptera.

FAMILY—TENTHREDINIDÆ (*The Saw-flies*).

The Saw-flies are a family of insects, some of which are dreaded by the agriculturist. They are a numerous family, and some of them, as the *Athalia centifoliæ*, occasion at times to the farmer such losses, by its ravages on his turnips, as to ruin him. This insect is sometimes seen flying in countless thousands. They are soft, heavy-looking insects, with wings covering the body in repose. There are forty-five British genera. *Tenthredo*, *Selandria*, *Allantus*, *Emphytus*, and *Lyda*, have the greatest number of species. Our figure is that of the *Crœsus septentrionalis* and two of its larvæ, copied from Ratzeburg's fine work, "Die Forst. Insekten"—see fig. 51.

Treatises have been written by many authors on the Turnip-fly, the insect to which we have alluded, whose caterpillars eat the leaves of the turnips, and keep the roots from growing.

Hartig has monographed the European species, and Klug has described many exotic species of this family. The character of one of the species, as observed by

* Of course, the comparative anatomist, and he who dissects minutely the mouth of an insect, will find that haustellated insects have small or abortive mandibles; and that mandibulated insects, like some Haustellata, have in their perfect state abortive mouths. The horny-jawed caterpillar of the Moth or Butterfly is changed into a haustellated insect, in its imago-state.

TRIBE—PUPIVORA.

So named from their being parasitic on the larvæ and pupæ of insects, at the expense of which the grubs of the Pupivora live. They were named *Muscæ trisetes* by old authors, from the three often long, bristle-like parts of which their ovipositor chiefly is composed.

FAMILY—ICHNEUMONIDÆ (*Ichneumons*).

The perseverance of these insects in depositing their eggs is very noticeable. In the summer months we often see some of them in our gardens, examining every leaf on the upper and under sides to find the caterpillars in which to place their eggs, vibrating their antennæ and wings, and evidently very restless and impatient.

One of the finest of the Ichneumonidæ is the North American *Rhyssa lunator*. It is common on Montreal mountain, in August and the beginning of September. The female may be then easily taken, when depositing her eggs in some stump or dead tree, as they insert their ovipositors so deeply into the wood that they cannot withdraw them quickly; and as the insect endeavours to escape, these organs are frequently broken.

In Canada many people fancy that it is the *Rhyssa* which kills trees by "stinging" them, as they term it, and so as often as they see it, they heedlessly destroy the very creature which helps to lessen the real enemy of the tree, whose works are more secret and deep.

In this country the fine *Rhyssa persuasoria*, the largest of the tribe, is frequently found in districts that are well wooded with firs; these trees are at times much injured by the large saw-fly, *Sirex juvencus*, which bores into the trunks and deposits its eggs. The larvæ, when hatched, do immense mischief by tunneling in all directions. These ravages are, however, frequently arrested by the *Rhyssa persuasoria*, the parasite of the Sirex. The Ichneumon larva, feeding upon that of Rhyssa, checks in some degree the injuries of that species.

PELECINUS POLYCERATOR—The Needle Ichneumon. Mr. Gosse, in his "Canadian Naturalist," p. 289, aptly applied the name of the Needle Ichneumon to this very singular insect. The female is of a polished black, and has a very long abdomen, the first five segments being each a third of an inch in length; the abdomen in the male, a sex which seems to be rare, is comparatively short. This insect seems to be abundant in Nova Scotia, but in Canada it is not so common. It is widely distributed over North America.

The long abdomen may be used by this insect in oviposition, it not being furnished with the usual ovipositor. Other species of the genus are found in Columbia and Brazil.

The family of Ichneumons is by far the most extensive one for numbers of species that exists. There are at least one hundred and twenty British genera, and *one* of these genera has upwards of two hundred species, while others have twenty, and others sixty species each. When it is considered that almost every Lepidopterous insect has its peculiar parasite of this family, and some of them more than one, some idea of their endless numbers may be formed.

The two Ichneumonidæ, figured on Plate 7, represent characteristic examples—fig. 3, the *Banchus pictus*, with a very short ovipositor, and fig. 7, *Ephialtes manifestator*, with a long one.

FAMILY—PROCTOTRUPIDÆ.

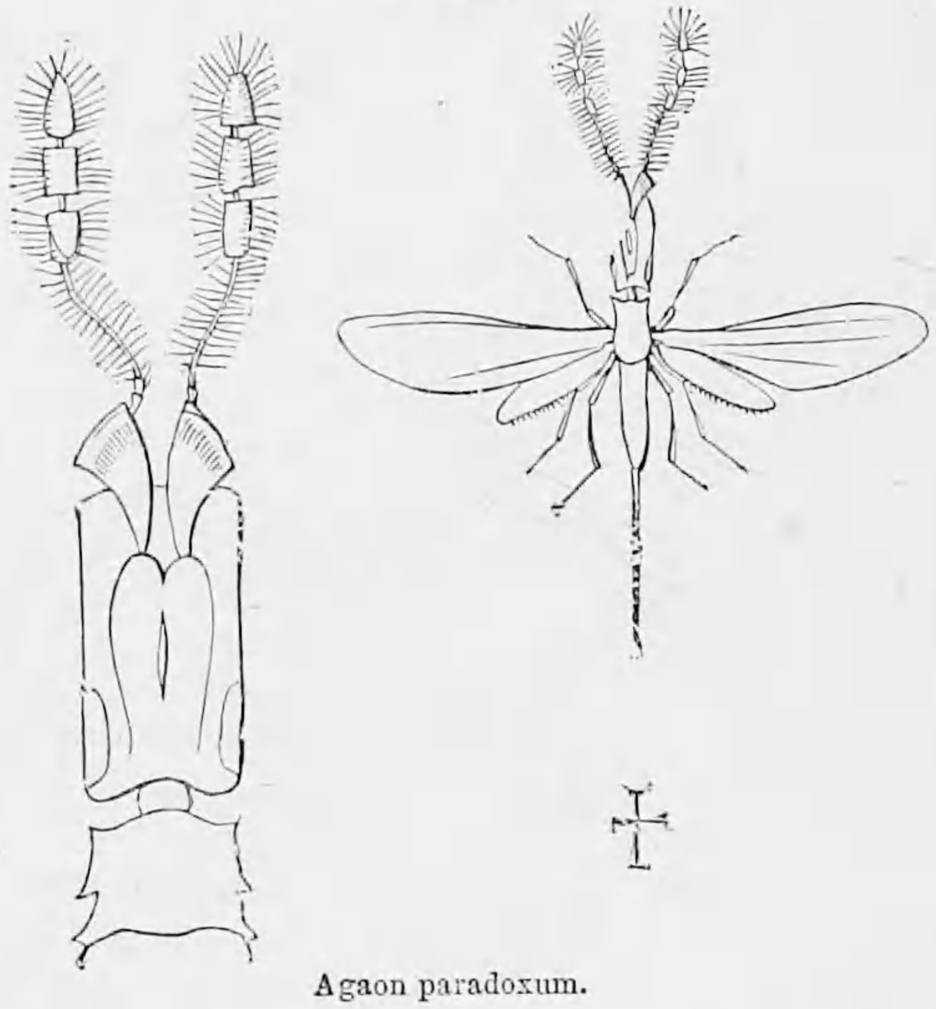
A very extensive family of insects, allied to the Ichneumonidæ. Many of them are exquisite little creatures, such as the charming *Mymar pulchellus*, figured by Mr. Curtis. There are nearly fifty British genera; one of these genera (*Platygaster*) has upwards of one hundred species. Mr. Haliday (note to "Westwood's Synopsis," vol. ii., p. 79) records, that the *Alaptus minimus*, one of the species, is the smallest Hymenopterous insect known.

All the species are very small, and are parasitic on eggs of insects or on insects themselves.

FAMILY—CHALCIDIDÆ (*The Brasslets*).

The Chalcididæ are a very minute family of parasitic insects, often of the most transcendant metallic polish, with filmy wings of few nervures, and sometimes with strangely-formed antennæ and heads, while the ovipositors of the females, are very curious—at times short and dagger-like, at others long and thread-like (fig. 53). Their numbers are legion—see fig. 53.

Fig. 53.



Agaon paradoxum.

I can only refer to one of the members of this family. In the cells of that interesting bee, the *Anthophora acervorum*, there is found a parasite of this family, named by Mr. Westwood *Melittobia;* by Mr. Newport, who very particularly described it, *Anthophorabia*. The female of this parasite is a shining dark-green insect, not more than half a line long. The male is equally small, but is of a testaceous yellow colour. In the male the wings are only rudimentary, and the eyes are not compound as usual; but in their place are simple

minute eyes, or ocelli, in addition to the three true ocelli on the crown of the head. This parasite was found feeding upon the larva of *Monodontomerus nitidus*, another parasite of the bee, which has been found in its cells, feeding on the pupæ. The late Professor Audouin, who first observed the *Melittobia*, discovered it in the nests of Osmia, Anthophora, and *Odynerus*, so that there are probably several allied species.

FAMILY—CYNIPIDÆ (*The Gall Insects*).

What has ink *not* done? to say nothing of a good goose-quill. And how little writing would there have been, had cuttle-fish ink bags been the only providers of the atramentous fluid! The galls of commerce, with their strong tannin so useful in making ink and in many other processes, such as dyeing black, are caused by the punctures of a small, dry-bodied insect with four clear transparent wings, on a species of oak (*Quercus infectoria*). This fly is the *Cynips Gallæ tinctoriæ*, and is abundant in the East—that is, in Western Asia.

The "blue galls" are most prized by the merchant. They are the galls of the first gathering, collected before the Cynips has issued from the gall, and consequently they have no hole in them. The "white galls" are inferior, containing a third less astringent matter than the others. The insect has escaped from them. The two sorts are generally mixed.

But there are plenty of other galls, some made by small flies, some by beetles, but more by members of this family. The long, hairy excrescences on the dog rose are the galls of a Cynips.

The *Poma sodomitica*—"Apples of Sodom"—are galls made by an insect of this family. These "*mala insana*" were mentioned by ancient writers as "beautiful exceedingly" to look at, but tasting like bitter ashes. Walter Elliott, Esq., of Wolfelee, long in India, on his route home found that these galls whose existence had begun to be doubted were *bonâ fide* galls, two inches long and about an inch and a half in diameter, on the outside of a rich, glossy, purplish red colour; while the inside was filled with a very bitter, porous, easily pulverized substance, surrounding the fly which produced them, and which was called *Cynips insana* by Westwood, and figured in the Trans. Ent. Soc., London, vol. ii.

The family EVANIIDÆ contains insects generally with very small abdomens. They are parasitic on the Cockroach and other insects. Plate 7, fig. 4, shows the *Evania appendigaster*.

FAMILY—CHRYSIDIDÆ (*The Golden Wasps*).

These species are small, but beautiful; while some of the exotic species, such as *Stilbum*, are of considerable size. They belong to the section called *Tubulifera*.

The Golden wasps lay their eggs in the nests of the sting-possessing Hymenoptera. They have the power of rolling themselves up into a little ball when alarmed, and, in this way they escape the stings and jaws of the insects into whose nests they enter.

TRIBE—ACULEATA.

So called from the females possessing a sting.

GROUP—HETEROGYNA.

In these the females and males are very different and there are also workers, abortive females.

FAMILY—FORMICIDÆ (*The Ants*).

This family of insects is characterized by the habits of the species, which reside in more or less numerous societies underground, or on trees. They have a great number of individuals with the sexual organs and instincts abortive, so that they are admirably adapted to perform the labours of the community; these are named workers or neuters, and are without wings. The males and females are much less numerous, and possess wings. They do not labour. In the males the body is small, and the legs and antennæ are long and slender. The females are much larger than the males, and have the antennæ and legs shorter and thicker. Both males and females have ocelli and a continuous thorax, while in the neuters this part is contracted in the middle, and they are frequently without ocelli.

Mr. Frederick Smith, who has paid so much attention to the habits and economy of the ants of this country,* as well as to the history and structure of the Formicidæ of the world, remarks that their economy, even in the imperfect records that we have, has furnished some of the most interesting and wonderful histories in the wide domains of zoology. "When their habitations are by any means injured or destroyed, no time is lost in useless despair; one spirit animates each individual; simultaneously they set to work to repair their misfortune; unceasingly they labour; nothing damps their ardour or abates their industry: until, as if by a magic wand, their habitation again rises to its former height and beauty, and all trace of ruin has disappeared."

In the work from which we quote, detailed descriptions are given of twenty-five species of British ants, with notes on their habits. With the exception of *Formica rufa* and *F. congerens*, all the British species belong to the mining ants. One, *F. fuliginosa*, usually selects decaying trunks of trees, posts, and such like situations, though it occasionally mines in banks or mud walls. *Formica flava* differs in one part of its economy from the other British ants; it carries down the last brood of larvæ into the deepest recesses of their subterranean dwelling, where they pass the winter in a state of torpidity. These larvæ are at this time more hairy than the larvæ produced during the summer months.

FORMICA RUFA is commonly called the Wood Ant, the Horse Ant, or the Hill Ant. They construct a nest composed of bits of straws, sticks, and such things, which they heap up into a conical mass; hence one of their names. This nest, though rough enough outside, is admirably arranged within. The nests of this species are resorted to by several beetles, partien-

* Catalogue of British Fossorial Hymenoptera, Formicidæ, and Vespidæ, in the collection of the British Museum, 1858.

larly by some of the Staphylinidæ, which seem to be in some way useful to the community; they probably yield some secretion which serves as food to the young brood.—See part Coleoptera, subject *Brachelytra* further on.

FORMICA SANGUINEA, to which we refer more particularly further on, plunders the nests of other species of ants of their pupæ, which it rears; when perfect, they are the slaves of this ant. It constructs its galleries in banks; its large workers are a bold and courageous race, attacking with great fury. It is not a very common species.

FORMICA FUSCA is a common species, found in banks, particularly those with a warm southern aspect. By removing the particles of earth, this species constructs in these banks large and intricate galleries and passages. These nests often contain some of the rarest little beetles, which are much prized by entomologists.

FORMICA FULIGINOSA is of a jet-black colour. It forms its chambers in decaying trees or old posts, which they gnaw into numberless stories. The movements of this species are extremely slow as compared with those of any other species. Numbers of these ants frequently congregate in masses near the nest, apparently sunning themselves, and not, like other species, incessantly at work.

FORMICA NIGRA, commonly called the Garden Ant, is a most abundant species in this country, being found everywhere. It is abundant even in the gardens and squares of London. It usually builds in banks, but is also found in walls of gardens and outhouses.

FORMICA FLAVA, so called from its yellow workers, is a most abundant species everywhere. It raises its little mounds in meadows and on heaths. These mounds serve to carry off the rain from its dwelling. In hilly districts it avails itself of the protection of a stone or other substance, beneath the shelter of which it constructs its roads and nurseries.

PONERA CONTRACTA is a rare ant in this country; only occasional specimens have been taken.

The *Myrmicidæ* are small ants, the pupæ of which are not inclosed in cocoons; the petiole of the abdomen has two nodes. One of the species, the *Myrmica scabrinodis*, is frequently to be met with, occupying one side of a little hillock, thrown up by *Formica flava*. In some parts of the country it abounds to such an extent, that clouds consisting of myriads of the winged males and females are seen flying in the air, frequently taking the course of rivers, when thousands of specimens may be seen floating in the stream.

MYRMICA CÆSPITUM is a local species in this country, but in many places on the coast it is found abundantly.

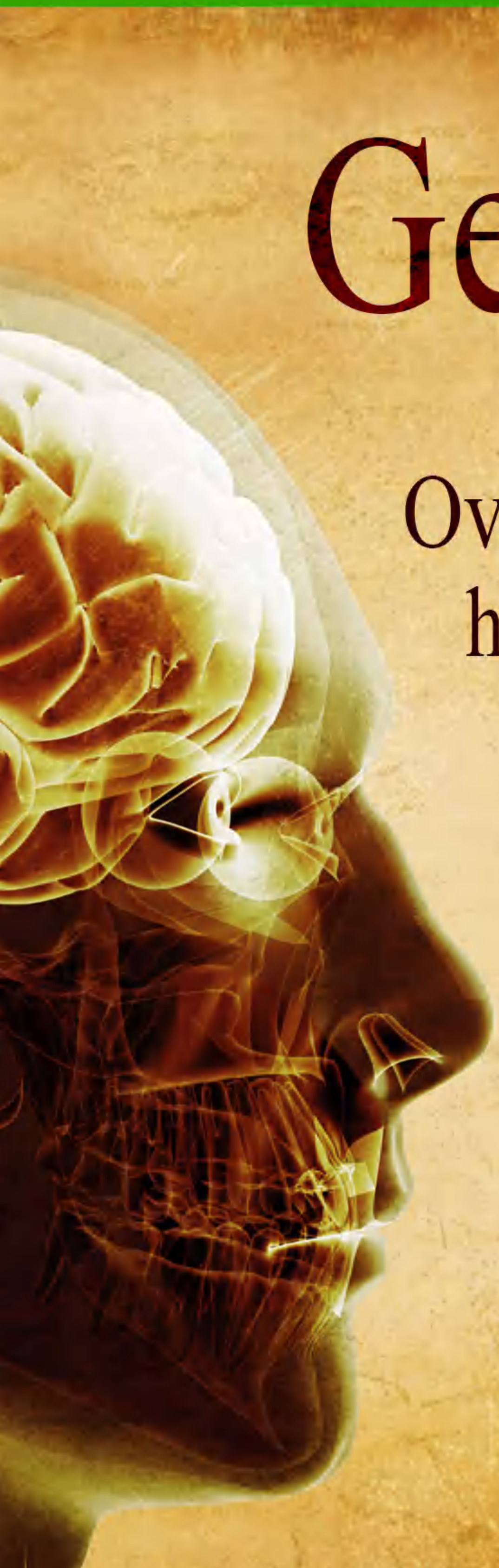
MYRMICA MOLESTA is a small ant, most abundant in houses; hence Mr. Shuckard named it *M. domestica*. It sometimes becomes so numerous in houses as to be a perfect nuisance, swarming over eatables of every kind. This domestic ant seems to have been introduced with merchandise. It is abundant in North America, and we were told by the Rev. Hamlet Clark, that at Rio Janeiro it is everywhere—indoors, out of doors, and upon everything.

The walls of the burrows of some of the European and American ants (*Formica fuliginosa—F. Caryæ*) are always of a black colour. This discoloration is not confined to the surface of the burrow, but penetrates through the wood surrounding it on all sides to the depth of an inch or more; probably the ant, by saturating the wood with acid, hastens its decay, so that it may be more easily mined. These burrows are long narrow passages.

Some ants are furnished with a remarkable instinct; this instinct, that of slave-making, was first discovered by one of the Hubers.* This indefatigable observer first noticed the habit in the *Formica rufescens*, and has shown that the species is absolutely dependent on its slaves. The males do not work, and fertile females only keep up the race, and the only work the sterile females engage in is that of capturing slaves. They neither make their own nests, nor feed their own larvæ. Should the old nest prove inconvenient, the slaves determine the migration to more suitable quarters, and actually carry their masters in their jaws; these are so helpless, that when Huber shut up thirty of them without a slave, although they had plenty of their favourite food and had their larvæ and pupæ to stimulate them to work, they did nothing—they could not feed themselves. Our observer introduced a single slave of the species, named *Formica fusca* by naturalists. This ant instantly set to work, fed and saved the survivors, made some cells, and attended to the larvæ.

The *Formica sanguinea*, which is found in the south of England, is also a slave-maker. Mr. Darwin says, "Although fully trusting to the statements of Huber and Mr. Smith, I tried to approach the subject in a sceptical frame of mind, as any one may well be excused for doubting the truth of so extraordinary and odious an instinct as that of making slaves. Hence, I will give the observations which I have myself made, in some little detail. I opened fourteen nests of *F. sanguinea*, and found a few slaves in all. Males and fertile females of the slave-species (*F. fusca*) are found only in their own proper communities, and have never been observed in the nests of the *F. sanguinea*." He observes that the slaves are black, and not above half the size of their red masters. If the nest be slightly disturbed the slaves come out, and like their masters, are much agitated, and defend the nest. Should the larvæ and pupæ be exposed, the slaves work energetically with their masters in removing them to a place of safety. The slaves feel quite at home. During the months of June and July, in three successive years, Mr. Darwin watched several nests in Surrey and Sussex for many hours, and never saw a slave either leave or enter a nest. The masters bring in material for the nest and food of all kinds, although, occasionally, slaves are observed assisting in the latter operations. Huber says that in Switzerland the slaves habitually work with the masters in making the nests, and they alone open and close the doors in the morning and evening. Huber also noticed that their principal office was to search for aphides or plant-lice.

* The account here given is from chap. vii. of Mr. Darwin's work on the Origin of Species, as that author has paid very considerable attention to the subject.



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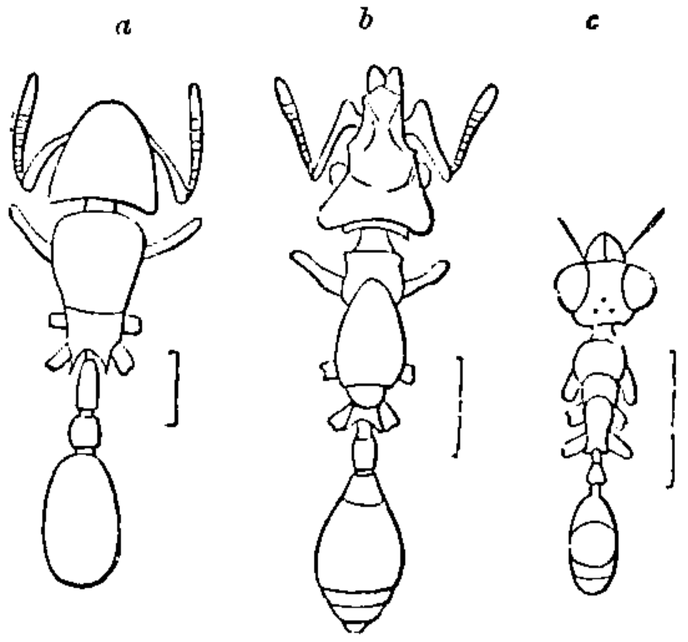
other disagreeable guests. Having accomplished their work, which it seems they disperse to do, they again form themselves into a long train, and move onwards. Tschudi, who had ample means of observation, speaks of the united forces of these creatures as being vast, and he says there is no approach to the fabulous when he mentions, that not only snakes, but rather large mammalia, such as Agoutis, &c., on being surprised by them, are soon killed.

Ants of various species and of various genera abound in the forests of Borneo. Mr. Adams* calls one the *Bombardier*, from its habit. When irritated, this fellow turns up the end of his body like a Staphylinus, and "forthwith emits a continuous stream of dense white acid vapour." This ant is about half an inch long, and has a large head and enormous mandibles; it is of a shining black. The naturalist of H.M.S. *Samarang* mentions another ingenious species indigenous to Borneo, which constructs its nest out of a large leaf, "bending the two halves by the weight of united millions, till the opposite margins meet at the under surface of the mid-rib, where they are secured by a gummy matter." Into this aerial habitation the stores and grubs are conveyed by regular beaten tracks along the trunk and branches of the tree. Mr. Adams noticed on the banks of the Linga, that the trees were covered with black-coloured nests, built by a large red ant. These nests were formed of prepared vegetable matter, mixed with a tenacious secretion. The ants stung most tormentingly. In Borneo, too, Mr. Adams noticed a small shining black ant, which kept to its subterranean galleries during the day; but on the approach of night it covered the ground, especially in moist places, with its myriad hordes.

Fig. 54.

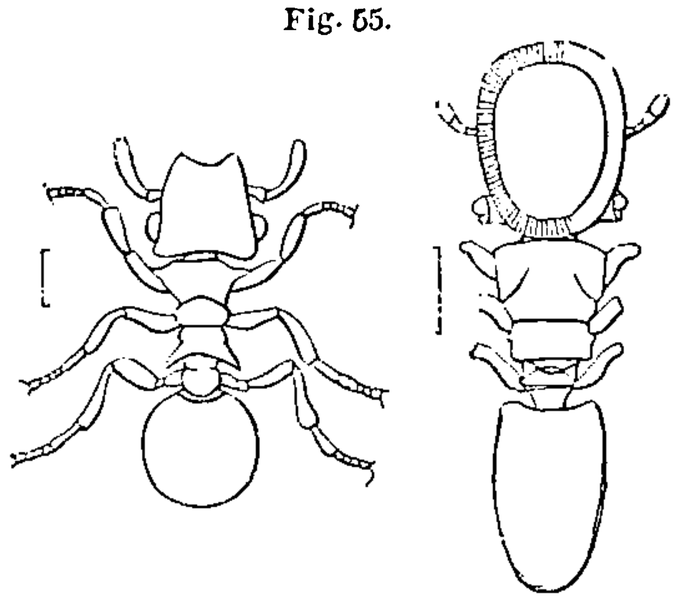


a. Cryptocerus striatus. *b*. Meranoplus singularis.
c. Formica solitaria.

These three figures are copied from figures by Mr. Smith, and show (fig. 54, *a*) *Cryptocerus striatus* (fig. 54, *b*) *Meranoplus singularis*, with its strange collar, remarkable triangular head, and curious basal joint of the antennæ. Fig. 54, *c*, shows the *Formica solitaria*, with its immense eyes and ocelli, so that this fine species must be endowed with very considerable powers of sight. What a subject of research are exotic ants alone!

CRYPTOCERUS.—This is a remarkable genus of ants of very varied form, but all having the antennæ, at least the base of these organs, concealed under the projections of the head. Hence the name *Cryptocerus*—see fig. 55.

Fig. 55.



Outlines of two species of Cryptocerus (from Smith).

The species are generally wood-borers, usually perforating the dead trunks of trees. The species have been observed chiefly on low trees and bushes in dry open places, or running on branches of newly-felled trees. They also visit flowers abundantly. Both males and females have wings; the latter only retain them for a time. The common species, *Cryptocerus atratus*, constructs its nests in the dead suspended branches of woody climbers. Outside, the observer notices a number of neatly-drilled holes; but inside he finds that the solid wood is perforated with galleries, communicating with each other. The insects are omniverons, and seem to be attracted by the excrement of birds. In the pupa state they are not inclosed in cocoons. Each community seems to consist of a single female, and two kinds of workers. In some species these latter are totally unlike each other, differing in the form of the head and in the armature of the thorax and nodes of the peduncle.

Of the genus *Eciton*, only the workers are known, and in these the eyes are extremely minute. The insects of this genus are very numerous in Brazil, but neither male nor female are known. Their societies are so numerous, and their sting so severe, that an attack upon one of their colonies is not to be rashly undertaken. About twenty species of the genus are known. "The processions of these insects are of common occurrence, and the different colours of the species are very observable when the lines are seen upon the march, some appearing like a liquid stream of metal. These ants are regular clearers of all animal matter, living or dead. When on a foraging expedition they spread out their columns, climbing over every leaf, plant, shrub, and tree, putting the whole animal as well as insect world into commotion and alarm; should any decaying mass of vegetable matter fall in their way, it is instantly covered with a living crowd; every chink and cranny are carefully searched, after which the army resumes its march. All apterous insects, particularly *Blattæ* and spiders (the former being exceedingly numerous under fallen leaves, especially in their larva state), are preyed upon; the larvæ of Lepidoptera and Diptera fall an easy prey, as well as the species of Formicidæ. At other times a community of *Ecitons* engage in a regular attack upon

* Voyage of H.M.S. Samarang, vol. i. p. 409.

a nest of some peaceful and industrious species of *Formica*. The *Ecitons* crowd into the nests of the ants, each seizing upon a helpless victim, and carry or drag it out of the nest; if the ant prove too heavy for a single *Eciton* to carry, it is ruthlessly torn into pieces, two or more assisting in the operation. The march is then commenced back to the nest of the *Eciton*, the living ants and the mangled remains of others being probably conveyed there, for the purpose of feeding the young brood of the marauders."

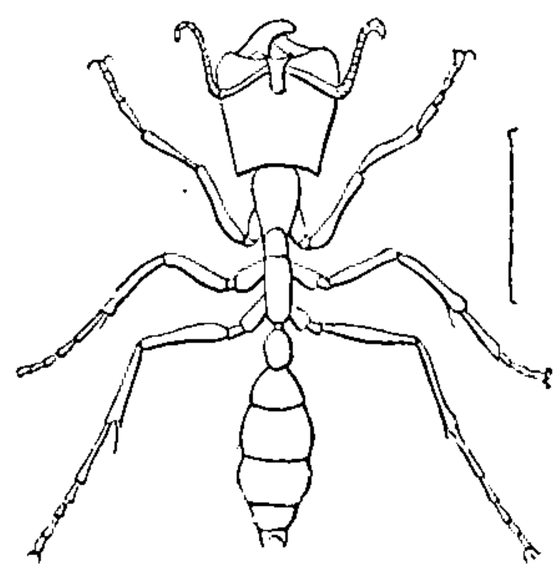
In every nest there are two distinct forms of workers. In the *Eciton hamatum* the larger worker or soldier is furnished with long, curved, sickle-shaped mandibles. There are about five of these soldiers to every hundred of the smaller individuals.

A curious genus of ants has been described, called *Pseudomyrma*, distinguished by its elongated form, petiolated abdomen, and by the large eyes in both sexes; these organs in many species occupying the whole side of the head. Most of the species excavate the pith from dried twigs; the eggs are laid in the burrows thus formed, and the young brood developed.* The communities are not very populous, as they frequently consist of not more than twenty, exclusive of larvæ and pupæ. The *Pseudomyrma termitaria* takes up its abode in the nests of different species of white ants (*Termes*), while others form small elliptical chambers in the outer walls of the tumuli of the white ants, a single colony only apparently occupying each chamber; these are generally wide apart. The pupæ of *Pseudomyrma* do not spin cocoons. The insects, when out of the nest, are to be seen coursing rapidly over trees and herbage. The sting is very slight.

THE GREAT-HEADED RED ANT (*Œcodoma cephalotes*) is mentioned by Mr. Alfred Wallace as one of the insects used by the Indians of the Amazon for food. It inhabits the whole district of the Amazon, and is found generally over Brazil in sandy districts and places where red earth is found. The nests of this species are formed in woods and in gardens, where it turns up the soil to such an extent, that one seeing the heaps it can raise would almost doubt whether so small an insect could have been the workman. Mr. Wallace has seen elevations of this kind twenty feet square and three feet high, which contained many tons of earth. "These hillocks are riddled with holes in every direction, and into them the ants may be seen dragging little circular pieces of leaf, which they cut off from particular trees which they prefer. Orange trees and leguminous shrubs suffer most from their ravages, and these they will sometimes entirely strip of their leaves in a night or two. Young plants, too, of every kind suffer very much, and cannot be grown in many places on account of them. They remain in one locality for a long time; for, on my observing to a gentleman at a cattle estate near Para how remarkably the track of these ants was worn down across a pathway and through grass, he informed me that he had observed them marching along that very track for fifteen or twenty years." Mr. Wallace continues, that the insects which do this are the neuters, who employ in this way their tremendous jaws. They come into the houses at night, and often swarm there, crawling over the supper table, and carrying off any fragments that may have been left. Should any cloth or handkerchief be left on the ground, with anything eatable wrapped up in it, the housekeeper will be sure to find it cut with semicircular holes in every direction, as regularly as if it had been done with scissors. Mr. Wallace found, that it was the female of this ant which furnishes the Indian with a luxurious repast. At one time of year the female ants come out of their holes in such numbers that they are caught by basketsful. There is great stir and excitement in the neighbourhood of the Indian village, when this takes place. Mr. Wallace describes the young men, women, and children, as going out to catch *saübas*—for so they call them—with baskets and calabashes, which they soon fill. The female ants, although furnished with wings, are very sluggish, and seldom, if ever, fly. "The part eaten is the abdomen, which is very rich and fatty from the mass of undeveloped eggs. They are eaten alive; the insect being held by the head as we hold a strawberry by its stalk, and the abdomen being bitten off, the body (of course, Mr. Wallace refers to the thorax), wings, and legs, are thrown down on the floor, where they continue to crawl along apparently unaware of the loss of their posterior extremities. They are kept in calabashes or bottle-shaped baskets, the mouths of which are stopped up with a few leaves; and it is rather a singular sight to see for the first time an Indian taking his breakfast in the *saüba* season. He opens the basket, and as the great winged ants crawl slowly out, he picks them up carefully, and transfers them, with alternate handfuls of farina, to his mouth." Mr. Wallace adds, that when the Indians catch great quantities, they roast them slightly or smoke them, and then sprinkle a little salt on them. In this state they are generally much liked by Europeans.*

ANOMMA ARCENS—the Driver Ant of Western Africa—fig. 56. We are indebted to the pen and eye of the Rev. Thomas Savage, an American missionary on the coast of West Africa, for an account of this very interesting ant. This species is well called *Driver*;

Fig. 56.



Driver ant.

for it not only travels and visits in common with other species of ants, but it also *drives* everything before it capable of muscular motion, so formidable is it from

* See Mr. Smith's paper in the Journal of Entomology, p. 66; 1860.

† Trans. Ent. Soc., second series, vol. ii., p. 243.

its numbers and bite. Its permanent abode, if it may be called so, Mr. Savage finds to be a shallow excavation under the roots of trees, shelving rocks, and almost any other substance that will afford a shelter. From these recesses the Driver ants make their sallies in cloudy days, and in the night, chiefly in the latter. An exposure to the direct rays of the sun is almost immediately fatal to them. Should they be detained abroad till late in the morning of a sunny day by the quantity of their prey, they construct arches over their path, of dirt agglutinated by a fluid excreted from their mouth. If they can obtain shelter in long grass, they dispense with the arch. When Mr. Savage was residing near Cape Palmas, he was greatly annoyed by the frequent visits and ravages of these ants. At one time they literally drove out every member of the female department of the school; at another, the male department; then the inmates of his own dwelling. His horse, pigs, fowl, and everything that had animal life, were attacked by these formidable armies. He says, "They always pounced upon us at night, and generally when our senses were reposing in sleep. Occasionally we were apprised of their designs at nightfall by a few suspicious individuals lurking in the vicinity in advance of the main body, but mostly they took us by surprise. At last their annoyance seemed to have reached the highest point of our forbearance, and a resolution was forthwith taken to discover their habitation, and, if possible, expel them from the vicinity. Accordingly I commenced cutting over the premises, and had proceeded as far as two-thirds the way down the mount on which my dwellings stand, when, beneath a shelving rock of decomposing granite, their haunt was discovered. They had been roused by the efforts of the workmen, and had come forth in incalculable numbers for defence, literally blackening the surrounding grass and shrubbery. Lines of ants, going and coming agreeably to the rules of their order, were running in opposite directions. Their paths were very distinct and well trodden, of about an inch in width. . . . Their numbers could not be computed; millions on millions seemed to be there, besides thousands that were going and coming with astonishing speed and alacrity. In attempting their destruction, I adopted the mode of the natives, which is to ignite on the spot a collection of the dried leaves of a species of *Corypha* (fan palm of this coast) about six feet in diameter, and dried grass, with other combustible matter. A fire of great intensity was thus kindled, which continued to burn for a considerable time. This, I supposed, would be the last of our troublesome neighbours. Two days after, however, on going to the spot for the purpose of examining into their domicile, I was surprised to see a tree at a short distance, about eighteen inches in diameter, to the height of four feet from the ground, with the adjacent plants and earth, perfectly black with them. From the lower limbs (four feet high) were festoons or lines of the size of a man's thumb reaching to the plants and ground below, consisting entirely of these insects; others were ascending and descending upon them, thus holding free and ready communication with the lower and upper portions of this dense mass. One of these festoons I saw in the act of formation. It was a good way advanced when first observed. Ant after ant coming down from above, extending their long limbs and opening wide their jaws, gradually lengthened out the living chain till it touched the broad leaf of a *Canna* coccinea below. It now swung to and fro in the wind; the terminal ant in the meanwhile endeavouring to attach it by his jaws and legs to the leaf. Not succeeding, another ant of the same class (the very largest) was seen to ascend the plant, and fixing his hind legs, with the apex of his abdomen, firmly to the leaf under the vibrating column, then reaching forth his fore legs, and opening wide his jaws, closed in with his companion from above, and thus completed the most curious ladder in the world."*

Mr. Savage assures us, that whenever a stream of water intercepts their course in their migrations, if it be not very extensive they compass it; but if not, they make a line or chain of one another, gradually extending themselves by numbers across, till the opposite side is reached. Over this living bridge the main body passes in safety. During the wet seasons, the Driver ants are liable to be driven by the continued rains from their haunts. Mr. Savage observes, that "in such an emergency they throw themselves into a rounded mass; deposit their feebler folk, pupæ, and eggs in the centre; and thus float upon the water till a place of safety is reached, or the flood subsides. Even in situations beyond this overflow, they must be deluged in their holes for days, so copious and incessant are the rains at times; and one would suppose that under such circumstances vast numbers must perish. Some undoubtedly do; but the LORD in this, as in other orders of the animal kingdom, has pursued a system of compensation beautifully illustrative of his goodness, and the minuteness of his providential care over even the meanest of his creatures. As he has endowed this insect with a high degree of life, so he has given to it a corresponding degree of tenacity, thus enabling it to exist under the many unfavourable circumstances incident to its habits. Feeling assured that such was the fact, I commenced a series of experiments in proof of the point. An individual of the largest class was submerged to the bottom of a glass of water, where it struggled for about three-fourths of an hour, then apparently expired. It revived in about ten minutes after it was taken out, exhibiting about as much vitality and ferocity as before." Mr. Savage submerged it three times, keeping it under water at one time for six hours, and yet it revived. He gives other instances of their tenacity of life.

Mr. Savage mentions an instance of the ants killing a snake four feet long. They seem to have first blinded it—at least so the American missionary judged by its motions. He tells that the entrance of the *drivers* into a house is soon known by the simultaneous and universal movement of rats, mice, lizards, *Blapsidæ*, *Blattidæ*, and the numerous vermin that infest their dwellings. He says that "when they are fairly in, we give up the house, and try to await with patience their pleasure; thankful, indeed, if permitted to remain within the narrow limits of our beds and chairs." To prevent their ascending the beds, the feet are placed into a

* Trans. Ent. Soc., vol. v., p. 7.

two females. He found the larvæ of the Mutilla in the cells, closed in, as usual, by the full-fed grub of the bee, which seems to have unwittingly closed in with it the egg of the parasite which, when reared, fed on it; for there is little doubt that Mutilla is carnivorous, and devours the larva and pupa of the humble bee. The Australian and African Mutillæ must be parasitic on other Hymenoptera, for humble bees are not found in those countries.

MUTILLA EPHIPPIUM.—This is a much smaller species than the *M. Europæa*, and more common in this country than that insect. The Brazilian species are well marked, and some large. Black and white, red and black, are their prevailing hues. Mr. Westwood first figured some of the Australian species. Dr. Dalton specifies one as being very common in British Guiana, the *Mutilla diadema*. It is about three-quarters of an inch long, of a deep black, and striped, with yellow on the thorax and body. It is solitary, and is often seen in sandy places. "They are very cautious and shy in their habits, and sting severely. They build in the ground; for when chased they disappear rapidly in subterranean passages."* The males are not so common as the females.

FAMILY—THYNNIDÆ.

This family consists of insects closely allied to the Mutillidæ in many respects. The family is chiefly Australian, but a number of species have been found in Brazil. Mr. Robert Bakewell, who has done so much for Australian entomology, informs us that the Thynnidæ are parasitic on Lepidoptera. That gentleman obtained specimens from the cocoons of moths which had been dug up from the ground.

FAMILY—CRABRONIDÆ.

In this family the insects have frequently the head very large; the abdomen is oval or elliptical, sometimes clavate, sometimes petiolated. The eyes are ovate, but sometimes kidney-shaped. The antennæ are often thickened at the end.

In the genus *Trypoxylon* the eyes are large, and deeply notched on their inner orbit. Three British species are known; one of these (*T. figulus*) is very abundant everywhere, and may be frequently noticed conveying its prey to its nest, consisting of spiders. In June, 1845, a colony of Trypoxylon was found burrowing in a bank of light earth, above which was a cut hawthorn hedge. On this hedge spiders were numerous, and the female insects were flying in numbers from the burrows up into the hedge, provisioning their nest with great facility. The cocoons of this species are met with in banks and decayed wood; the cells are separated from each other by a cap of agglutinated sand.

The genus *Crabro* is very extensive; the eyes are rounded, the face being usually covered with silvery or golden pubescence. Thirty-six British species are described. Many burrow in decaying wood, some perforate bramble sticks and rose branches, so that by gathering such perforated sticks in the spring, many species of the genus and occasionally the parasites are bred. *C. luteipalpis* provisions its nest with the rose aphis. One species, *C. varius*, carries gnats to its burrows. *C. podagricus* and *C. leucostoma*, and other species, provision their nests with dipterous insects.

The genus *Oxybelus*, of which there are seven British species, belongs to this family. The insects of this genus prey upon Diptera, and their mode of capturing them is singular. Several females were observed running amongst blades of grass which shot up from the surface of a little hillock upon which the sun shone, and tempted various Diptera to occasionally alight. The *Oxybeli* continued to run about apparently unheedful of the flies, until at length the latter became somewhat accustomed to their presence; but when the *Oxybelus* came within five or six inches, it darted upon the luckless fly in the same manner as a cat springs upon its prey. The most common British species is the *Oxybelus uniglumis*, which occurs in most sandy situations.

The species of the genus *Diodontus*, so called from the mandibles being bidentate, are small, and may be taken in plenty by collecting perforated rose branches or bramble sticks. In these they burrow for the most part, and provision their nests with *Aphides*, so that they are among the numerous bands of insects useful to mankind.

One species of the genus *Pemphredon* occurs in this country: this is the *Pemphredon lugubris*. It burrows in posts, rails, &c., in a decaying state. This insect provisions its nest with Aphides.

FAMILY—PHILANTHIDÆ.

In these insects, so named from *Philanthus* the typical genus, the head is wider than the thorax. The intermediate tibiæ are armed with a single spur at the tip; the legs and anterior tarsi are strongly ciliated.

The genus *Philanthus* has the clypeus with three lobes, and the antennæ are suddenly thickened. It has a large head, eyes, and mandibles. See Plate 7, fig. 10, for a figure of the front of the head of the *Philanthus triangulum*. Mr. Smith took it abundantly during a visit to the Isle of Wight, in which he discovered what may be regarded as the British metropolis of the unique British species (*Philanthus triangulum*).* This fine insect is abundant in Sandown Bay. The female takes various bees for her prey, such as the *Andrena fulvicrus*, *Halictus zonatus*, or more frequently the Honey bee (*Apis mellifica*).

This genus *Cerceris* contains some of the most beautiful species of insects of the whole tribe of fossorial Hymenoptera. It is found in all parts of the globe. In this genus the antennæ are gradually thickened, and the segments of the abdomen have their margins constricted. Some of the Indian species are the giants of the family, being upwards of an inch in length. In some of the South American species, the first segment of the abdomen is prolonged into a long

* History of British Guiana, by Henry G. Dalton, M.D., vol. ii., p. 297; 1855.

* The *Philanthus apivorus* of Latreille, who named it *apivorus* from its bee-destroying propensities.

petiole. There are five species of the genus indigenous to the British islands.

CERCERIS ARENARIA, as its name implies, burrows in sandy spots, where it may be met with abundantly in the month of July. It stores up different species of Curculionidæ, taking any that may be abundant near its nest.

CERCERIS QUINQUE-FASCIATA, is a local species, which seems to delight in frequenting the flowers of the wild parsnip. It selects hard-trodden pathways for its burrows, and provisions its cells with the *Apion rufirostre.*

CERCERIS ORNATA, a variable and beautiful species, is found to be gregarious. It forms large colonies, and provisions its nest with different species of wild bees, such as the *Halictus rubicundus*, *Zonulus*, &c.

CERCERIS LABIATA conveys to its burrows specimens of the vaulting beetle, named *Haltica tabida.*

FAMILY—LARRIDÆ.

In this family the mandibles are notched outwardly towards their base; the tibiæ of the fore and middle legs have a single spine at their apex, while the tibiæ of the hind pair have two spines. This structure indicates a peculiar habit in this family, of which there are two or three British genera.

MISCOPHUS BICOLOR, one of these taken at Weybridge, provisions its nest with a small white-bodied spider, which is found commonly on heath.

TACHYTES UNICOLOR is another rare and very local species of this family. It is met with in that warm spot, Sandown Bay in the Isle of Wight, in the month of July; it is an extremely active insect, flying with great rapidity.

ASTATA BOOPS, so called from its large eyes, is another local insect, found on Hampstead Heath amongst the sand pits. Its usual prey appears to be the larva of a hemipterous insect of the genus *Pentatoma*, occasionally also capturing a small hymenopterous insect of the genus *Oxybelus.*

FAMILY—BEMBECIDÆ.

Of this family there is no British representative. The insects inhabit warm climates, and some of them are said to emit a rose-like scent. In the genus *Bembex*, the maxillæ and labium are produced into a long beak, hence the species of Southern Europe is named *Bembex rostrata.* This species constructs its nests in the soft light sea-sand, and catches its prey on the wing. This prey consists chiefly of flies.

FAMILY—NYSSONIDÆ.

In this family the mandibles are not notched beneath, and the legs are subspinose. It is so called from its typical genus *Nysson*, of which five British species are described. Two of these (*N. trimaculatus* and *N. dimidiatus*) are observed to feign death when alarmed, and to drop to the ground, like the Golden wasps.

Of *Gorytes* there are five British species, some of which have been caught carrying the larva of the *Aphrophora spumaria*—that larva which disfigures plants with its spittle-like secretion. It carries these and other larvæ to its nest.

Of the genus *Mellinus* there are two British species. One of these, a black insect with four yellow abdominal bands (*M. arvensis*), is perhaps the most abundant fossorial insect in the country. When the parent Mellinus has formed a burrow of the required length, and enlarged the extremity into a chamber of the proper dimensions, she issues forth in search of the proper nutriment for her young. This consists of various dipterous insects—flies of various genera are equally adapted to her purpose, Muscidæ, Syrphidæ, &c.—which she captures.*

FAMILY—SPHEGIDÆ.

The insects of this family are marked by the prothorax not having the posterior angles prolonged to the base of the wings, and by being narrowed in front, so as to be elongated into a sort of neck. The basal segment of the abdomen is narrowed into a long petiole. The mandibles are toothed on the inside. The insects of this family, of which the species figured (Plate 7, fig. 11) is one of the most gigantic, are specially interesting on account of their habits; the parent storing up for the young an ample provision of insects, but more particularly of spiders, which from their insect food and the softness of their parts may be looked on as a concentrated mass of the best juices of insects. We are informed that the large Brazilian species readily master spiders of the largest kind, such as *Mygale,*† rendering them powerless by their formidable sting. The spiders thus attacked die a lingering death, in some cases surviving five or six days. An egg is deposited on the first insect stored up, so that the larva is hatched by the time the cells in some instances are provisioned; but in this country our common Sand-wasp (*Ammophila sabulosa*) deposits the food at intervals, so that it is fresh and suited to the young larva, which lives principally on the juices and softer parts, leaving the head, legs, and wings untouched. Although *Arachnida* are the usual prey of the majority of these insects, still there is a species which at one time preys upon spiders, and at another chooses caterpillars, when each kind of food was equally at its command. Endless, indeed, are the variations of habit in the Hymenoptera; the more they are investigated, the greater will be our admiration of their wonderful instinct and tact in adapting their operations according to circumstances; and when unimpeded in them, of the beauty and fitness of their architectural elevations.

Ammophila sabulosa (*A. vulgaris*, Kirby) forms its burrow in sandy situations, with a chamber at its extremity. Into this she conveys the caterpillar, and deposits an egg on it. She subsequently stores up three or four additional ones, and her task is completed.‡ Each time that she deposits a caterpillar, she carefully

* Annals and Magazine of Natural History, vol. xx., p. 395.

† A genus of hairy-bodied spiders, often called Bird-catching spiders.

‡ Catalogue of British Fossorial Hymenoptera, p. 80.

stops up the entrance with a few pebbles, which she brings with her long spinose feet, the anterior tarsi of which are strongly ciliated. She does not wait till each caterpillar is devoured before supplying another. If uninterrupted in her economy by weather or other circumstances, the whole are stored up in a few hours, and she then begins to form a fresh burrow. This species seems to be peculiarly attached to caterpillars as the food of its progeny. Its ally, the *Ammophila viatica*, seems usually to prey upon spiders. There are three other British genera—*Miscus*, *Sphex*, and *Dolichurus*. It is doubtful if the Sphex be indigenous; and the Dolichurus is a rare Devonshire insect. We have not the curious "Dirt-daubers," so nicely described by Gosse in the *Zoologist*, and also by the venerable Abbot of Georgia in an extract quoted by me from his manuscripts.—(See a paper on Darwin's Spiders in the *Annals* and *Magazine of Natural History* about the year 1842.) Our figure (Plate 7, fig. 8) represents the *Pelopæus spirifex*, a common species in southern Europe, the habits of which are described by many writers.

STETHORECTUS INGENS, or Great Brazilian Spider Wasp, figured in Plate 7, fig. 11, is, perhaps, the largest of all the species of the family *Sphegidæ*. It was described by Mr. F. Smith, in the twentieth volume of the *Annals* and *Magazine of Natural History*. The male is two inches and some lines in length, while the female is only two lines short of her mate. Both sexes are black, and very smooth and shining, the wings being of a dark metallic blue. The head is large and subquadrate; the eyes are large and oval. The clypeus has four teeth in front, the two outer the largest. The mandibles are large, stout, and arcuated. The maxillary palpi are six-jointed, the terminal joint being very minute; the labial palpi are four-jointed, the terminal joints being conical. The thorax is very long and strong. The upper wings have one marginal and three submarginal cells, the second submarginal cell receiving two recurrent nervures. The hind legs are elongated. The abdomen is ovate-conical, and abruptly petiolated.

The negro children in some parts of Jamaica have given the name of Grave-digger to a species of *Sphex* which Mr. Gosse noticed there, and has described in his usual very interesting way. He noticed this Sphex at work on a deserted earthen floor of a boiling-house at Bluefields. He observed, when examining this floor closely, that there were numerous holes entering diagonally into the dry and dusty ground. From some of these flies are emerging, while others are entering. You may hear a buzzing in some of them: this proceeds from a Sphex actively at work. "At first," says Mr. Gosse, "we cannot see what she is doing, for she crawls in head-foremost, and in a second or two comes out tail-foremost, recedes a few inches and then advances again, again emerges in the same manner and again enters, and continues thus to crawl backward and forward with bustling activity, and with much flirting of the purpling wings. She is almost white with dust."*

On a close examination Mr. Gosse found, that each time the Sphex came out she brought a load of the earth larger than her head, and held tightly between the tibiæ of her two fore legs, her breast, and her chin, and dropped this burden an inch or two from the cave's mouth. He noticed that she sometimes dragged out a still larger stone, and grasped it with the jaws, pulling it to a distance of four or five inches, for fear it should roll in again. "I have seen her bring two stones together, one grasped beneath the chin, the other in the jaws. Each time she has dropped the load, she never fails, as she advances, to keep the road clear by scraping with the fore shanks, throwing the dust behind her. But for this, the earth brought out would soon accumulate in a heap and roll back." He noticed that when a dry leaf or small stick happened to drop against the mouth of the hole, the Sphex seized it with her curved jaws, and carried it to a safe distance.

When the hole is finished, and the egg deposited, with a store of disabled spiders and caterpillars to feed the larva when hatched, the Sphex fills up the hole by scraping back a little heap of dust, pushing it in with her head. This is repeated several times till the hole is full, and the dust has been well rammed down with the insect's head. As the ground is soft, and the insects are very indefatigable in their labours, these cells are soon made.

FAMILY—POMPILIDÆ.

In the family of POMPILIDÆ, a most extensive group of the order Hymenoptera, the insects store up caterpillars and spiders for their young. The prothorax is usually transverse, and broader than long; the hind margin is arcuate or subangular. The legs are long; the abdomen is more or less oval, and is attached to the thorax by a short peduncle.

Many of the British species store up spiders as food for their young, such as *Pompilus fuscus*, *P. gibbus*, &c.; while others take caterpillars, such as *Pompilus niger*.

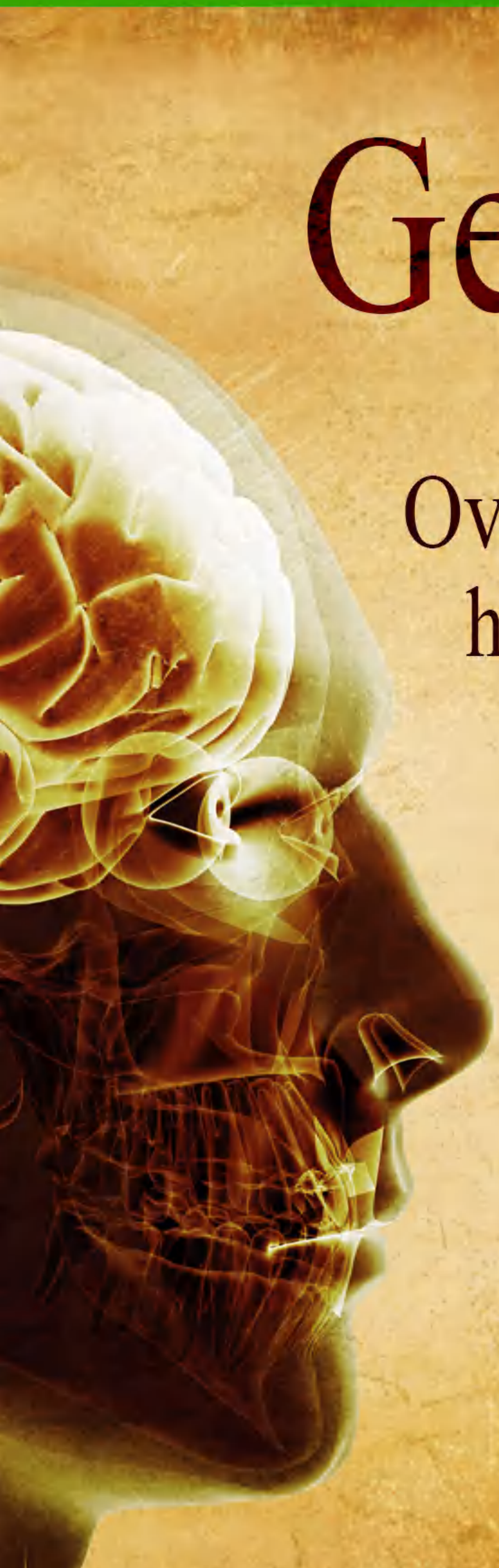
POMPILUS PUNCTUM, a British species, wants the cilia on the fore tarsi—a sure indication of a difference of habit. Mr. Smith obtained from the Rev. W. Delmar the cells of the Pompilus, found near Canterbury; they were formed of mud, and were placed irregularly side by side, and much resembled those made by the genus *Pelopæus*.

There are two other British genera of this family. One of these, *Ceropales*, is considered by some writers as parasitic on Pompilus. From their legs being almost destitute of spines, and from the tarsi having no cilia, it is probable that they have some peculiar economy. Species of this genus are found in all quarters of the globe, some of which are distinguished by a remarkable beauty of colouring, and others by the hind legs being disproportionately long. In the females the antennæ are always straight, and not convolute, as these organs are in Pompilus.

Dr. Kitto* observed a species of this group at Bagdad. In his journal of August 29, 1831, he remarks, "The wasps here are of a species and size I have not

* Gosse: Naturalist's Sojourn in Jamaica, p. 146.

* Journal, quoted in Ryland's Memoirs of John Kitto, D.D., p. 428; 1856.



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get many a poke when trying to get at the sweet gathering of the *Myrapetra*. The name is a fanciful one, compounded of the names of two ancient cities—one *Myra* in Asia Minor, with its curious rock tombs; the other *Petra* in Idumea, the ancient Selah, with its houses and temples in the rock. The nest I have described was, at once, the home and the tomb of the wasps I found in it.—See fig. 60.

Fig. 60.

Nest of Myrapetra scutellaris.

In the Brazilian forests many different kinds of wasps' nests are met with. Mr. Wallace describes them as being generally attached to the under sides of leaves, especially of the young Tucuma palm, as the leaves of that plant are broad and afford a good shelter. Some of these nests are little flat domes, with a single small opening. Others have all the cells exposed. In some there are only two or three cells, this being an early stage of the nest; when completed they have a great number; they are of a delicate papery substance. Others build large cylindrical nests, of a material resembling thick cardboard. Some form their nests in hollow trees, while others construct them among the roots in the ground. Many of the wasps sting very painfully, while some are so fierce, that, when the traveller disturbs their nest, they fly out and attack him.

FAMILY—EUMENIDÆ (*Solitary Wasps*).

Mr. Henry Saussure has described and figured most of the species of this group, as well as those belonging to other groups of the *Diploptera*. There are many genera and species, but reference here can only be afforded to some of the British species.

Of the genus *Eumenes*, the abdomen of which is pear-shaped, the basal segment being narrowed into a petiole at its base, we have one species in the British islands. This (*Eumenes courctatus*) is a very local insect, apparently restricted to the southern counties of England. It constructs small globular cells of mud, which it attaches to twigs of shrubs, particularly to those of the common heath. The insect provisions each nest with the larvæ of small Lepidoptera, for the support of its solitary grub. The Eumenes grub is occasionally the subject of a parasite of the genus *Cryptus*.

Of the genus *Odynerus* there are many species, which are spread over all parts of the world. In the British islands there are twelve species, some of which are very difficult to discriminate, as their colouring is very inconstant. Some of the species burrow in wood. *Odynerus trifasciatus*, a common species, selects for its burrows decayed rails, posts, or fencing. *Odynerus quadratus* forms its cells in old posts, and generally, if not always, prefers some ready-made tunnel or hole, fitted for its peculiar economy. Mr. Ingpen once knew of this species constructing its cells in the folding of a piece of paper which had fallen behind some books. It also makes use of the tubes of reeds used in thatching outhouses in a farm-yard. But the most curious adaptation I have heard of, is its having lined the bores of a double-barrelled pistol which hung on a post in an arbour of a garden.

Odynerus antilope has its burrows in sand-banks. These burrows are provisioned with small green caterpillars of lepidopterous insects. The Golden wasp, *Hedychrum auratum*, is parasitic on this species.

The *Odynerus spinipes* is abundant in sandy lanes during the months of June and July, when it may often be met with in large colonies. The females store up small green caterpillars as food for their larvæ. Their larvæ are often subject to the parasitic attacks of *Chrysis bidentata*, and other species of Golden wasps are sometimes seen hovering about or entering their burrows. These wasps construct beautiful granular tubes, as entrances to these burrows, which are frequently met with on sandbanks in early summer. *Odynerus lævipes* and *O. melanocephalus* have been found burrowing in dead bramble sticks, or in those of the rose. The former species excavates and lines the tube with a coating of fine sand, and constructs the divisions between the cells also of fine sand. It stores up small caterpillars, and is subject to the attacks of two species of Ichneumon, the *Cryptus ornatus* and *C. bellosus*.

The *Odynerus crassicornis* is one of the most local of the British species. It has been taken near Darenth wood in Kent. Mr. Westwood has observed it near Paris, carrying the larvæ of the beetle named *Chrysomela populi*, to its nest.

In the family MASARIDÆ the antennæ are widely separated, and they appear to be composed of only eight joints. On Plate 7, fig. 6, is represented a species of this family, *Celonites apiformis*.

FAMILY—VESPIDÆ (*Wasps and Hornets*).

The Social Wasps or VESPIDÆ—so called from the typical genus *Vespa*, are thus characterized. The fore wings are folded longitudinally, and have three complete submarginal cells, the second receiving both the recurrent nervures. The eyes are kidney-shaped, and on the side of the head they extend to or nearly reach the base of the mandibles. The claws of the tarsi are simple. The societies consist of males, females, and workers.

The insects of this family are pre-eminent as architects. The endless variety of form, the different materials used by these industrious insects in the construction of their nests, and the various textures consequently produced, cannot fail to strike the careful observer. In this country, we have but one genus of the family (*Vespa*), and of this genus there are eight indigenous species. Their nests are works of great beauty; and when we examine the differences in the construction—the adaptation of the nest to the circumstances likely to ensue in the various situations in which we find them—we are astonished at the amount of intelligence displayed.

The originator of a wasp's nest is a single individual, a female, which has passed the winter in a torpid state, and has been aroused from lethargy by the genial warmth of spring. She first seeks for a site in which to lay the foundation of her vesparium; possession being the title-deed by which she and her progeny hold it, and a formidable array of stings being the defence of the nest from foreign aggression. The female, then, having found a hole in a place adapted to her purpose, proceeds to enlarge it, and to form a subterranean chamber of suitable space. She then collects materials for the foundation. This foundation is formed of raspings and scrapings of wood; having got together some of this material, she first forms a footstalk strong enough to support the first two or three layers of cells; at the end of this footstalk she forms three cup-shaped receptacles; these are reversed, hanging like a bell, and are each about one-tenth of an inch in depth. Over the foundation cells the wasp now places a covering like an umbrella; she deposits an egg in each cup, and then proceeds to form additional cells, depositing an egg in each as soon as it is constructed. The first eggs are by this time hatched, and the young larvæ require some of her attention. These larvæ grow rapidly, and as they grow, the mother wasp from time to time adds to the walls of their cells; the cells of the foundation comb are never carried up higher than the length of the larvæ. As it grows day by day, the female wasp adds a fresh course of wall until the grub is full grown, when it covers itself in by spinning a convex cap to its cell, of a light-coloured, tough, silky texture. "The angles of the planes of the hexagons are determined by the points of contact of the circular bases; from these the wasp gradually commences the flattened sides of the hexagons, at first a little curved; but at a slight elevation, the sides become perfectly flattened planes, and as such, are carried up to the required height. Thus the gradual raising of the walls is as regular and progressive as that of a bricklayer constructing hexagonal chimneys. Each additional layer is laid upon the previous one, which has had time to become hard and suitable for supporting the additional weight of wall required." Wasps, however, do not at all times form cup-shaped foundations. Some Brazilian wasps of the genus *Polybia*, lay cup-shaped foundations for their first cells; but they construct a flat roof as the comb increases in dimensions. As soon as they have formed the first comb, the species of Polybia begin to build upon the flattened roof, "laying the hexagonal foundations at once, sharp and angular, from the flattened roof. One, two, three, or more planes are in different instances to be seen, merely as it were chalked out by the slightest amount of elevation possible."

Three of the British wasps (*Vespa arborea*, *V. sylvestris*, and *V. norvegica*) build their nests in trees or bushes, such as gooseberry bushes. The section containing these, has the scape of the antennæ yellow in front, in all sexes. Their style of building corresponds with that of the ground wasps, such as the *V. vulgaris*, described above, but their texture is firmer. The nests are consequently capable of resisting the effects of the wind and rain, and the changes of temperature to which they are liable to be exposed.

The Social wasps are most courageous. They seldom attack when unmolested; so it would be well for any one, should a wasp fly near them, not to wave it away, but to take no notice of its presence, or to sit quiet. Should any one attack their nest, the inmates boldly defend their citadel, and resent all attempts of the invader. From the much abused, and too often cruelly treated wasp, we may learn an admirable lesson of parental care, of courage in the defence of her young brood, and of careful and cleanly housewifery; no particle of rubbish of any kind being suffered to strew her dwelling. The number of individuals which compose the different communities of wasps varies much. Reaumur calculated thirty thousand as the number likely to be found in a populous community. The celebrated French observer had estimated the entire number of the cells at ten thousand, and supposed each might have been the cradle of three larvæ.

THE COMMON WASP (*Vespa vulgaris*) generally appears in this country in April. Mr. Smith once saw a female flying at Hampstead on the 13th February, 1859, when the weather was unusually mild. I have a record of its early appearance in February near Edinburgh, about twenty-nine years ago, when first I began to attend minutely to natural history.

VESPA GERMANICA is widely distributed in Britain, though not so abundant as the preceding.

VESPA RUFA, like the two preceding, is a ground

wasp. It is widely distributed. From a nest of this species numerous specimens of the *Chrysis ignita*, and five of the *Anomalon vesparum*—an ichneumonidous insect—which are parasites, have been bred.

VESPA ARBOREA, one of the Tree wasps, was first taken by Mr. Smith in 1836, near Wakefield in Yorkshire. It builds its nest in fir-trees.

VESPA SYLVESTRIS, though a Tree wasp, has occasionally been found inhabiting an underground nest.

THE HORNET (*Vespa crabro*) is the largest of the British wasps, the female being from thirteen to fourteen lines long, while the workers and males are from nine to eleven. In Hampshire it is very abundant, usually building in decaying trees, sometimes under the eaves of houses, and occasionally even in a bank. It has been observed carrying on its building operations on a fine moonlight night, as briskly as during the daytime. The rare *Velleius dilatatus*, one of the staphylinidous beetles, is found in its nest.

Worthy Edward Topsell, whose "native soyl" was Duckworth in Huntingdonshire,* reckoned wasps and hornets, and even bees, by no means interlopers among serpents. He introduces them in his foolscap folio history between the asp and the boa—the caterpillars connecting the hornets with these great tropical Ophidia—one of which, distended to a frightful extent, is engaged in swallowing an infant of considerable size. He evidently observed hornets at his native home, and remarks that "their combes are wrought with greater cunning, more exquisite art, and curious conceit, than those either of wasps or bees, and these excellent devisers do make them one while in the trunks of trees, and sometimes again in the earth, increasing them at their pleasure with more floors and buildings, according to the increase of their issue, making them smooth and bright, decking and trimming them with a certain tough or binding slime or gelly gathered from the gummy leaves of plants." This, Master Topsell, is a mistake; careful observers now know, that wasps form this binding material themselves.

GROUP—ANTHOPHILA OR MELLIFERA.—THE BEES.

Well may the bees be called *Anthophila*, or Flower-lovers, the name invented for the tribe by Latreille. Without flowers they would not be *Mellifera*, that is, Honey-gatherers. This tribe, in all the solitary species, consists of two sexes, males and females. In the social species, to these two sexes is added what is called a neuter or worker, which is in reality an abortive female. The females and workers are generally furnished with apparatus for conveying pollen: they are armed with a sting.

The antennæ of the females and workers have twelve joints; in the males there are thirteen of these articulations. The abdomen of the females consists of six segments or rings, while in the males there is one more. In addition to the two lateral compound eyes, they have three simple eyes, called ocelli or stemmata, on the crown of the head. The tongue, so important an organ in this tribe, is lanceolate, or filiform. In the larva state these insects are fed on pollen or honey, stored up by the parent. Several of the tribes are parasitical; that is, they collect no honey or pollen, but consume food stored up for the legitimate inhabitant of the nest. In these insects the basal joint of the hind tarsi is dilated into an oblong or subtriangular plate, most frequently rough on the inside, and provided, except in the parasites, with instruments for collecting and carrying pollen. The maxillæ and labium are elongated, and often form a proboscis which can be folded several times beneath the head, and is useful in reaching into the long tubes of flowers.

FAMILY I.—ANDRENIDÆ.

This family derives its name from its typical genus *Andrena*, of the habits of which more will be said hereafter. The following are the characters of this family:—The mentum is elongated, the labium at its extremity is small, and either spear-shaped or cordate, with a small ear-shaped lobe on each side. It is either straight or very slightly deflexed in some, and reflexed in others, and considerably shorter than the tubular mentum, the labium and terminal maxillary lobes not forming an elongated proboscis; the labial palpi are four-jointed and resemble the maxillary palpi, which are always six-jointed. The mandibles are simple, or end in one or two notches. The antennæ are elbowed, the hind legs are generally completely clothed with hairs, the trochanters and femora in the females are pollenigerous, the basal joint of hind tarsi is never externally dilated into an angle, and the second joint of the tarsi arises from the centre of the lower edge of the preceding joint.

The insects of this family are all solitary, and consist of males and females; the latter collect pollen from flowers, which, with the addition of a little honey, they form into a kind of paste, which is the food of their grubs. They burrow in the ground, and deposit an egg on a supply of this paste sufficient for the rearing of the grub.

GENUS COLLETES.—In the genus *Colletes*, of which there are four British species, the ocelli are placed in a line on the vertex. The wings have one marginal and three complete submarginal cells. The economy of this genus of insects was graphically described by Reaumur, who found them constructing their burrows in the interstices of stone walls. Our account of the bees is chiefly compiled from Mr. Smith's monograph of the bees of Great Britain, published in 1855.

The *Apis Daviesana* is very abundant in many sandy districts, particularly in the county of Kent. These insects form burrows, which are from eight to ten inches in length. At the further end they are lined with a very thin, transparent, membranaceous covering, resembling gold-beaters' skin. "The insect having stored up a sufficient supply of pollen and honey in a semifluid state, closes up the cell with a cap of the same substance as the lining of the tube. This cap is stretched flat across, like the parchment on a drum-head; a little within she next constructs a concave cap, serving as the end of the cell; her former

* He tells us so at p. 659 of the work, of which his History of Serpents forms the second book, published in 1658.

together in perfect harmony, issuing from and entering into the burrows indiscriminately. It may be observed that between *Eucera* and *Nomada* no resemblance exists in general appearance, one being several times larger than the other, and covered with pubescence of a sombre colour; whereas the parasite is a gaily-coloured insect, destitute of pubescence, and readily observed from the brightness of its colouring. To some extent a constant connection between certain species exists; and some species of these parasites are always found in connection with certain species of *Andrena*." It is the opinion of some authors that when the parasitic bee has deposited her egg upon the store of pollen collooted by the industrious bee, the latter at once deserts it, and proceeds to construct a fresh burrow; and that the parasites, which may be seen constantly entering different burrows, enter them that they may find the requisite quantity of food, which will usually be found to be much less than that required for the industrious bee. As soon as they have found this, they deposit their egg, and the nest is then possibly deserted by its legitimate owner.

ANDRENA HATTORFIANA is the largest species of the genus found in these islands. The female is eight lines long, while the male is a line shorter. *Andrena florea* is truly a summer insect, is associated with the brightest of all the sunny days of June, when the wild bryony is creeping over the hedge, the flowers of which are its chief delight. *Andrena cineraria* is an early species, appearing in April. It is fond of burrowing in trodden pathways, and may be met with abundantly in the walks of Hyde Park. It is deep blue-black, the head and thorax clothed with white pubescence.

ANDRENA PILIPES is seldom found but in the county of Kent; is very partial to thistle heads, from which it obtains a white pollen; when loaded with this it has a very strange appearance.

ANDRENA NITIDA may be found in the flowers of the common dandelion, in which they cover themselves with pollen. It is an early spring bee, and so is the *Andrena albicans*, a species found too by arctic travellers on the shore of Lake Winnepeg.

ANDRENA FULVA is a bee fond of the apple blossom, and appears when that bloom is out.

ANDRENA CLARKELLA is usually the first bee which appears in spring. It is found all over Europe, in Algeria, and occurs also in Nova Scotia.

ANDREA TRIMMERANA is very abundant on Hampstead Heath, and is frequently infested by *Stylops*.

Among the *Andrenæ* one species is peculiarly liable to the attacks of *Stylops;* this is the *A. convexiuscula*, some having frequently one, two, and a few even three specimens, projecting from the segments of the abdomen.

Of the genus *Macropis* there is one species (*Macropis labiata*) occasionally found in these islands; but it would appear to be very rare, as it has only been met with thrice.

There are two species of the genus *Cilissa* found in Britain. In habit they resemble the species of Andrena. *Cilissa hæmorrhoidalis* is found in the month of August "where the blue-bells grow," for it does not appear to frequent any other flower (Smith, Monograph, p. 110).

The genus *Dasypoda* contains but one British species, which is perhaps the most beautiful bee found in this country (*Dasypoda hirtipes*). This bee derives both its generic and its specific names from the long dense brush of fulvous hairs on the hind legs. The appearance of the female, when loaded with pollen, is sufficiently singular to attract the attention of the most apathetic observer. Kirby records that she forms burrows, like Andrena, and sits at the mouth of them enjoying the warmth of the sun, while the male flies in circles round her.

FAMILY—APIDÆ.

This family is characterized by Professor Westwood as follows:—The mentum is long, with the labium at its extremity forming an elongated slender seta, reflexed when at rest, and as long as, or longer than the mentum, with two small lateral filaments, and forming with the elbowed maxillæ an elongated proboscis, capable of being stretched out in front of the head when in action, or folded up beneath it and the breast when at rest, in the shape of a flattened Σ.

Without alluding to sub-families, we proceed to give, from Mr. Smith's Monograph, an account of the economy of the British genera of the family.

GENUS PANURGUS.—There are two species of the genus *Panurgus* in Britain. In structure they are very similar to the Andrenidæ; the females possess the brush on the tibiæ and the apical fringe on the abdomen, and their tarsi are similar. The chief difference lies in the tongue being folded at the tip when in repose. They excavate burrows, and lay up a store of pollen and honey, like the Andrenæ. They are summer bees, and black in colour. The most abundant species is the *Panurgus Banksianus*, which forms large colonies in retired sandy spots on heaths, making its appearance in July. For years such a community has existed on the north side of the Vale of Health, Hampstead Heath, where in spring the larvæ may be found in small cells about six inches beneath the surface. They do not change to nymphs many days before arriving at their perfect condition. This species and the *Panurgus calcaratus* seem to prefer the flowers of the mouse-ear hawkweed (*Hieracium*) to those of any other plant.

GENUS NOMADA.—The bees of the genus *Nomada* are popularly called Wasp bees, from a close resemblance they have in their gay colouring to some of the smaller wasps. The body is elongated and smooth; the legs are simple in both sexes. The maxillary palpi are six-jointed. The bees of this genus are known to deposit their eggs in the nests of other bees. They deposit their eggs on the provision laid up by the working bee, which, finding an egg deposited, commences a fresh cell for her own progeny. Mr. Smith thinks it probable that the parasite closes its cell, having frequently captured *Nomadæ* and *Melectæ* with masses of clay attached to their posterior tibiæ; and in the well-known genus of exotic parasitic bees (*Crocisa*) specimens are of frequent occurrence, which have masses of clay or mixed earth on their tibiæ. Twenty-four British species are described; one of these (*N. Solidaginis*) is often very abundant on the ragwort and

wild thyme. The *Nomada sexfasciata* is parasitic on the bee called *Eucera longicornis*, and may be seen in the month of June flying about where these bees have a colony, and occasionally entering into and issuing from their burrows.

GENUS EPEOLUS.—There is but one British species of this genus; it is short and glabrous, and distinguished by the maxillary palpi being short and one-jointed. *Epeolus variegatus* is a parasite on another bee, *Colletes Daviesana*, and is found in its burrows. The males like the males of most bees, seem to be a lazy set, passing most of their time reposing in flowers. The females are also very sluggish, and may be easily taken with the hand. Their sting is very sharp.

GENUS CŒLIOXYS.—This is another genus of parasitic bees, and may be known by the abdomen being conical in the female, and toothed at the tip in the male. The mandibles are broad and toothed. There are six British species described; they are parasites on Saropoda, and Megachile.

GENUS STELIS.—This is another parasitic genus of bees, which is short and ovate. There are three species found in these islands. The female of *Stelis phæoptera* has been observed entering the burrows of *Osmia fulviventris* in an old post. On one occasion it flew out to a short distance and settled on another post, apparently waiting for the *Osmia* to complete her labour, for immediately on the latter leaving, the *Stelis* re-entered. One of the species is parasitic on an *Osmia*, which makes its nest in bramble sticks.

GENUS MELECTA.—Two species of this genus are found in this country. One of these (*Melecta luctuosa*) is a beautiful jet-black bee, spotted with snow-white. It is parasitic on *Anthophora*. Mr. Smith has frequently bred it from the cells of that bee. In the autumn of 1852 he procured a great number of larvæ from the nests of the *Anthophora*. He could detect no difference in their form, but some were orange-yellow and others white. All the yellow larvæ turned into *Anthophora*, and some of the pale larvæ proved to be Melecta. He adds that these bees are frequently infested with the larva of the genus of beetles called *Meloë*, a dozen of them sometimes adhering to the sides of the metathorax.

GENUS OSMIA.—Of the genus *Osmia* ten species are British.

OSMIA RUFA is the most abundant species in this country; the female is armed on each side of the clypeus with a stout horn (hence the name also given to it of *Osmia bicornis*). This pretty bee varies its economy according to circumstances. "In hilly country or at the sea-side, it chooses the sunny side of cliffs or sandy banks, in which it forms its burrows; but in cultivated districts, particularly if the soil be clayey, it selects a decaying tree, preferring the stump of an old willow. It lays up a store of pollen and honey for the larvæ, which, when full grown, spin a tough dark-brown cocoon, in which they remain in the larva state until the autumn, when the majority change to pupæ, and soon arrive at their perfect condition. Many, however, pass the winter in the larva state." This Osmia frequently makes its burrows in the mortar of old walls.

OSMIA LEUCOMELANA selects for her nest the dead branches of the common bramble, and removes from them the pith, usually to the depth of from five to six inches. At the end she deposits a supply of food, which she closes in with a substance like masticated leaves. In one bramble stick she usually forms five or six cells. She does not extract the whole of the pith, but alternately widens and contracts the diameter of the tube, each contraction indicating the end of a cell. Immediately before closing up each cell, she deposits an egg. The egg is white, and about the size and shape of a caraway seed. The larva is hatched in about eight days, and feeds about ten or twelve, when it is full grown, and spins for itself a thin silken covering. In this cocoon it remains till the following spring, when it goes through its other transformations, appearing in June as a winged bee.

"The two most interesting species found in these islands are the *Osmia aurulenta* and *O. bicolor*. These bees generally burrow in banks, particularly the latter, which forms colonies. It appears to be the natural habit of these species to construct tunnels in hard banks with great labour and untiring perseverance; still we find them at times exhibiting an amount of sagacity and a degree of knowledge that at once dispels the idea of their actions being the result of mere blind instinct, impelling them in one undeviating course. A moment's consideration will suffice to call to mind many tunnels and tubes, ready formed, which would appear to be admirably adapted for the purposes of the bee; for instance, the straws of a thatch and many reeds; and what could be more admirably adapted to their requirements than the tubes of many shells? So thinks the bee. *O. aurulenta* and *O. bicolor* both select the shells of *Helix hortensis* and *Helix nemoralis*. The shells of these snails are, of course, very abundant, and lie half hidden beneath grass, mosses, and plants. The bees, finding them in such situations, dispense with their accustomed labour, and take possession of the deserted shells. The number of cells varies according to the length of the whorl of the shells selected, the usual number being four; but in some instances they construct five or six, commencing at the end of the whorl. A suitable supply of pollen and honey is collected, an egg deposited, and a partition formed of abraded vegetable matter. The process is repeated until the requisite number is formed, when the whole is most carefully protected by closing up the entrance with small pellets of clay, sticks, and pebbles; these are firmly cemented together with some glutinous matter, and the bee has finished her task. When she has selected the shell of a much larger snail, say that of *Helix aspersa*, in which the whorl is much larger in diameter than that of the other two, in fact, too wide for a single cell, our little architect, never at a loss, readily adapts it to her purpose, by forming two cells side by side; and as she advances towards the entrance of the whorl, it becomes too wide even for this contrivance. Here let us admire the ingenuity of the little creature: she constructs a couple of cells transversely!—and this is the little animal which has been so blindly slandered as being a mere machine. On the beautiful chalk slopes, not far from Mr. Atkin's seat of Halstead Place,

in Kent, I found snail shells so tenanted in 1843, and snail shells also tenanted by a beautiful spider of the genus *Attus*, or *Salticus*, as it was named by Latreille. A wood-boring bee constructs her tunnel, not by excavating downwards, as she would be incommoded with the dust and rubbish which she removes; no, she works upwards, and so avoids such an inconvenience. When she has advanced to the length required, she proceeds in a horizontal direction to the outside of the post, and now her operations are continued downwards. She constructs a cell near the bottom of the tube, a second and a third, and so on to the required number. The larvæ, when full fed, have their heads turned upwards. The bees which arrive at their perfect condition, or rather those which are first anxious to escape into day, are two or three in the upper cells. These are males. The females are usually ten or twelve days later.

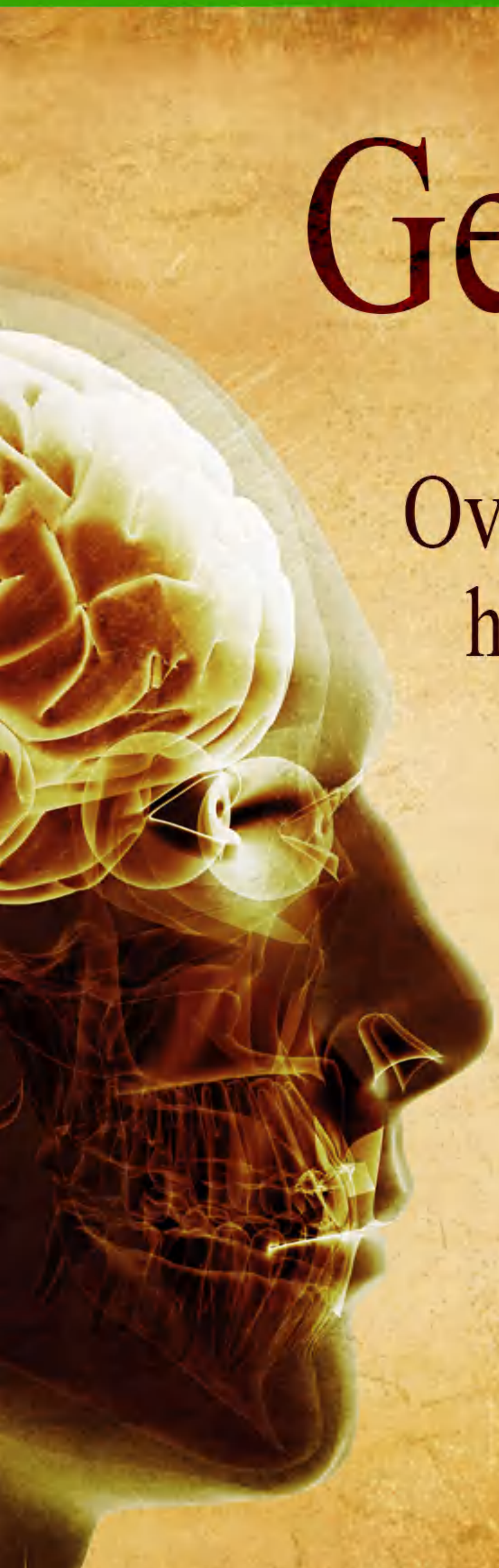
OSMIA PARIETINA is a species of Osmia only found in the northern parts of this country. It selects the under side of a slate or stone on the ground, with a hollow space beneath it. The bee attaches the little balls of pollen to the stone. Mr. Robertson sent a stone of this kind from Glenalmond in Perthshire, which contained beneath it a mass of cocoons. This stone was ten inches by six, and there were two hundred and thirty cocoons attached to it. In November, when found, about one-third of them were empty. In March a few males made their appearance, and shortly after a few females; others came out at the end of June. At this time there were thirty-five undeveloped cocoons containing larva. The following April they were still in the larva state. By the end of May they had changed to pupæ, and about the end of June began to come forth perfect insects; so that a portion of eggs deposited in 1849 had been three years in arriving at maturity. May this not be a provision for the preservation of a species living in a most uncertain climate? A species of *Chrysis*, or Golden wasp, is parasitic in the nests of this bee.

POPPY BEE.—The Rev. William Kirby (for doubtless the rector of Barham wrote that chapter in Kirby & Spence's "Introduction") has thus alluded to the habits of another bee, now placed in a genus by itself, named *Anthocopa*, or the "flower-cutter." It has not yet been discovered in this country.

Kirby classes these bees among "the hangers of tapestry, or *upholsterers*—those which line the holes excavated in the earth for the reception of their young with an elegant coating of flowers or of leaves. Amongst the most interesting of these is *Megachile papaveris*, a species whose manners have been admirably described by Reaumur. This little bee, as though fascinated with the colour most attractive to our eyes, invariably chooses for the hangings of her apartments the most brilliant scarlet, selecting for its material the petals of the wild poppy, which she dexterously cuts into the proper form. Her first process is to excavate in some pathway a burrow, cylindrical at the entrance, but swelled out below to the depth of about three inches. Having polished the walls of this little apartment, she next flies to a neighbouring field, cuts out oval portions of the flowers of poppies, seizes them between her legs, and returns with them to her cell; and though separated from the wrinkled petal of a half-expanded flower, she knows how to straighten their folds, and, if too large, to fit them for her purpose by cutting off the superfluous parts. Beginning at the bottom, she overlays the walls of her mansion with this brilliant tapestry, extending it also on the surface of the ground round the margin of the orifice. The bottom is rendered warm by three or four coats, and the sides have never less than two. The little upholsterer, having completed the hangings of her apartment, next fills it with pollen and honey to the height of about half an inch; then, after committing an egg to it, she wraps over the poppy lining, so that even the roof may be of this material, and lastly closes its mouth with a small hillock of earth. The great depth of the cell, compared with the space which the single egg and the accompanying food deposited in it occupy, deserves particular notice. This is not more than half an inch at the bottom, the remaining two inches and a half being subsequently filled with earth. When you next favour me," he adds, "with a visit, I can show you the cells of this interesting insect, as yet unknown to British entomologists, for which I am indebted to the kindness of M. Latreille, who first scientifically described the species."

GENUS MEGACHILE (*Leaf-cutter Bee*).—In this genus the head is generally large, and the mandibles very stout. These bees are commonly called Leaf-cutters, from their habit of cutting off pieces of the leaves of various trees, with which they form cells in which they store up food for their larvæ; they prefer the leaves of the rose and laburnum. Some of the species, such as *Megachile Willughbiella* and *M. ligniseca*, select decaying trees, posts, and rails, in which they form their tunnels. *Megachile maritima* burrows in the ground. Some species, such as *M. circumcincta*, form large colonies. The various species of *Cœlioxys* are parasites on *Megachile*. The *Megachile argentata* is a very active little insect; it makes a piping sound, which is extremely shrill and acute. It frequents the flowers of the *Echium vulgare*, or Viper's bugloss, which when seen is such a handsome ornament, growing among the trap debris of Salisbury Crags, near Edinburgh. In one of the divisions of this genus the fore tarsi of the males is dilated. To this section belongs the bee mentioned by John Ray in his Letters as "the Willow Bee," and named by Kirby *Willughbiella*, after Ray's friend, the naturalist Willughby. This name is a very appropriate one for this bee, as it burrows in the old stumps of willow trees.

THE LEAF-CUTTER BEE (*Megachile centuncularis*) is a well known British species, which is peculiarly fond of the leaves of rose bushes. These may often be seen with circular pieces cut out of them, and one who has watched the insect at work, thus describes its mode of operation. The bee places itself on the edge of the leaf, so that it passes between its legs, and with its great and sharp mandibles it cuts out a piece quickly, poising itself on its wings when it has nearly finished its work, so that it may not tear the piece, and to keep it and the cutter from falling to the ground. When it has quite detached the piece, it holds it firmly between its legs, and carries it to its nest, where it uses it with similarly formed pieces to build its cell. It takes many



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their burrows in decaying posts and rails; but when they meet with ready-formed tubes adapted to their purpose, they avail themselves of the convenience. Mr. Marsham describes the *Pimpla manifestator* as introducing its eggs into the nests of this bee; but the bee is so small, and the parasite so large, that it can hardly be on the Chelostoma that the Ichneumon preys, but more probably on some beetles (such as the *Clytus arietis*) which deposit their eggs in the same posts. *Fœnus assectator* enters the burrows and searches till it finds the nest. Two species of Chrysis are also found to be parasitic on this bee.

CERATINA.—The labial palpi in the genus *Ceratina* have four joints. Spinola first ascertained the habits of the species. These bees hollow out the pith of brambles and briars, and furnish their larvæ with a deposit of semifluid honey. Mr. Smith, who has confirmed the observations of Spinola, says—"Some years ago I observed a small bee most industriously employed in excavating a dead bramble stick. My attention was directed to the circumstances from observing some of the falling pieces of pith on the ground immediately beneath. Occasionally fresh quantities of dust were pushed out. At length the little creature came out of the stick as if to rest, and after sunning itself a few minutes, it re-entered, and again commenced its labours." Later in the day he stopped up the hole, cut off the branch, and found a male and female Ceratina. The Count St. Fargeau regarded these bees as parasitic, from their wanting pollenigerous appendages; but there are, as has been shown before, other genera similarly destitute, and yet not parasites. The *Ceratina cœrulea*, is very local. It frequents the flowers of the *Echium vulgare*.

EUCERA.—The genus *Eucera* is so named from the antennæ in the males being as long as the body. There is but one species found in this country—the *Eucera longicornis*, or Long-horned bee. Encera prefers a clayey soil for its burrows. At the end of the burrow the female forms an oval chamber or cell. The sides of this are made perfectly smooth, and capable of resisting the moisture of the mixture of pollen and honey stored up for its young brood. Each cell has one larva. This larva does not spin a cocoon, but passes the winter as a larva; about the end of April it changes to the pupa state, shortly after attaining which, it becomes a perfect bee. "The male, on emerging from its cell, passes its long antennæ through the notch at the base of the first joint of the anterior tarsus, drawing the antennæ through, and thus readily divests those organs of the thin pellicle in which they are enveloped. Here we see another beautiful exemplification of the truth, that nothing is made in vain. The long antennæ of the males of this genus are doubtless adapted to some peculiar phase in their economy, and the remarkable hexagonal reticulation of the joints also answers some purpose connected with a peculiar sense, the exact function of which we are unable to appreciate."

SARAPODA.—The genus *Sarapoda* is distinguished from all the other genera of British bees by the setiform labial palpi, the joints of which are continued in a straight line. The only British species, the *Sarapoda bimaculata*, is abundant in Hampshire and Sandown Bay in the Isle of Wight. It is evidently a prime favourite of the able monographer of the British bees, who thus writes of it:—"Of all the busy bees that revel in the beauty of a summer's day, *Sarapoda bimaculata* must ever be an especial favourite. It is only to be found when it is sunniest, brightest, and hottest—when summer days are summer days indeed. Who has not heard its merry hum? Who has not seen it when for a moment it settles on a flower, or rests on some sunny bank, panting with delight? Their eyes splendid as opals; could their brilliancy be preserved, this bee would rival and challenge admiration with the most brilliant of its tribe. It is a local species, but abounds in many localities; it flies with incredible swiftness, darting from flower to flower."

ANTHOPHORA.—There are four British species of the very fine genus *Anthophora*, which is one of great extent, and distributed over the whole world. One of the British species (*Anthophora furcata*) is a wood-burrower, according to Kirby. It occurs abundantly near London in July and August, frequenting the flowers of the red dead-nettle. The other indigenous species burrow in the ground or in walls, and such like places. The *Anthophora acervorum* is found in all parts of the United Kingdom. It literally swarms in some places. "There is a colony of this bee, in the chalk-pits at Northfleet, of such amazing extent that, in the middle of April, a dark flickering shadow is cast on the ground from the countless numbers assembled." There is little doubt that this is the very bee alluded to by the Rev. Gilbert White—in his Observations on Insects usually printed with the "Natural History of Selborne"—in the following passage:—"There is a remarkable hill on the Downs, near Lewes in Sussex, known by the name of Mount Carburn, which overlooks that town, and affords a most engaging prospect of all the country round, besides several views of the sea. On the very summit of this exalted promontory, and amidst the trenches of its Danish camp, there haunts a species of wild bee, making its nest in the chalky soil. When people approach the place these insects begin to be alarmed, and, with a sharp and hostile sound, dash and strike round the heads and faces of intruders. I have often been interrupted myself while contemplating the grandeur of the scenery around me, and have thought myself in danger of being stung." In the south of the Isle of Wight, the cliffs are often completely riddled with their burrows. Among the parasites attacking this bee, we may specially mention the chalcididous genus *Melittobia*, of which an account is given elsewhere. The common earwig is also very destructive, as it penetrates their burrows, and eats greedily the food laid up for the progeny of the bee.

GENUS BOMBUS (*Humble Bee*).—Bees of this genus may be at once known by their very large and hairy bodies. In Hampshire they are called Dumbledors, while in other districts they are named Bumble bees and Hummel bees. The name Humble may be a corruption of Humming bee, from the loud hum so characteristic of the species. In Scotland they are called "Bumbees," while the brown species are called "Foggies." No one who loves to watch nature, in all her varied guise,

can have failed in early spring, when the catkins are first found on the willow, to notice the loud hum of the females of different species of *Bombi;* and in May, when the horse-chesnut blooms, from the break to the close of day the hum of these industrious bees is unceasing. Various authors have written on the economy of these bees. In the winter, torpid females are found in decayed trunks of trees, under turf-stacks, or in other sheltered and dry situations. These females, having passed the winter in a torpid condition, revive under the influence of the warmth of spring, and become each the foundress of a separate colony. The first nests which they construct are of small dimensions, only sufficient to contain a few cells, in which they rear the workers who assist them in the formation of the works necessary to the wants of a large colony. When the larvæ are full grown, they spin a tough, oval, silk cocoon, in which they assume the nymph state; and, when sufficiently advanced towards maturity to require food, they begin to gnaw off the crown of their imprisoning chamber, in doing which they are assisted materially by the workers. On first emerging from their confinement they are by no means matured. Their pubescence is of a uniform pale colour, and some days elapse before they acquire the gay livery which they have assumed ere they fly. The males and females are not reared before the season is well advanced. The males of the *Bombus pratorum* are the first that appear, beginning to come forth about the third week in May. The nests are infested by several insects which devour the wax and honey, and with others which destroy the young brood.

The Humble bees have likewise a parasitic genus of bees, which live in their nests. They form a separate genus called *Apathus*. I do not know what office these bees perform in the economy of the nest. They live on the most friendly terms with the industrious part of the community; and it is probable that upon them devolves some important office, the nature of which it would be very interesting to discover. It has been supposed, from the very close resemblance of the *Apathi* to the *Bombi*, that the former are an idle race, reared at the expense of the industrious bees, and wearing a livery in imitation of them for the purpose of deception; but there can be little doubt of these aristocrats of the community performing important and necessary duties highly conducive to the general prosperity of the whole. That the close resemblance of these bees is not for the purpose of deception, is at once proved by the fact of *Apathus barbutellus*, a yellow-banded bee, being found in the nest of *Bombus Derhamellus*, a black species, having the tip of the body red.

The numbers of which the societies of Humble-bees consist, vary greatly in different species. Generally speaking, those, whose nest is above ground, have the smallest number. In a nest of *Bombus senilis* were found twenty-two females, forty-four workers, and sixteen males, many of the males having left the nest. Of undeveloped workers the combs contained twenty-seven pupæ, and nine of males. Of empty cells believed to have held males, there were ten, making a total of one hundred and twenty-eight. In a nest of *Bombus fragrans*, a species met with in the north, five females and about twenty workers were taken, so that it is a species with a small community. The nest of *Bombus terrestris*, taken in August, contained thirty-five females, twenty males, and one hundred and sixty workers; but by this time the majority of the males and females had left the nest. There were found in this nest, besides, two females of *Apathus vestalis*, and nine of the males of that parasite. The Moss-builders among the Humble bees appear to have very little pugnacity, as they show no courage in the defence of their citadel, while the underground nest builders are bold insects, and defend their homes, when attacked, with great courage.

The species called Moss-builders often compose their nests of nothing but grass and leaves, although in situations, where moss is abundant, they use it in the construction of their habitations. To show that these diligent hairy creatures make use of such materials as come most readily to them, an interesting instance has been recorded:—"One of the brown species of Humble bees was observed frequently flying into a stable through the latticed window. The bee was busily engaged in collecting bundles of short horse-hair accumulated from the currying of horses. This she fled off with to a short distance, and settled down with it among some grass. On examining the spot, a nest composed entirely of horse-hair was discovered." Unfortunately this interesting nest was destroyed, before it was quite finished. The same author mentions another curious deviation from its usual site, as selected by an eccentric black Humble bee with yellow bands (*Bombus pratorum?*). This was the nest of a robin, which built in the porch of Dr. William Bell's cottage at Putney in the summer of 1854. The Humble bee took possession of this nest, and adapted it to her own purposes.

No fewer than eighteen species of true Bombus have been described as occurring in Great Britain, but we have not space for them.

We have alluded under the preceding genus to *Apathus*, which closely resembles it in most particulars, though the posterior tibiæ have no corbiculæ, and are convex on the outside. There are only males and females of the Apathi. Four species are described as natives of this country.

Read this distinguishing description of a Humble bee by Professor Wilson, the far-famed Christopher North.* How often he had watched them on the moors of Renfrewshire, and on the hills of Scotland and Westmoreland!

"True to thy time, even to a balmy minute, art thou, with thy velvet tunic of black, striped with yellow, as thou windest thy small but not sullen horn, by us called in our pride humble bee; but not, methinks, so very humble, while booming high in air in oft-repeated circles. As if the smell of some far off darling heather had touched thy finest instinct, away thou fleest straight southward to that rich flower-store, unerringly as the carrier pigeon wafting to distant lands some love message on its wings. Yet humble after all thou art; for all day making thy industry thy delight, thou returnest at shut of day cheerful even in

* Recreations of C. N., vol. ii., p. 48.

thy weariness, to thy ground cell within the knoll, where, as fancy dreams, the fairies dwell, a silent people in the land of peace."

Hugh Miller,* when a boy at Cromarty, observed the various species of Humble bees. "The wild honey bees, in their several species, he observes, had peculiar charms for us. There were the buff-coloured Carders, that erected over their honey-jars domes of moss; the lapidary red-tipped bees, that built amid the recesses of ancient cairns, and in old dry stone walls, and were so invincibly brave in defending their homesteads that they never gave up the quarrel till they died; and above all, the yellow-zoned Humble bees, that lodged deep in the ground along the dry sides of grassy banks, and were usually wealthier in honey than any of their congeners, and existed in large communities. But the herd-boy of the parish, and the foxes of its woods and brakes, shared in my interest in the wild Honey bees; and, in the pursuit of something else than knowledge, were ruthless robbers of their nests."

Mr. Darwin believes, from observations made over a series of years, that Humble bees are indispensable to the fertilization of the hearts-ease (*Viola tricolor*), as it is the only set of bees which visit that flower. He has tried experiments which convince him that the visits of bees are, if not indispensable, at least highly beneficial to the fertilization of our clovers. He has observed that Humble bees *alone* visit the common red clover (*Trifolium pratense*), as other bees cannot reach the nectar. He adds—"Hence I have very little doubt, that if the whole genus of Humble bees became extinct or very rare in England, the hearts-ease and red clover would become very rare, or wholly disappear."† "*Credat Judæus Apelles, non ego!*"

THE HONEY BEE (*Apis mellifica*). The most important part of the produce of bees is their wax, which was proved by the illustrious and pious Bonnet to be secreted by the bees from between the scales or plates which cover the body. At one time it was universally believed that wax was only the pollen of flowers a little altered. But experiments of John Hunter and of Huber, continued by the late George Newport, demonstrated the accuracy of Bonnet's statement. Huber showed that with honey and water, when the bees were kept confined, and could not by any possibility get at flowers, these industrious creatures formed their waxy cells, as if they had been allowed to wander over the marjoram and thyme of the Swiss gardens, or to rob the innocent sweet Alpine flowers of their pollen.

Propolis is collected by the bees from the resinous secretions often found exuding from the buds of trees. On the "physiological effects" of honey we may dwell a little, and with the pharmacologist say, that it is "emollient, demulcent, nutritive, and laxative," generally much liked by children—not so much so by grown-up people. In ancient times, before the new world and the sugar cane were discovered, it was a much more important article than it is now. It was the chief thing with which the Egyptian, Assyrian, Jew, Greek, Roman, and old European sweetened anything he ate. Dr. Pereira* recommends patients who are troubled with severe coughs, to take warm barley water mixed with honey, and sharpened with slices of lemon, as a very agreeable and useful demulcent.

Bees sometimes collect the honey from poisonous plants, and instances are recorded of persons having died from partaking of this honey. Kirby and Spence quote some proofs of this, such as that given by Dr. Barton, an American physician, who records, that in 1790 many persons died in Philadelphia from eating honey. Inquiries were instituted, and it was found that the honey was derived by the bees chiefly from the flowers of the *Kalmia latifolia*. Xenophon, in his "Anabasis," mentions that some of his soldiers were singularly affected by honey which they took in Asia Minor. Some of them seemed as if intoxicated, others were much excited, and others lay on the ground as if about to die. The honey of Trebizond, near which the Greek army encamped on their retreat, still retains its deleterious properties. Mr. Abbott sent some of it to the Zoological Society in 1834, and confirmed the account of Xenophon.

The Honey bee of the mountain districts of Honduras is said by Squier† to resemble closely the bee of the United States. Its honey is largely used by the natives, who derive the chief part also of the wax used in the pompous ceremonial of the Roman Catholic church, from the natural bee-hives of the forest.

On the curious subject of Parthenogenesis, which has excited the attention of scientific men for some time, much has been written. An able naturalist‡ remarks that no form of it is "more remarkable or instructive than that which is present in connection with the economy of the common Honey bee. Many strange mistakes have prevailed from early times as to the history of the perfect societies of these insects, ruled by laws of instinct which have stimulated the curiosity of man, as much as their productive industry has served his uses and attracted his observation. But it has been only at a comparatively recent period that the true characters of the sexes have been anatomically fixed; and these discoveries have not yet succeeded in dispelling, among the practical bee-keepers in general, either inveterate errors or wild conjectures. Yet it is to one of this class, Dzierzon, pastor of Carlsmarkt in Silesia, that science ultimately owes the discovery of the true physiological relations which rule the generation of the race. The main facts are these:—The Queen bee, or perfect female, before impregnation lays eggs which produce males only. After impregnation, which takes place but once only in the course of her lifetime, the eggs produce male or female larvæ according to the sort of cells in which they are laid. By a delicate and difficult microscopical examination, Siebold has proved that the eggs laid in the queen's and workers' cells have been penetrated by one or more zoosperms, which, on the other hand, are never found in the eggs deposited in drone cells. He concludes, with reason, that the access of the

* My Schools and Schoolmasters, p. 65.
† On the Origin of Species by means of Natural Selection, p. 73.

* Materia Medica, vol. i., p. 765.
† States of Central America, p. 219: 1858.
‡ A. H. Haliday Esq., in the Natural History Review for April, 1857, p. 66.

segments, of which the first is the largest, and may be considered as a cephalothorax. In this state the males are easily distinguished from the females. The cephalothorax of the male larva is conical and arched, and the last segment of the body is straight and pointed. In the females the cephalothorax is truncated or rounded in front, and flattened or scale-like in the rest of its extent, and the terminal segment of the body is large and rounded."

Professor Westwood exhibited at the Entomological Society, in 1858, a mutilated strepsipterous insect (*Myrmecolax*), taken by Mr. Nietner of Ceylon, as it was issuing out of the body of a Ceylonese ant. In this genus the antennæ are remarkably large. On Plate 4 are figured six species of the males of these very curious insects.—Fig. 16 is the *Xenos vesparum* of Rossi, found in Italy on a species of Polistes common around Florence. It was the first discovered species.

Figs. 12, 14, and 17 belong to the genus *Stylops* of Kirby. Fig. 12 is the *Stylops Kirbii*; fig. 14, the *Stylops melittæ*; fig. 17, *Stylops Dalii*, named after J. C. Dale, Esq., of Glanville's Wootton, Dorset, who dicovered it and other species of Strepsiptera.

Fig. 13 is the curiously-pectinated horned *Halictophagus Curtisii*, named by Mr. Dale after John Curtis, Esq., whose superb work on "British Entomology," with its truly admirable figures of insects and beautiful British plants, has not been surpassed in any work on natural history.

Fig. 15 is the *Elenchus Walkeri*, named by Mr. Curtis after Francis Walker, Esq., a most amiable, intelligent, and diligent British entomologist.

NOTE.—It is my opinion, that in reality every order has, like Scotland and England, its "*debateable ground*," and that Strepsiptera are neither Coleoptera nor a distinct order, but connect Coleoptera with Hymenoptera; and so the Forficulæ connect the Coleoptera with the Orthoptera; the Perlæ connect the Orthoptera with the Neuroptera; the Phryganeæ, or Trichoptera, and the Neuroptera with the Lepidoptera; and so on. I fancy I could show it in Myriapoda, Arachnida, and Crustacea.

ORDER—COLEOPTERA (BEETLES).

THESE insects belong to an order called COLEOPTERA, from two Greek words for "a sheath" and "wings," the latter appendages being generally covered by, or concealed beneath, two hard cases which protect them. In the Stag beetles they are very apparent, and meet close on the back, having generally a straight suture or edge. Coleoptera vary in their antennæ: compare the thread-like antennæ of the Tiger beetle with the leaf-plated organ possessed by the Cockchafer. Some have the antennæ immensely long, as in the Longicorns. The antennæ are organs of a sense probably but little understood, hearing, feeling, and some third sense as yet unknown to man—a sense, which enables a shrimp to see, to smell, to catch its food. In the antennæ lies the "free-masonry" of the ants; they salute each other with these, like soldiers on guard giving the password. The antennæ are as wonderful as they are different; you may see this in two Water beetles, easily obtained, Dytiscus and Hydrous. There is much attention requisite to observe these differences, if you are one who wishes to attend to them with discrimination, or in other words, "scientifically."

In the feet, you will find that most beetles have five joints, but others have only four on the foot of the hind legs, as in Blaps and Tenebrio. Longicorns have only four apparent, while Lady-birds have only three joints to the tarsus.

I felt inclined to begin with the Brachelytra, and then to have taken the Adephaga, and tried to form a new arrangement; but a popular work is not the place for that purpose. I will, however, alter the situation of some of the groups, such as *Brentidæ*, which I consider to be Longicorns. I adopt, in great measure, the Latreillian system.

M. Lacordaire's work on Genera is a monument of industry and ability. He has made it comparatively easy now to class Coleoptera, and to ascertain *at one view* what has been done, by his references to species.

SECTION—PENTAMERA.

We are indebted to the French naturalist for an easy, though not always strictly correct way, of dividing Coleoptera into sections. This is by counting the joints of their feet or tarsi. In the first section called *Pentamera*,* all the tarsi have five joints, while in the other sections a different numeration obtains.

SUB-SECTION—ADEPHAGA.

The Adephagous beetles are all predaceous in their character, some getting their prey on the ground, and others in the water. The outer lobe of the maxillæ is distinct and articulated, "so that these insects have been ordinarily stated to possess six palpi; one pair being attached to the lower lip, and a pair to each of the maxillæ, as though the gluttony of these insects required an additional organ."† The antennæ and legs are long and slender, and the tarsi of the front legs are generally dilated in the males. The Tiger beetles, the Ground beetles, and the Water beetles, belong to this group, which is widely scattered over the world; and although the colours of the greater part of the species are dull, black, and deep brown, yet many of them are brilliant green, and other brighter colours, and they are frequently beautifully varied with lines and spots of yellow and white.

* Πεντε, five, and μερος, a part or division.
† Westwood; Modern Classification, vol. i. p. 45.

GROUP—GEODEPHAGA (*Ground Carnivorous Beetles*).

Of the group or family named *Cicindeletæ* by Laoordaire, only nine species were known in the days of Linnæus. At present at least five hundred species are known. These are arranged by Lacordaire into five tribes, which may be shortly divided in the following manner:—

I. Maxillæ ending in a jointed claw.

A. Third joint of the maxillary palpi longer than the fourth.

a First joint of labial palpi scarcely extending to beyond the base of the notch of the mentum, *Manticorides*.
They are great, African, large-jawed, black beetles.

b First joint of labial palpi extending far beyond the notch, ... *Megacephalides*.
Chiefly natives of the New World, though one is found in Europe, and one also in N. Australia.

B. Third joint of the maxillary palpi shorter than the fourth.

a Fourth joint of the tarsi entire, . *Cicindelides*.
Tiger beetles, everywhere found, except in arctic and antarctic regions; essentially "children of the Sun." There are five British species.

b Fourth joint of the tarsi heart-shaped, at least in the fore legs, ... *Collyrides*.
Long, thin, long-thoraxed, Asiatic insects, generally dark-blue with red legs.

II. Maxillæ without jointed claw, . . *Ctenostomides*.
Curious South American insects, with strange palpi.

The great group or family *Carabici* contains from five to six thousand known species. Lacordaire divides it into the following legions and tribes:—

LEGION I. (corresponding with the *Grandipalpes* of Latreille, and the *Simplicipedes* of Dejean), is known by the tibiæ of the fore legs being entire; their two spurs are generally both apical. It is divided into five tribes:—

I. Mesosternum indistinct, covered by the prosternum, *Omophronides*.
Roundish aquatic-like beetles—S. Europe, North America, and Asia; one (*Omophron limbatum*) is figured, Plate 4, fig. 5.

A. Spurs on fore tibiæ, one at the tip, the other before the tip, ... *Elaphrides*.*
Found in boggy places. Coleoptera (Plate 4, fig. 1), *Elaphrus uliginosus*.

B. Both of the spurs apical.

a Prosternum more or less prolonged behind, antennæ as it were broken, with the first joints very long, *Hiletides*.

Antennæ of the normal form, . . . *Carabides*.*
Among the largest of the race—Europe, Asia, N. Africa, N. America, and S. America.

aa Prosternum not prolonged behind, . *Cychrides*.*
With prominent mouth, body bulging behind, convex.

LEGION II. is known by the tibiæ of the fore legs being more or less deeply notched on the inner side. Spurs of these tibiæ, one at the tip, the other before the tip.

The first section of this legion contains but one tribe (*Pamborides*), in which the fore tibiæ are scarcely notched, and the last joint of the palpi is very large.

In the second section, which nearly corresponds with that named by Latreille, *Truncatipennes*, the elytra are truncated or notched at the end, nearly in all. The tibiæ of the fore legs are deeply notched, and the body is more or less depressed. Lacordaire divides the section into *nine tribes*:—

I. Mesosternum of normal breadth.

A. Claw of the maxillæ jointed, . *Trigonodactylides*.
Flat insects—Africa, &c.

B. Claw of the maxillæ fixed.

a Labrum moderate or short.

b Tongue moderate, more or less detached from its appendages (*Paraglossæ*).

c First joint of the antennæ of normal length.
Elytra truncated at the tip, . . *Odacanthides*.*
Elytra entire at the tip, . . *Ctenodactylides*.*

cc First joint of the antennæ elongated, *Galeritides*.*
See further on for a figure and description of one.

bb Tongue very large, without side appendages, *Helluonides*.
Australian and Indian insects.

bbb Tongue and appendages united at the sides.
Body more or less thick and robust, *Brachinides*.*
Bombardier beetles, crepitating.
Body in general much depressed, . *Lebiides*.*
Generally distributed.

aa Labrum very long, rounded in front, *Pericalides*.
Java and other Asiatic islands, and Indian continent.

II. Mesosternum very narrow, . . *Pseudomorphides*.
Flat, depressed, aquatic-like insects, also resembling Nitidula—a few fine species in Australia, one in N. America. Westwood and Guerin have figured them.

In the third section the elytra are entire at the end in nearly all. The anterior tibiæ, except in *Siagonides*, deeply notched, never palmated. Thorax united generally to the abdomen by a distinct peduncle.

I. Intermediate coxæ contiguous, . . . *Ozænides*.
Brazilian generally. Near these perhaps *Paussidæ* should be placed. See end of Coleoptera.

II. Intermediate coxæ distant.

a Mentum united with submentum, . *Siagonides*.
Flat, longish-beetles.

aa Mentum not united with sub-mentum.

b Anterior tibiæ not widened within at the end.

Tongue moderate, more or less free in front, *Ditomides*.

Tongue moderate, united closely to its appendages, *Graphipterides*.
Pretty, flat, desert-loving beetles—Africa and Arabia—black spotted with white or lined with white.

Tongue very large, without appendages, *Anthiades*.
Coleoptera (Plate 4, fig. 2, *Anthia guttata*).

bb Anterior tibiæ more or less widened at the end, *Morionides*.

The fourth section contains one tribe, *Scaritides*, which may be known by the anterior tibiæ being widened at the end, palmated and digitate at the tip, and deeply notched inside. The prothorax is separated from the abdomen by a peduncle. It is a family of generally large, ferocious, sand-loving beetles; our little *Clivina* and *Dyschirius* belong to this section.

In the fifth section the elytra are entire at the tip. The fore tarsi of the males are sometimes simple, but most frequently the three or two first joints are dilated into a square more or less rounded at the angles, except the first, which is generally triangular. They are clothed below with brushes of hairs

* Mr. Waterhouse includes these three families in one, Carabidæ, with thirty-six British species in the genera *Notiophilus*, *Elaphrus*, *Blethisa*, *Leistus* (with their formidably armed mouths), *Nebria*, *Pelophila*, *Calosoma*, the last-mentioned winged; *Carabus*, apterous insects: and *Cychrus*.

* Mr. Waterhouse unites these in one family *Lebiadæ*, with thirty four species belonging to the genera *Odacantha*, *Drypta Zuphium*, *Polystichus*, *Demetrias*, *Dromius*, *Lebia*, *Tarus*, *Masoreus*, *Brachinus*, &c.

1. Tongue and appendages united throughout their whole extent, ... *Panageides.**
Beautiful insects, especially two fine metallic South American species with fiery elytra.

II. Tongue partly free.
Head not widened in front; body very often pubescent. *Chlæniides.**
Another set of insects with fine colours, and a soft downy aspect. Head widened in front; body always smooth, ... *Licinides.**

In the sixth section the elytra are entire or simply sinuated at the tip. The fore tarsi are sometimes simple in both sexes, sometimes dilated. The number of the dilated joints, their form and clothing on the under side, are variable.

I. Mandibles short, or moderate, . . *Cnemacaathides.*
II. Mandibles elongated, ... *Stomides.*
Placed by Waterhouse in the *Feroniidæ* close to *Broscus.*

In the seventh section the first four joints of the fore tarsi, and often the intermediate, are more or less dilated in the males. They are triangular or heart-shaped. Their garniture on the under side is variable.

I. Anterior tarsi of the males simply ciliated or spiny beneath, ... *Cratocerides.*
II. The same, furnished with brushes of hairs, *Anisodactylides.*
III. Anterior tarsi of males furnished with scales, *Harpalides.*
There are sixty-four species in Britain placed in the genera *Anisodactylus*, *Diachromus*, *Harpalus*, *Stenolophus*, *Bradycellus*, *Trechus*, and *Aëpus*. Before me is *Thalassophilus Whitei*, a rare Madeiran insect, figured and described by T. Vernon Wollaston, Esq. I insert its figure elsewhere.

In the eighth section the three first joints (rarely the two first) of the fore tarsi are dilated in the males, and almost always furnished with scales below. The intermediate tarsi are constantly simple.

I. The three first joints of the fore tarsi in the males dilated.
a Tongue and appendages united, . *Pseudo-feronides.*
aa Tongue free at the tip.
b Mentum very feebly, scarcely notched, *Trigonotomides.*
bb Mentum, notched in the usual way.
c Fore tibia more or less robust, and dilated at the end, *Feronides.*
There are fifty-one British species in genera *Amara*, *Pterostichus*, *Broscus*, *Labrus*, &c.
cc Fore tibia more or less slender; anterior tarsi of males furnished with brushes of hairs beneath, *Antarctiides.*
Anterior tarsi of males furnished with scales, *Anchomenides.* (See *Panagæides.*)
II. The two first joints of fore tarsi dilated in the males, *Pogonides.* (See *Chlæniidæ.*)

In the ninth and last section the last joint of the palpi is in nearly all very small and slender, and appears as if planted in the end of the preceding joint, which is of considerable size. The elytra are entire, and the tarsi of the males are of variable form, often with the first joint much dilated. Lacordaire divides the section into two tribes.

I. Last joint of palpi not acicular, . . *Anchonoderides.*
II. Last joint of palpi acicular, . . *Bembidiides.*
There are fifty-three British species in the genera *Blemus*, *Cillenum*, *Bembidium*, and *Tachypus.*

This is an enormously large group of insects, much studied by the Count Dejean, and more recently by Mr. Tatum and the Baron Chaudoir.

I now proceed to notice a few members of this great section of beetles.

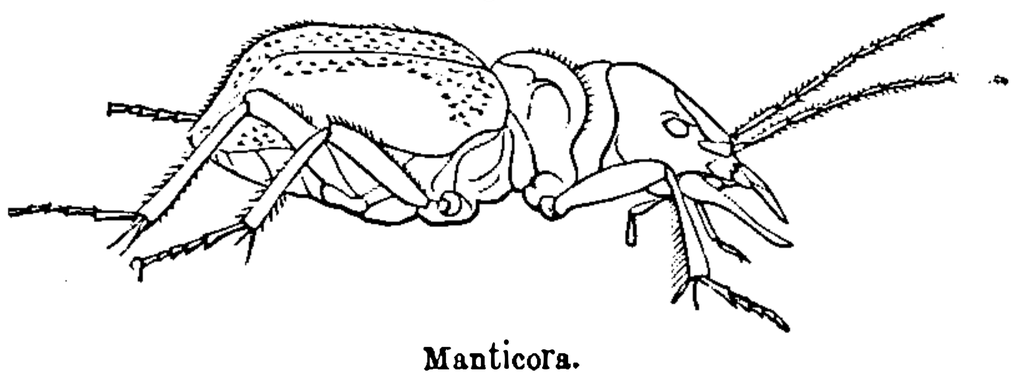
The Rev. Mr. Dawson has published a valuable work on the British Geodephaga. How desirable that a similar work on the remaining groups should be published, now that we have a list by Mr. Waterhouse, published in 1861, it is indispensable as a guide.

FAMILY—MANTICORIDÆ.

PLATYCHILE.—This genus is African; it is a flat, pale insect, usually placed at the beginning of the *Geodephaga.* It is very rare in collections, and must be nocturnal, judging from its colour, or may come from the coast of some seldom visited part of South Africa.

MANTICORA.—This genus—fig. 61—is peculiarly African. The larger species must be formidable opponents to caterpillars and the grubs of insects.

Fig. 61.



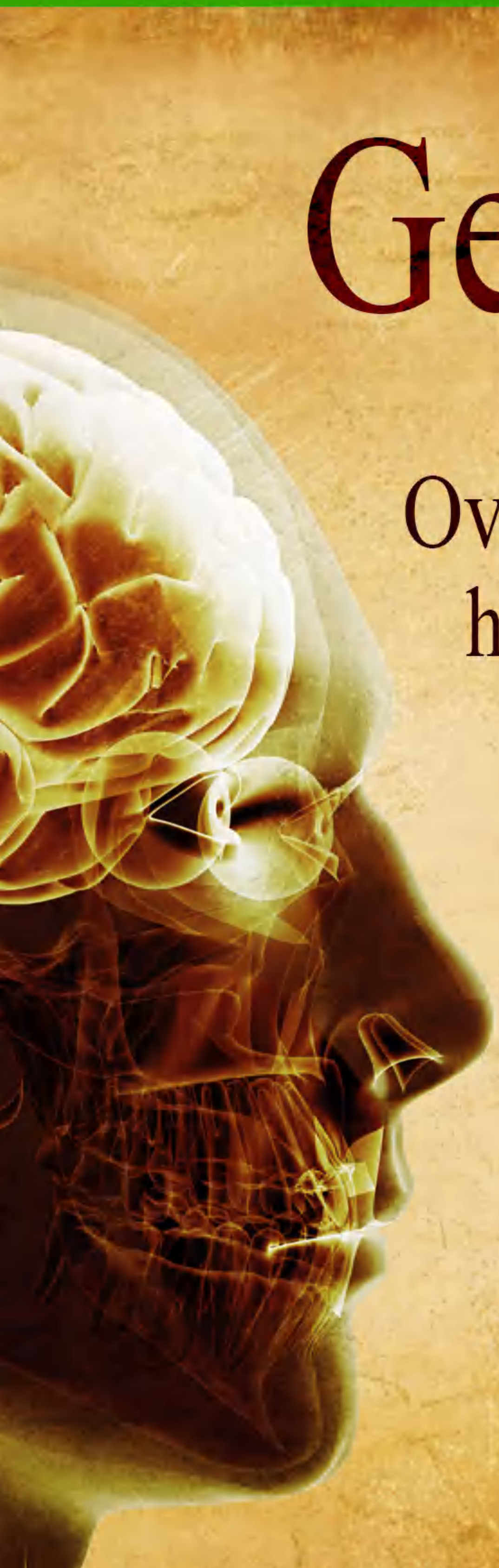
Manticora.

Three or more *good* species are figured. Mr. Thomson, in his fine work on *Cicindelidæ*, has figured several species.

OMUS.—The genus is indigenous to the west coast of America, California, and Vancouver's Island. I have seen many specimens of a species of this genus from the latter locality.

MEGACEPHALA.—This is an extensive genus, or rather group, allied to the Tiger beetles, and resembling them closely in habit. The body is much more robust, the head and thorax are broader and stronger, the upper lip is short and transverse, and the mandibles are stronger, which shows that they prey upon larger insects, and require greater force to tear their food in pieces; the antennæ are longer, more tapering, and the legs more robust than in the other Tiger beetles. Mr. Bates, who collected so assiduously on the banks of the Amazon from the sea to Ega, and beyond it, and who spent eleven years making researches on the entomology of that fine tropical region, took eleven species. He describes them as being all natives of sandy soils in exposed situations, as he never met with a specimen in the shades of the moist forests, which cover nearly the whole surface of the country. They appear to be all nocturnal in their habits. During the day they are concealed several inches deep in burrows in the sand. Although possessed of wings, he never observed any one make use of them; but he adds, "their powers of running exceed anything I have ever observed in locomotion; they run in a serpentine course over the smooth sand, and when closely pursued in endeavouring to seize them, they are apt to turn suddenly back, and thus baffle the most practised hand

* With Anchomenus placed in one family by Mr. Waterhouse. *Chlæniidæ* containing fifty-six species in the genera *Panagæus*, *Loricera*, *Licinus*, *Badister*, *Callistus*, *Chlænius*, *Oödes*, *Pogonus*, *Patrobus*, *Pristonychus*, *Sphodrus*, *Calathus*, and *Taphria.*



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narrow thorax, and reddish legs. The grub is considerably magnified, and must be a very ferocious fellow to any poor insect getting into its arms or jaws. It has five eyes grouped behind the antennæ. Its maxillary palpi are spined. The fore legs have four spines on each shoulder. Its pupa has a pale, bright, testaceous, depressed body, with two sets of fleshy tufts on each side of the segment behind the head. The perfect insects were found by M. Auguste Sallé, under bushes deeply sunk in sandy ground, on the banks of the Mississippi near New Orleans. Our friend, who described and figured them,* found the insect in all its stages from July to October. The larva constructs a feeble cocoon with thread and earth, in which to undergo its transformations.

The Carabidæ are generally very abundant in gardens and fields, running among grass or concealed under clods of earth or small stones. Some, such as the brilliant *Pœcilus* and *Amara*, run actively about in the sunshine, and are called "Sunshiners" from this habit. Generally, however, it is at night that they are on the alert. They are a very useful group of beetles, helping to keep down many noxious larvæ of other insects, which, but for the Carabidæ, might extend to an alarming degree. In this country, at least in its southern parts, a tree-frequenting species is found, called *Calosoma inquisitor*. On the continent of Europe a large, brilliant, metallic-tinted species of the same genus, called *Calosoma sycophanta*, is not uncommon. This fine beetle passes its life on trees, feeding chiefly on caterpillars. The ravages committed by some of the caterpillars of the family Bombycidæ are in many places much restrained by the Calosoma, which deposits its eggs in the nests of the moths, so that the voracious Carabidæ from their infancy begin to reduce the numbers of the noxious moths.

It has been noticed in France that in those parts where the *Carabus auratus* is abundant, the Cockchafer is almost unknown. The Cockchafer is a very destructive insect, especially where it abounds, as the grub feeds on the roots of grass, continuing in that state for some years. This fine Carabus seizes the Chafer before it has deposited its eggs, and it is said to be fonder of the eggs than of any other part of the insect.

The finest Carabi are found in China and Siberia. In North China is the noble green, warted, or nippled *Carabus cœlestis*, and the great blue-black *C. Lafossei;* in South China, the great *Carabus prodigus*, with its elytra cut out at the end. How fine, too, are the Siberian Carabi—also the exquisite *Carabus Vietinghovii*, black, exquisitely roughened, and the elytra and thorax encircled by the most lovely narrow girdle of green, passing into bronze and fiery red. Near it is the beautiful *Carabus Bowringianus* from Japan or Chowsan, named after my friend J. C. Bowring, Esq.

The Carabi from Chili and the extreme south of Terra del Fuego are very fine also.

Our little *Dyschirius*, one of the Scaritidæ, shakes its prey like a dog worrying a rat; and the larger species allied to it seem to have the same habit, for Mr. Adams records the manners of one which he observed abundant on the shores of the Corean archipelago. "When approached it burrows rapidly in the sand, bites very severely, and makes vigorous efforts to escape. It is a most predaceous creature, feeding greedily on the Talitri, Gammari, and other small crustacea which abound in these places."

"One very dark and warm night, in the early part of the present month I observed a considerable quantity of some brightly luminous matter on a gravel path in my garden. On a closer inspection I found that this consisted of many small detached patches, among which some animal was moving at a rapid pace, carrying with him a large quantity of the same luminous matter, and every now and then depositing a fresh patch. My curiosity was much excited by such a remarkable proceeding; I procured a light as quickly as possible, and discovered, to my surprise, that all this illumination had been the work of a Nebria brevicollis, who was literally detected *flagrante delicto*. I have often before this seen a strong phosphorescent light produced by various species, such as worms, centipedes, and the small white animals allied, I believe, to the Oniscidæ, so common in decaying vegetable substances; but this is the first instance I have met with of a coleopterous insect depositing any luminous matter on the ground. I can form no conjecture as to the cause of its proceedings, unless the light was intended for a sexual signal."

The *Aëpus marinus* and *A. Robinii* are found in places where at times they are covered by the sea. So is the curious Madeiran genus *Thalassophilus*, described and figured in the "Coleoptera Maderensia" of Mr. Wollaston.

GROUP—HYDRADEPHAGA (*The Water Beetles*).

In this group the beetles are all aquatic, and have legs peculiarly formed for swimming. The two hind pairs are flattened like an oar, and are ciliated or fringed with hairs; the hind pairs being placed at a considerable distance from the others, whereby a much greater impulse is given to the animal in its motions through the dense element of which it is an inhabitant.

Their bodies are more or less oval, the best shape for water, and they are convex beneath, somewhat like a boat, and generally smooth above. They swim rapidly, occasionally coming to the surface, when they keep the feet motionless, "the body ascending, being specifically lighter than water. In this situation they rest obliquely, the extremity of the body being protruded out of the water, whereby the air is enabled to enter the large space beneath the elytra, and reach the spiracles along the sides of the back."

The Water-beetles, of which at least five hundred and fifty species are known, are scattered over the whole world, and are divided by Lacordaire into the following six sections:—

1. Posterior coxæ not widened in front.

   a Prosternum received into a hollow of the mesosternum. This tribe is formed by a North American insect (*Amphizoa insolens*), found in the valley of the Sacramento. It seems to be a link connecting this group with the Geodephaga.

* Annales de la Soc. Ent. France, second series, vol. vii., p. 299 (1849); Plate 8, fig. 2.

aa Prosternum joined behind with the metasternum.
Posterior coxæ furnished with plates partly covering the abdomen, ... *Haliplides.*
Posterior coxæ without plates, . . *Pelobides.*

II. Posterior coxæ very large, widened in front.

b Four anterior tarsi, furnished with only four joints, *Hydroporides.*

bb All the tarsi furnished with five joints.
The dilated joints in the males simple, with small cupules of equal size, . . *Colymbetides.*
The dilated joints of males in the form of a great suborbicular palette, with small cupules of unequal size.

They are all included by Mr. Waterhouse in the family *Dytiscidæ.* He gives one hundred and eleven species as natives of the British islands. They are in the genera *Dytiscus*, *Acilius*, *Hydaticus*, *Colymbetes*, *Ilybius*, *Agabus*, *Noterus*, *Laccophilus*, *Hyphidrus*, *Hydroporus*, *Haliplus*, *Cnemidotus*, and *Pelobius.*

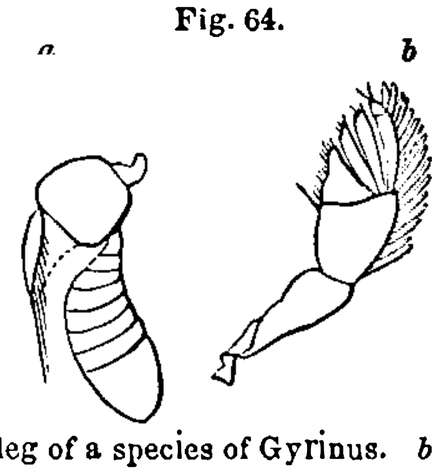
The *Dytiscus marginalis* is a common species in this country, and is so named from the conspicuous yellow margin of the thorax. Water-beetles fly about at night, and frequently in moonlight nights dash themselves against glass-windows, which they seem to mistake for pools or streams.

These water-insects are very carnivorous; their larvæ are often very beautiful objects for the microscope.

FAMILY—GYRINIDÆ (*Whirlwhigs*).

Who has not seen the Whirlwhigs gyrating on a pool or river—as if they did not touch the water? Some of the exotic species are of considerable size,

Fig. 64.



a Hind leg of a species of Gyrinus. *b* Antenna.

and are curiously formed. Others have pointed bodies and elytra. Their antennæ and legs are very curious. Of the figures *a* is that of the hind leg; *b* that of the antenna.

SUB-SECTION—RYPOPHAGA (*Cleansers*).

The next sub-section of the Pentamera has been named RYPOPHAGA, from the insects contained in it eating putrid animal and vegetable matter, and in this way *cleansing* and *clearing* the ground. They have only four palpi, and the antennæ in most of them are either gradually or suddenly clavate. In those which inhabit the water, the maxillary palpi are generally of considerable length; and these organs, but for their having fewer joints, might be taken by the beginner for their antennæ. In one large section of the group, the elytra are extremely short. This section is named *Brachelytra.*

GROUP—BRACHELYTRA.

Generally longish beetles, with very short elytra, though a few of them are very short insects, and have elytra nearly covering the abdomen.

There are at least two thousand species known of this extensive group of beetles. In fact, the greater portion of the above are European; six hundred are recorded as British in Mr. Waterhouse's Catalogue of British Coleoptera. It has been said that they are comparatively rare in the intertropical regions; this seems, however, to arise from their not having been so much searched for as other groups.

The following is the arrangement of the group in the monograph of Erichson, an arrangement which is generally adopted by all naturalists:—

I. Prothoracic stigmata visible, seldom covered by a horny free plate.

Antennæ inserted at the inner margin of the eyes, *Aleochoridæ.*
Two hundred and sixteen of these are British.

Antennæ inserted below the side margins of the front, *Tachyporidæ.*
Fifty-five are British.

Antennæ inserted on the fore margin of the epistome, *Staphylinidæ.*
Mr. Waterhouse divides this, as Kraatz does, into Quediidæ and Staphylinidæ—with one hundred and six British species.

II. Prothoracic stigmata concealed by the epimera of the prothorax.

A. Posterior coxæ conical.

a A membranous space between the fore-coxæ, *Pæderidæ.*
Xantholinidæ and Pæderidæ have fifty-seven recorded British species.

aa Prothorax quite horny below.
Antennæ inserted below the side margins of the front, ... *Pinophilidæ.*
Antennæ inserted on the front, . . . *Stenidæ.*
There are fifty British species.

B. Posterior coxæ transverse.

b The anterior coxæ globular, not prominent, *Piestidæ.*
Only one British species. Some of the exotic species are fine and large.

bb The anterior coxæ conical, prominent.

c No ocelli.
Abdomen seven-jointed, . . . *Oxytelidæ.*
There are forty-nine British species.
Abdomen six-jointed, . . . *Phlæocharidæ.*

cc Front with two ocelli, ... *Omalidæ.*
There are forty-three British Omalidæ.

bbb Anterior coxæ sub-cylindrical, transverse, *Proteinidæ.*
There are nine British species.

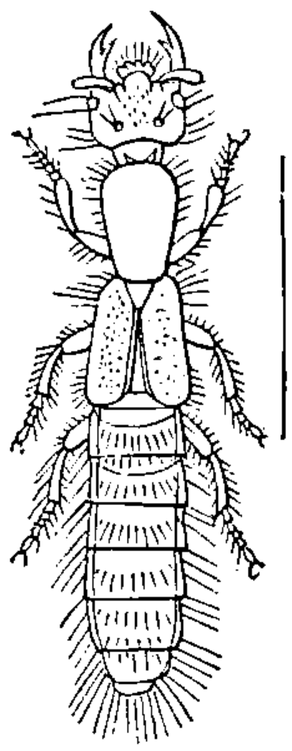
Of the little pretty Micropeplidæ, with their curiously-pitted elytra, there are four British species.

We here figure from Erichson's work the *Scytalinus serpentinus*, *Tanygnathus terminalis*, and the very curious *Megalops cephalotes* (figs. 65, 66 and 67), which, with the other figures, show the great variety of form amongst the Brachelytra.

In their perfect state Staphylinidæ chiefly feed on decaying animal and vegetable substance. Many of the species which are found on flowers or in fungi seem to be carnivorous; the former frequent the flowers on account of the small insects which they find there, while the latter feast on the grubs which abound in fungi. These insects are accordingly found in many different

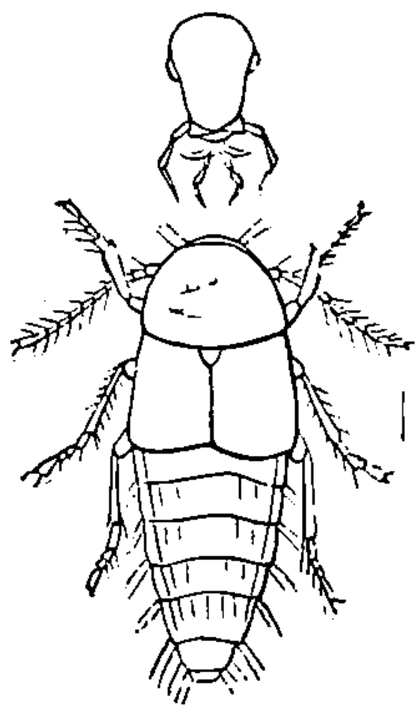
situations—in carcasses, dung, among fallen leaves, mosses, barks, and such localities. Many are only found on the coast, and several, as noticed afterwards, live in ants' nests.

Fig. 65.



Scytalinus serpentinus.

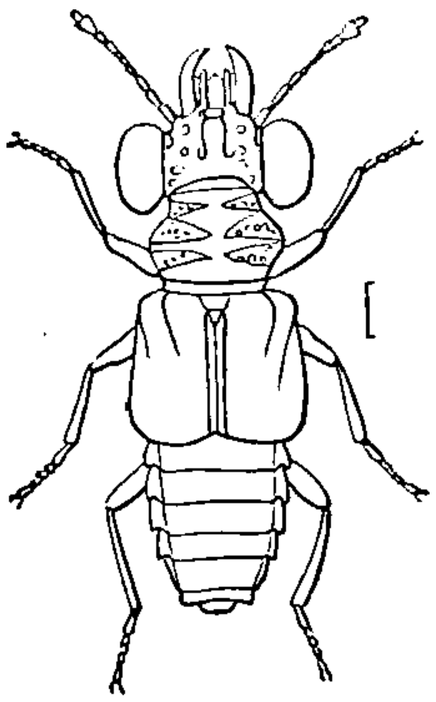
Fig. 66.



Tanygnathus terminalis.

In their movements these insects are very active, and they fly frequently, though not for any length of time. When the larger species are disturbed, they emit a most noisome stench, which proceeds from two ovoid whitish vesicles they exsert from their cloaca.

Fig. 67.



Megalops cephalotes.

They often turn up their abdomen over the back when excited. The great mass of the Staphylinidæ are of dull colours; but some of the exotic species, particularly those of South America, have most brilliant colours.

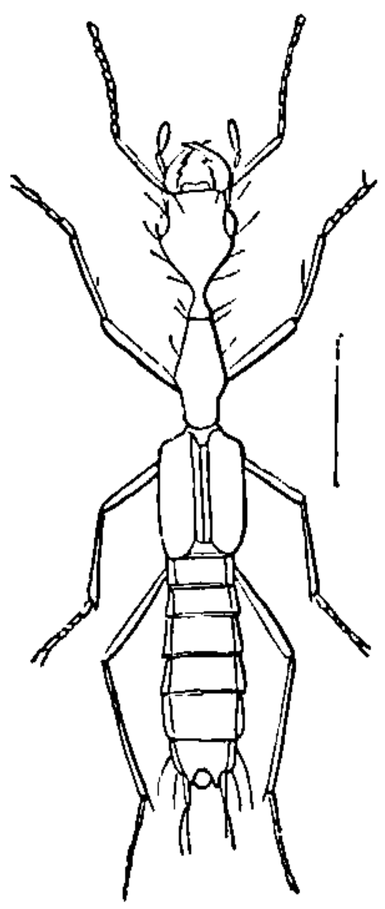
The *Staphylinus villosus* is a common North American species. It is described by Mr. Gosse as being so abundant in Newfoundland as to be quite a pest, for it crawls about and devours the drying cod-fish. From this habit it has acquired the name of "the fish-fly." This species seems to enjoy an extensive range, for it is met with as far south as Jamaica.

The *Emus hirtus*, covered with yellow and black hairs like a Bombus, is a rare British insect; *Velleius dilatatus* is a parasite in the hornets' nests, from which it has been often taken.

Some of the Staphylinidæ are almost peculiar to the sea-shore. In such localities the different species of *Cafius* are met with under sea-weed, cast up on the coast. They are well fitted for rapine by their broad heads, and long jaws armed with strong teeth. Their voracity does not spare their own species, and they sometimes fight for the exclusive possession of a common prey. They burrow with great agility under the loose sand when alarmed; their flattened body and expanded pilose anterior tarsi being admirably adapted for making their way through this loose material.

The group *Pæderini* are much elongated, and have a rounded thorax, attenuate in front. The British species have often a pretty red thorax. A very singular genus of the group is figured here from Dr. Erichson's work. The long tapering thorax and strange head attenuated behind, much as in Casnonia, one of the Carabidæ—or Raphidia, the Crane-fly, one of the Neuroptera—mark this out from other genera, as well as its broken antennæ; the first joint is very long, while the others are very short.

Fig. 68.



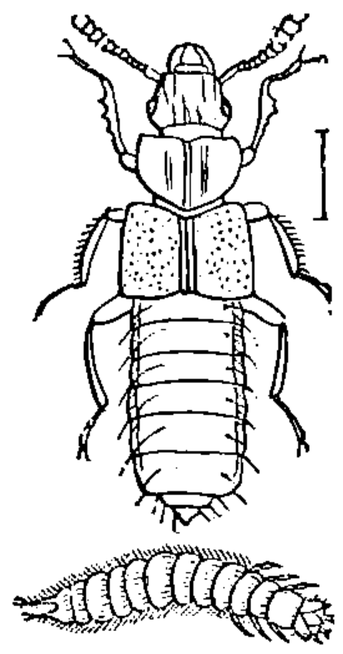
Ophites versatilis.

Species, small in size, are often found in the valleys of Columbia. The individual figured is of a pitchy-black colour, the tip of the short elytra and the legs are whitish; it is named *Ophites versatilis*.

The genus *Stilicus* is near this. One species, the *S. fragilis*, is beautifully figured in one of Mr. Curtis' exquisite plates; they are found under tufts of grass and fallen leaves.

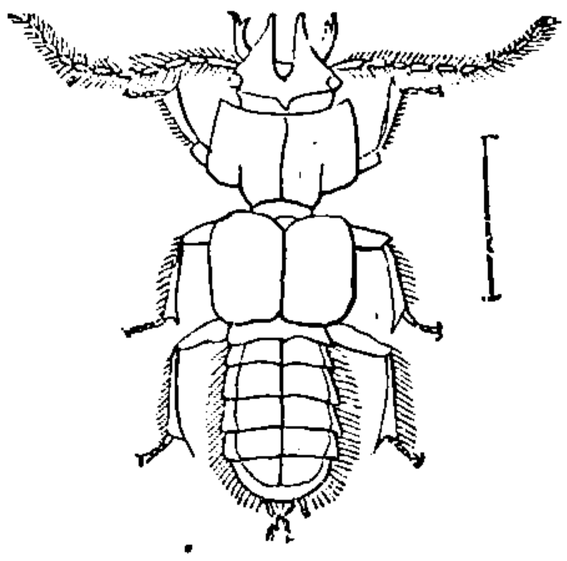
The following figure shows the form of the genus *Oxytelus* and its larva (fig. 69), belonging to a group

Fig. 69.



Oxytelus carinatus, with larva.

Fig. 70.

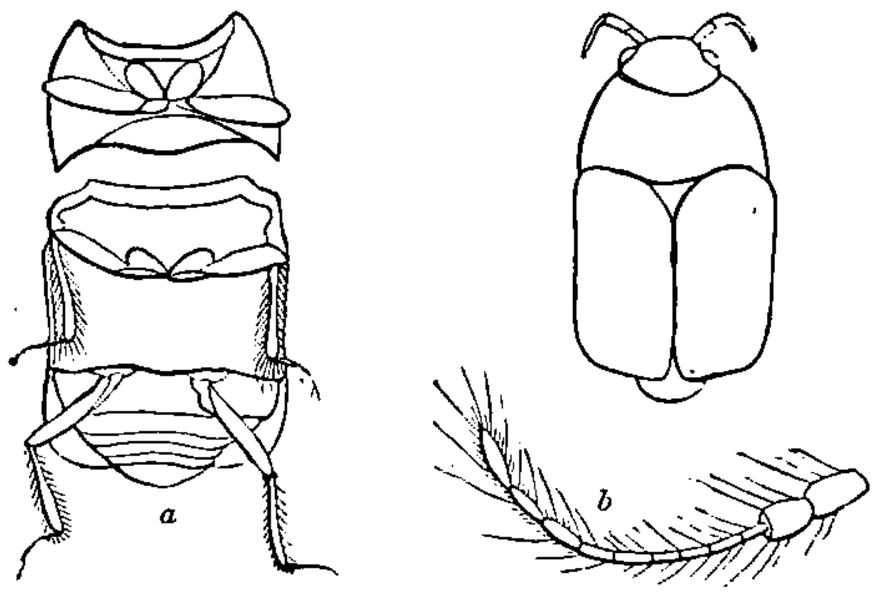


Male of a cornuted Bledioid beetle.

containing species, the males of which are often armed with horns or spines on the head. The genus *Bledius* is particularly marked in this way. There are forty-

may be brought in an allusion to those miscroscopic wonders, the *Trichopterygidæ*, or those which have wings ciliated most beautifully with hairs. Some of

Fig 73.



a The underside. *b* The antenna.

them are the smallest of insects. There are forty-two British species as yet recorded. Our figure shows one of these greatly magnified—*a* the underside; *b* the antenna.

GROUP—NECROPHAGA.

These are necrophagous beetles, which are so called from their feeding on dead animal substances. The antennæ are generally more or less suddenly thickened at the tips. The mandibles are strong, the maxillæ end in two lobes, the outer one of which is not palpiform. In this group the elytra frequently do not entirely cover the abdomen. The legs are strong, and formed for running. Although the chief food of this group consists of decaying animal matter, yet some of them live on fungi and other vegetable remains. The *Silpha quadripunctata*, lives exclusively upon trees, feeding greedily on caterpillars.

In this group is placed the curious genus LEPTODERUS, characterized by its oval elytra, closely united at the suture, and by the very long, slender, cylindrical thorax, from which its name is derived. There are three species known, which live exclusively in the innermost recesses of some of the Carinthian caverns. They are quite blind, and are of an uniform brown or ferruginous hue.

FAMILY—SILPHIDÆ (*Carrion Beetles*).

The most characteristic family of the group is that named by authors SILPHIDÆ. In these islands are found many species (forty-nine) of this family, some such as the *Necrophori*, of considerable size. The body is depressed; the thorax is more or less circular, its sides being expanded, while the head can be drawn down under it. The larvæ of these insects have a great general resemblance to those of the Staphylinidæ. They have four jointed antennæ, and two styliform appendages on the last segment of the abdomen, and an anal prolongation which assists them in progression. They possess a labrum, which is wanting in the Staphylinidæ. They have the power of emitting a most disgusting smell.

The Necrophori have been named Sexton beetles from the wonderful instinct they have been endowed with, and which is thus described by Mr. Westwood:—"No sooner," says he, "is any small dead animal, bird, or bit of flesh exposed in the open air, than the Sexton beetles make their appearance; and after rigorously inspecting the object, as it were for the purpose of taking its dimensions, several of them commence operations by creeping beneath the carcase, where, by digging away the earth with their fore-legs beneath and around the animal, it by degrees descends into the ground, although many times larger than the insects engaged in burying it."

On Plate 4, fig. 11, is figured the *Necrodes littoralis*, another common dark species, with the femora of hind legs often enormously thickened in the males. The *Silpha lapponica* is often a great nuisance in the huts of the Laplanders, consuming much food when it abounds.

The *Silpha thoracica* is black, but distinguished by its orange-coloured thorax.

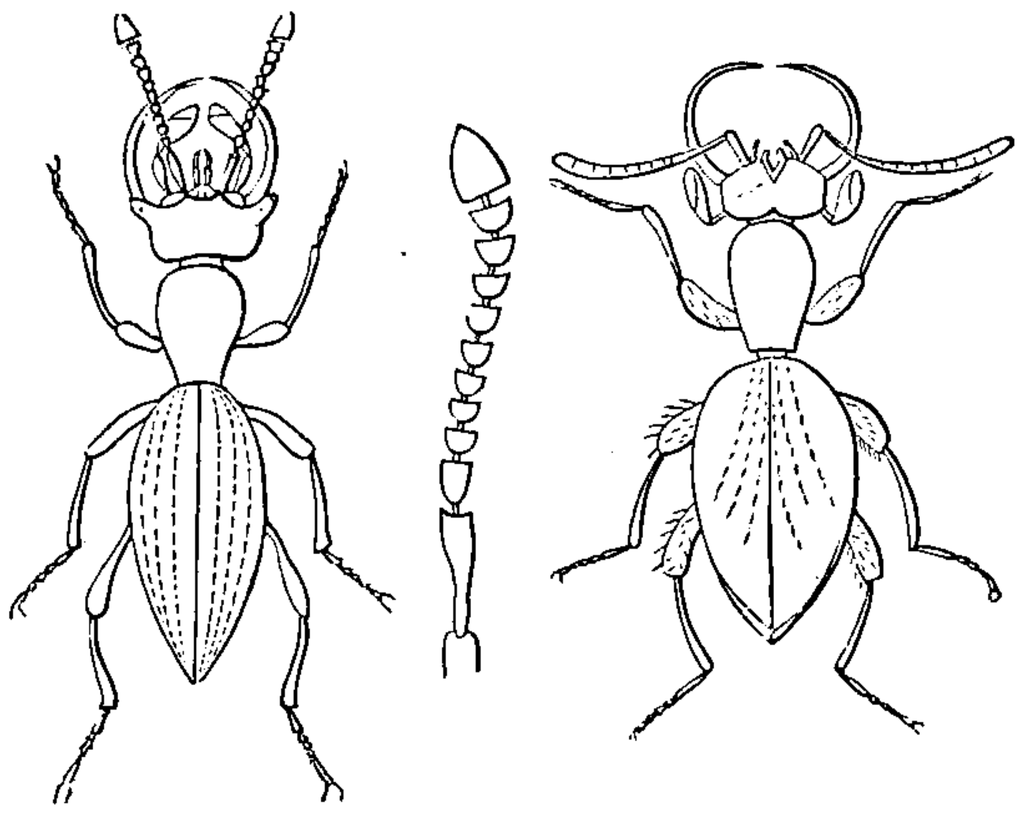
The *Cholevæ* and *Colons* are an interesting group, once studied by Mr. Spence.

The strange genus ADELOPS, found originally in the caves of Carniolia, has been found in this country by that talented entomologist, Mr. Janson. He also found and described a new species, naming it *A. Wollastoni*. *Adelops* is supposed to be blind, as is the curious pale *Leptinus testaceus*, also a very rare British insect. *Sphærites glabratus* is a rare Scottish beetle belonging to this group.

FAMILY—SCYDMÆNIDÆ.

Of the beautiful family SCYDMÆNIDÆ, little well-defined insects, there are sixteen British species. The

Fig. 74. Fig. 75.



Pylades Caquereli. Leptomastax hypogeum.

figure, 74, represents a most remarkable form in this family (*Pylades Caquereli*), found by M. Caquerel,

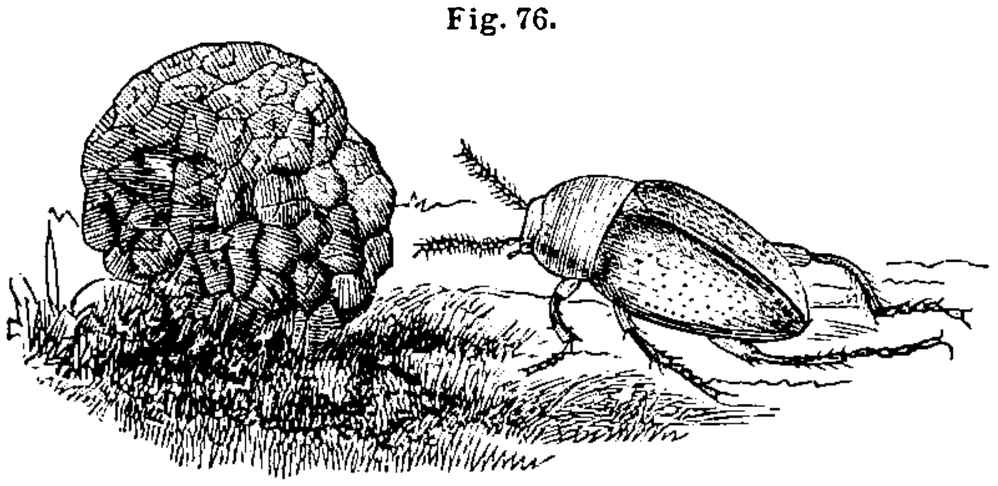
on the shore in the Bay of Beikos, opposite to Constantinople.

Its strange immense transverse head, formidable mouth, the apparent want of eyes, and the curious situation of the antennæ, all distinguish it. In place of eyes, it has only two small dots. Of course the figure of the antenna is greatly magnified. Fig. 75 is an allied species.

FAMILY—ANISTOMIDÆ.

There are thirty species of ANISTOMIDÆ, beetles, generally of small size, found in fungi. One of them is found in the Truffle. A figure of the Truffle and of this beetle, *Leiodes cinnamomea*, with its bent tibiæ, is subjoined. The species of *Agathidiun* and *Clambus*,

Fig. 76.



Truffle beetle (Leiodes cinnamomea).

on being alarmed, roll themselves into a ball, and look like little beads or "mites" of earth. But I must dwell but cursorily on these and other curious little insects.

The family SCAPHIDIADÆ contains pretty insects, with the abdomen extending beyond the elytra. They are found generally in fungi. On Plate 4, fig. 8, is shown the *Scaphidium quadrimaculatum*.

FAMILY—NITIDULIDÆ.

This family is of considerable extent, and contains insects generally of small size, and for the most part of an oval or oblong form. The greater part of them are more or less depressed, though others are very convex, and some even subglobular. Although some of them are metallic on the surface, yet, for the most part, they are covered with a fine short pubescence. The mandibles are short, but strong, and frequently notched at the tips. The palpi are short. The antennæ consist of eleven, and, in a few cases, of ten joints; the two or three last joints formed into a short club. The elytra are truncated at the end, and in one or two of the genera (*Cillæus Conotelus*) the abdomen extends beyond them much as in the Staphylinidæ. The normal number of abdominal segments is five; the sixth, when it exists, is small, and nearly always only present in the males. In the perfect state some of the *Nitidulidæ* are found under bark, and others on flowers, while some are found among bones and dead or decaying animal substances. The larvæ are depressed, and are furnished on the end of the body with four small, horny, conical appendages, curved upwards, and with small fleshy protuberances on the margin. The pupæ are found amongst the moist earth beneath the surface of the ground, from which they proceed in due time, the perfect insect being generally found in the crevices of bark. The larva of some species live also, according to Erichson, in the galls of the oak. The distinguishing characteristics of the Nitidulæ are stated below.

Lacordaire divides the group into six tribes, which he briefly characterizes in the following table:—

I. Antennæ of eleven joints.

A. Two or three last dorsal segments of the abdomen exposed.
Maxillæ with two lobes, . . *Brachypteridæ.*
Maxillæ with one lobe, . . . *Carpophilidæ.*

B. Pygidium only exposed.

b. Epistome not projecting between the mandibles.
Prothorax not covering the base of the elytra, *Nitidulidæ.*
Prothorax slightly covering the base of the elytra, ... *Cychromidæ.*

bb. Epistome projecting between the mandibles, *Ipsidæ.*

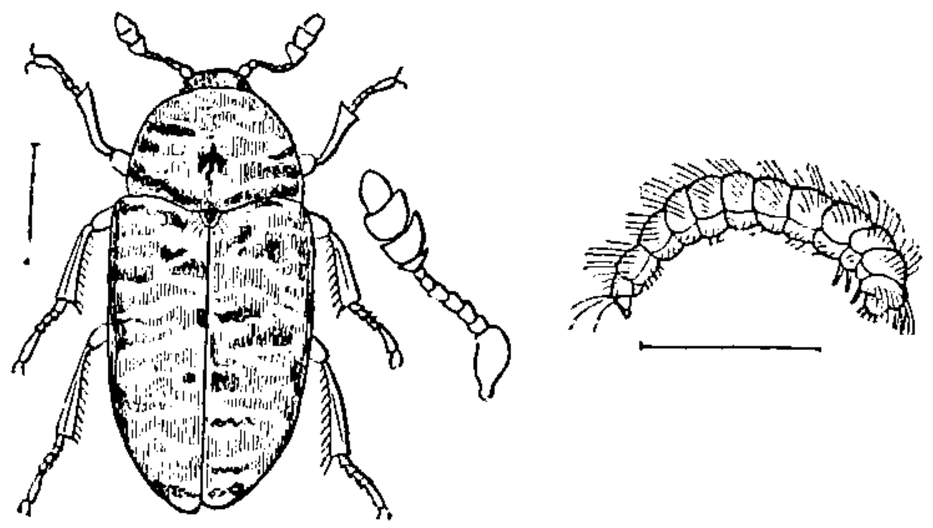
II. Antennæ of ten joints, . . . *Rhizophagidæ*

Species of these tribes occur in this country.

FAMILY—DERMESTIDÆ.

The insects of this family are peculiarly destructive. The name *Dermestes* was given to a genus in it from the Greek word δερμα, "a skin," the insects making

Fig. 77.



Dermestes murinus and larva.

great ravages in skins and furs. Most of them have a certain faculty of drawing their legs under the body. The *Dermestes murinus* may be found in the bodies of moles stuck up in fields to dry.

The larva of *Anthrenus muscorum*, whose ravages in insect cabinets are at times most considerable, is covered with bunches of diverging hairs, which singularly protect it. Fig. 77 shows an Anthrenus, and the larva of one.

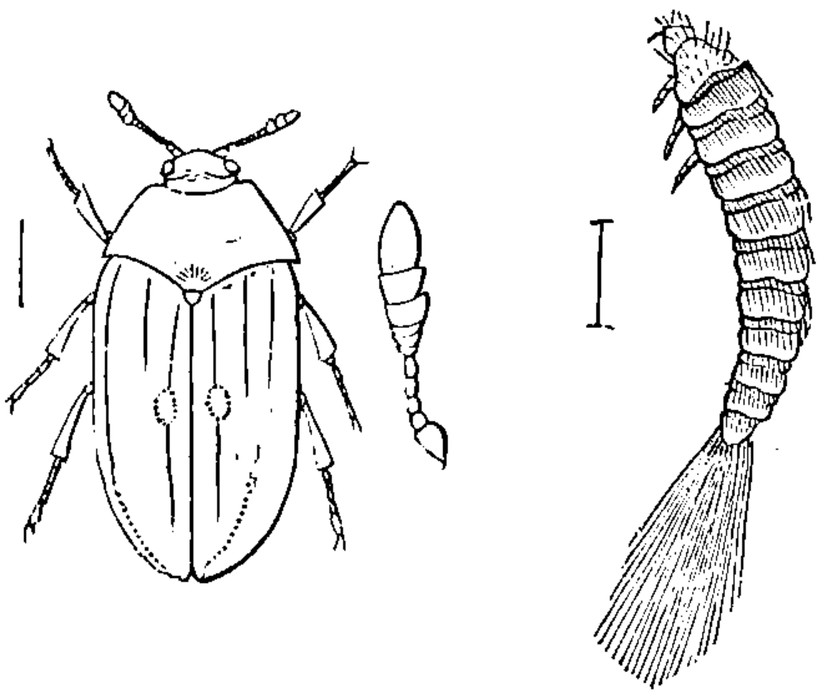
There are fifteen British species contained in the genera *Dermestes*, *Attagenus*, *Megatoma*, *Tiresias*, *Anthrenus* and *Trinodes*.

On the family BYRRHIDÆ, which are more or less globose insects covered with silky pile, I cannot enter, nor into the aquatic families, HETEROCERIDÆ, with

seven species; PARNIDÆ, with nine; and GEORYSSIDÆ, with one, like a small Byrrhus.

The various species of Byrrhus when in danger, or

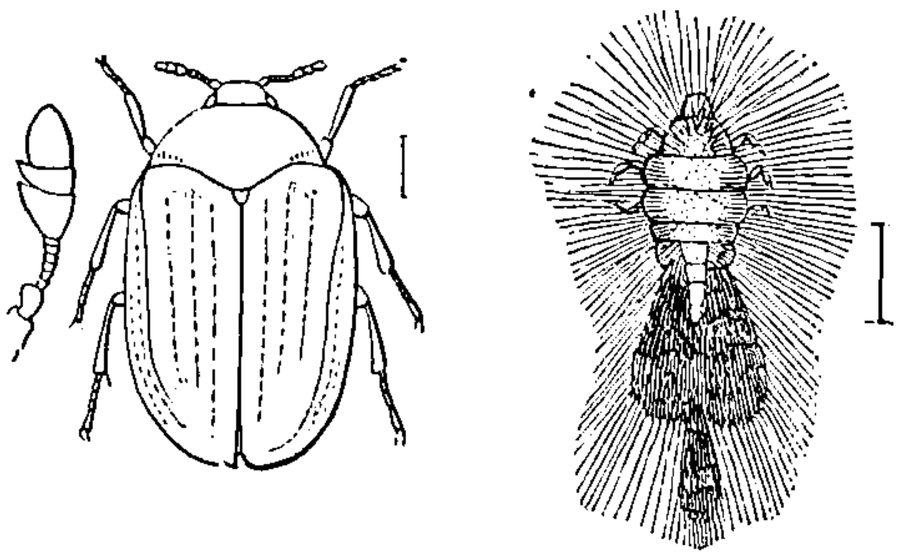
Fig. 78.



Attagenus pellio and larva.

when alarmed, pretend to be dead. Their legs are short and flat; they pack these legs so close to the

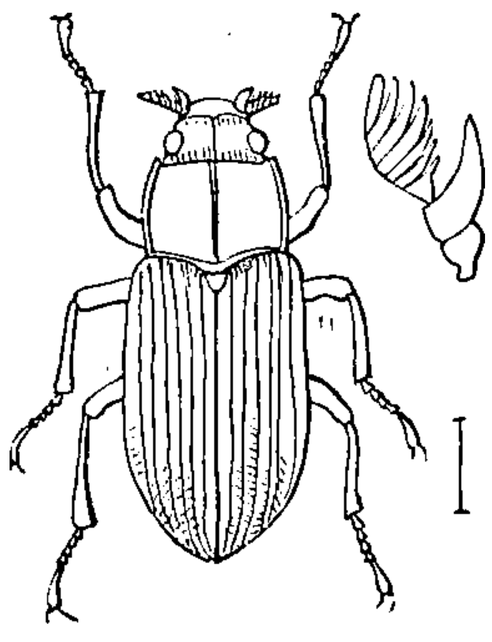
Fig. 79.



Tiresias serra and larva.

body, and lie so completely motionless, that when on the ground they look like a small pebble or seed, or the dung of a small animal. It requires the eye of an

Fig. 80.



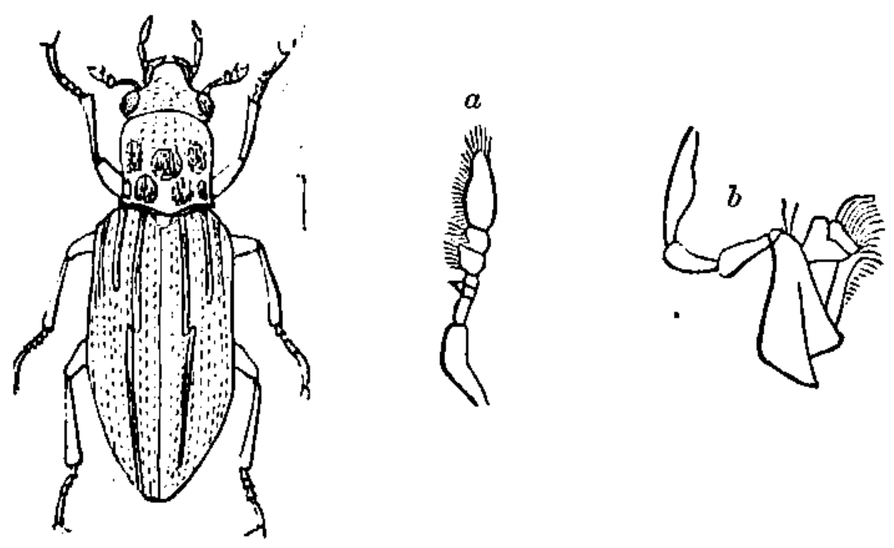
Parnus prolifericornis.

acute collector to recognize an insect in the apparently inanimate substance before him. The mottled appearance serves also much to conceal them.

TRIBE—PALPICORNES.

These insects were so called by Latreille, from the maxillary palpi being generally very greatly elongated. The woodcuts show the antenna and the maxilla, with

Fig. 81.



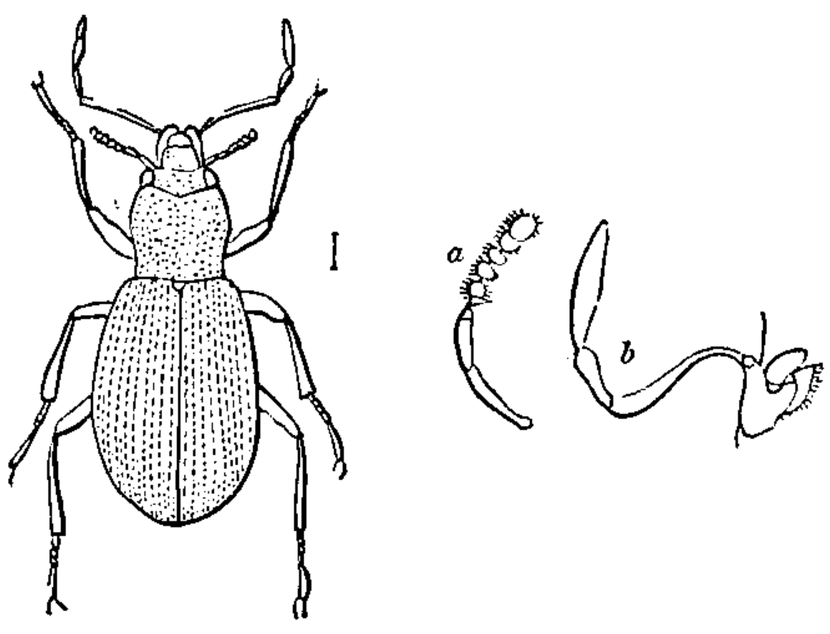
Hydrochus elongatus—*a* the antenna; *b* the maxillary palpus.

its palpus, of two different genera, in which this character is well marked. Figure 81 is that of *Hydrochus elongatus; a* the antenna; *b* the maxillary palpus.

FAMILY—HYDROPHILIDÆ.

The family HYDROPHILIDÆ, divided into two families, *Helophoridæ* and *Hydrophilidæ*, have ovate or ovate-oblong bodies. In one section the thorax is rough, in the other smooth. Fig. 82 is the *Hydræna testacea; a* the antennæ; *b* maxillary palpi. There are fifty-four British species, varying in size from the large *Hydröus piceus* to the small *Laccobius minutus*. The following genera are British:—*Spercheus*, *Hydrochus*, with its large bull-eyes; *Helophorus*, a genus of elongated form; *Ochthebius*, with its short slender last joint to the maxillary palpi; *Hydræna* (see fig. 82), in

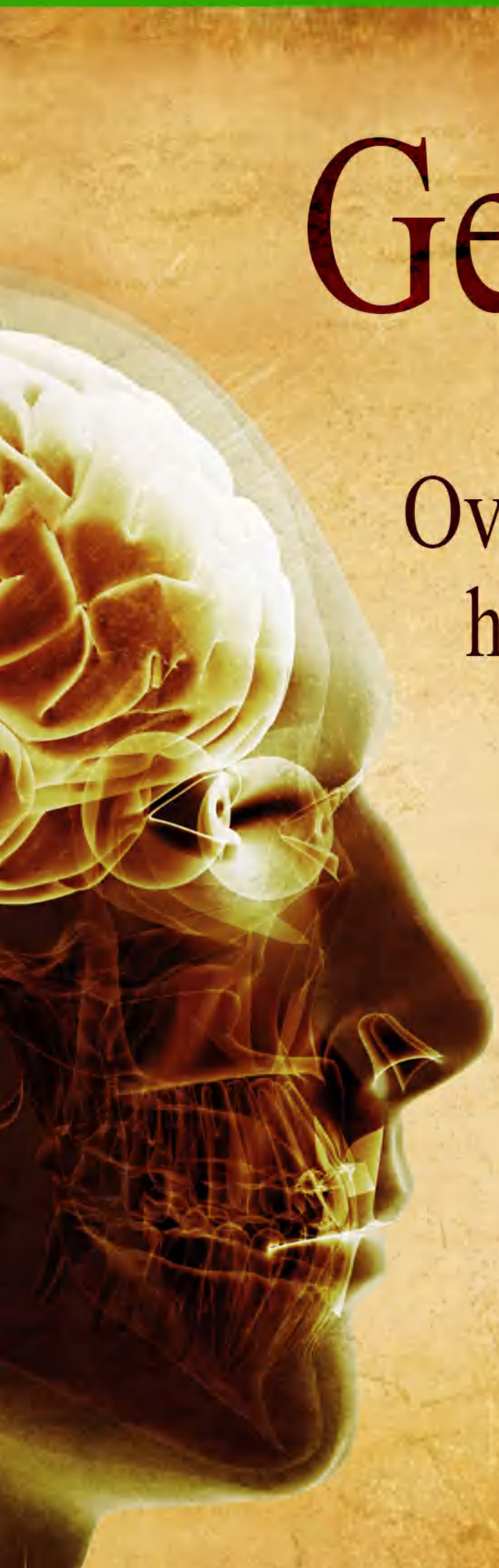
Fig. 82.



Hydræna testacea—*a* the antenna; *b* the maxillary palpus.

which that same joint is much elongated; *Limnebius*, *Berosus*, *Laccobius*, *Hydröus*, on which there are some particulars further on; *Hydrophilus*, *Hydrobius*, *Philhydrus*, and *Chætarthria*, with its very small species like a seed (*C. seminulum*).

Many of the insects of this family may be seen crawling on ditch banks; the species of the Helo-



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concluded that in tropical countries the chief use of the *Geotrupidæ* and other dung beetles was not so much to remove excrementitious matter from the surface of the earth, as to spread it over the ground, which was in this way manured. "This they effect by first collecting it in convenient round balls or masses, in which they deposit their eggs, and then, rolling them along with their hind legs, they bury them in different places in the ground." He adds that, when in Borneo, he found a species of *Gymnopleurus* engaged in this useful occupation, "under the shade of a grove of Casuarina trees, where the ground was covered in many places with large quantities of the dung of wild boars and of deer, which dozens of these indefatigable black-coated gentry were carefully spreading over the soil." Dr. Keith, in the desert between Egypt and the Holy Land, frequently observed one of the Sacred beetles similarly engaged, and has actually noticed that where the balls were buried, there were already indications of verdure.

Although the Dung beetles live in the midst of filth, and one might suppose that they would contract defilement from their home, it is not so. How clean and polished is a Dung beetle, scrupulously neat even in the minutest portion of its frame, looking, in its full dress of black, more like a drawing-room guest than the scavenger that he is, spending his life in dirt, except such portion of it as is occupied in flying about in quest of employment. It is in this stage of its existence that he is known as often making the acquaintance of the twilight wanderers in the fields by flying in their faces, to their consternation and the risk of his own life.

Some of the *Geotrupidæ* have armature on the thorax in the male, such as the genus *Typhæus*, that beetle so common in Greenwich park. In the genus *Athyreus*, especially the New World species, the thorax is armed; and in the group *Bolbocerus*, one Australian species, *B. proboscideus*, ranks as a subgenus, *Elephastomus*, from the mouth being elongated into a kind of proboscis.

In the genus *Lethrus*, the jaws are often much elongated and bent downwards, as in a *Walrus* or *Deinotherium* among recent and fossil mammalia. These jaws, no doubt, enable them to hang by projections in deep holes, and assist them in progression when they climb.

The *Lethrus cephalotes* is common in Hungary, and often proves a very great pest to the vine-grower, as the beetle gnaws off the young shoots of the vine, and drags them backward into its burrow, where it feeds on them. The country people destroy great numbers of this beetle, as they are painfully conscious of the great mischief it occasions in the vineyard, and the loss which they consequently sustain.

The curious genus *Silphodes*, and its allies, described by Mr. Westwood, Reiche, Burmeister, and other entomologists, are very interesting, from their resemblances (analogically) to other groups.

The family SCARABÆIDÆ is a large one, and contains, especially in the genus *Copris*, some very bulky species. They are widely distributed in tropical and temperate regions.

FAMILY—SCARABÆIDÆ.

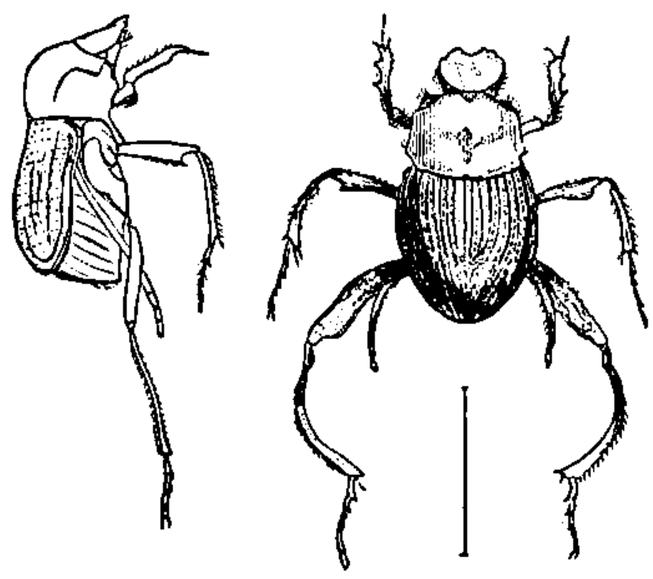
The genera *Onthophagus* and *Aphodius*, the one roundish, the other longish and parallel, have very many species. Of some the *Onthophagi* of the Indian species have most remarkable armature, especially the beautiful *O. Elliotti*. There are fine African species, especially one—a green one with long horns—found near Lake N-Gami. Our little *Aphodii* are the chief dispersers of the dung of cattle. There are fifty-five British species of Scarabæidæ.

SCARABÆUS SACER (THE SACRED BEETLE). This beetle is frequently sculptured on the ancient Egyptian monuments. It was a type of the sun, and was used as a symbol of the spring of the world, and of the warrior. Its symbolical affinity to the sun it derived from the angular projections on its head, somewhat resembling the rays of the sun. The world it symbolized from the roundness of its balls, and from the beetles which they produced. The Egyptians believed that the beetles were all males, and hence it was to them symbolical of a courageous warrior. In the British Museum galleries, the Scarabæus is a frequent symbol on the monuments. Amulets in its form are frequently met with, associated with the mummies.

There are many species of Scarabæidæ of the genera *Ateuchus*, *Gymnopleurus*, *Sisyphus*, and *Copris*, in S. Africa.

Among the insects allied to the "Sacred Beetle," is one genus, named *Sisyphus* by Latreille. It may

Fig. 85.



Sisyphus Bowringii.

be known by its very long hind legs, the triangular abdomen, and the antennæ having only eight joints. There are species of this genus found in Europe, Asia, and Africa.

Coprobius volvens, a common, dung-rolling beetle, abounding in the United States.

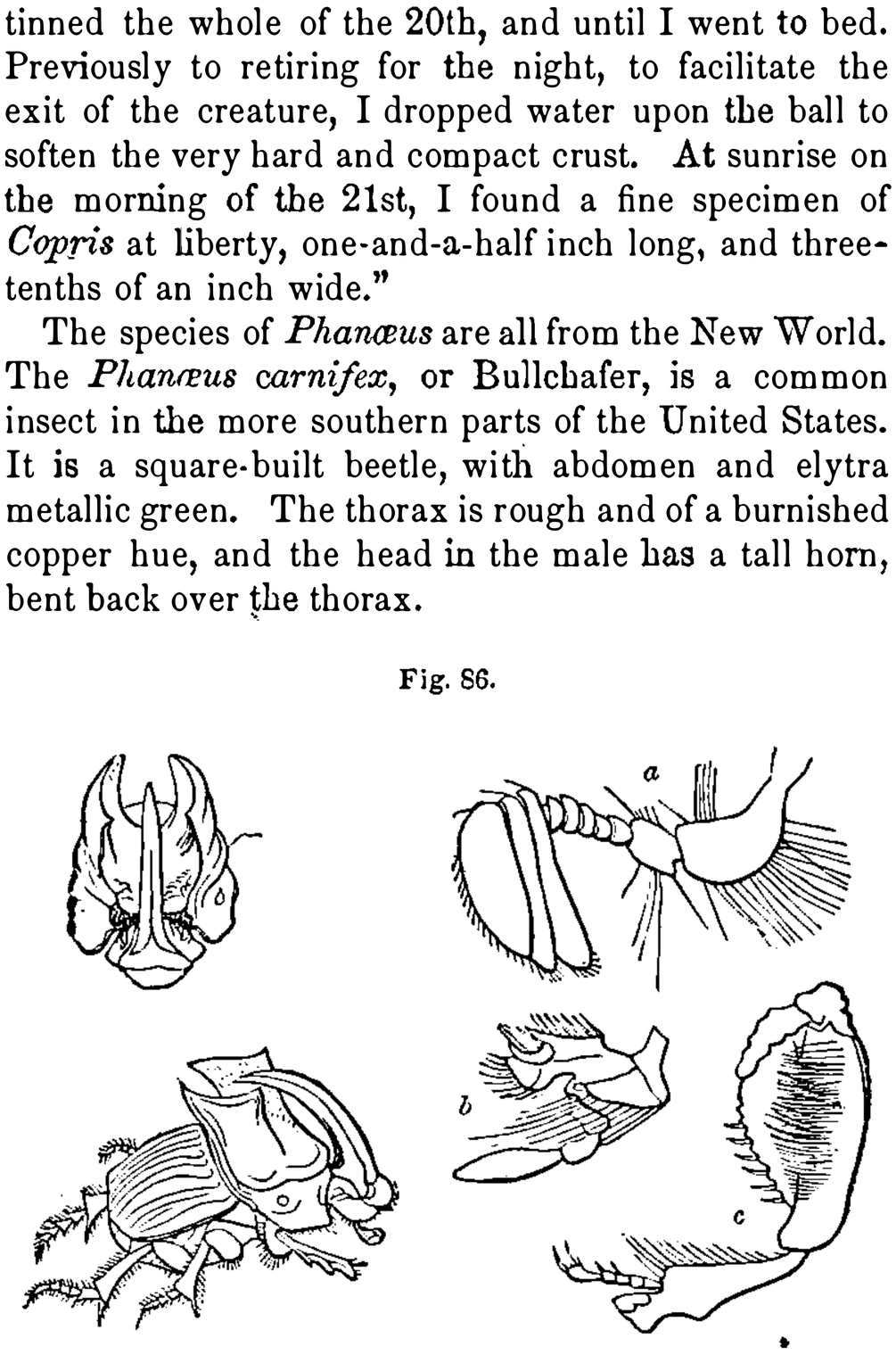
Our *Copris lunaris*, and the various species of Geotrupes form large cylindrical holes, which are often of considerable depth, beneath a heap of dung. In these holes they deposit their eggs, having first enveloped them in a mass of dung.

Colonel Sykes has published some interesting observations on the habits of the *Copris Midas*, a common East Indian species, from which we may make an extract:—

"At Poona, in the month of June, 1826, some of my palankeen-bearers turned up with their pickaxes, from some depth below the surface, four hard perfect balls; the pickaxe had injured one of the balls. The injured ball contained an amorphous animal mass, which I immediately pronounced to be the pupa of an unknown species of insect, at least unknown to me. To asoertain the insect proprietor of these curious domiciles, I placed two of the balls in a tin box, and continued for some months to watch them with attention; but my patience being wearied out, I abandoned further care of them and put the box away. Thirteen months had passed away, and I had forgotten the balls, when on the night of the 19th of July, 1827, being in my study, I heard a low scratching sound. The scratching continned the whole of the 20th, and until I went to bed. Previously to retiring for the night, to facilitate the exit of the creature, I dropped water upon the ball to soften the very hard and compact crust. At sunrise on the morning of the 21st, I found a fine specimen of *Copris* at liberty, one-and-a-half inch long, and three-tenths of an inch wide."

The species of *Phanæus* are all from the New World. The *Phanæus carnifex*, or Bullchafer, is a common insect in the more southern parts of the United States. It is a square-built beetle, with abdomen and elytra metallic green. The thorax is rough and of a burnished copper hue, and the head in the male has a tall horn, bent back over the thorax.

Fig. 86.



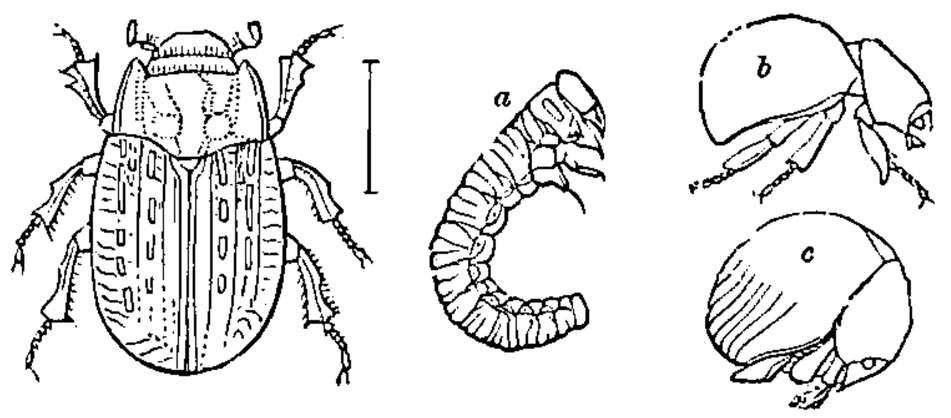
Phanæus pegasus. *a* antenna. *b* maxillary palpus. *c* anterior leg.

Fig. 86 is that of the male of a Mexican *Phanæus*, with an outline of its head and thorax, viewed in front. It is copied from Sturm's Catalogue.

FAMILY—TROGIDÆ.

A small family of generally dull, darkling, rough-coated beetles, found often on dried animal substances. I only once took a Trox, under the loosened bark of a post. The cuts in the margin show the form of a British *Trox* and the larva of the *Trox carotinus*. There are three species of Trox, and four if with Westwood and others you regard the sand-frequenting genus *Ægialia* as a member of the family. In the woodcut (fig. 87) is given the profile of a species of *Ceratocanthus*, as I long ago named the genus *Acanthocerus*, from that name having been preoccupied in natural history. Species are found in the Old World, though America is the metropolis. *Phoberus* has stiff,

Fig. 87.



Trox sabulosus—*a* larva of T. carotinus.
b Sphæromorphus basilicus. *c* Ceratocanthus nitens.

bristle-like hairs all round it. It is an African genus without wings. Mr. Macleay, who founded this genus, remarks that he fancies it must not feed on dried animal substances, because his great experience has shown him that all "insects intended to live on animal matter, partially dispersed and collected in masses, are furnished with wings in order to convey them the more rapidly to the objects pointed out by their instincts."

FAMILY—RUTELIDÆ.

A very extensive family of Beetles, chiefly natives of the New World. Many of them are very sumptuons insects, especially the species of *Chrysophora*. One of these, the *Chrysophora macropus*, has been named the "Kangaroo Beetle" from its immensely developed hind legs, large in the female, but much larger in the male. These legs are used for clinging, not for leaping, like the *Halticidæ*, or the species of *Orchestes* and other beetles. Its delicate rich green, laid on, as it were, thickly and smoothly, and actually as if translucent; the red washes on the legs and under side contrast well, and the lovely blue tarsi are quite exquisite with the green. There is a very fine species called *Victoria*, after our gracious queen.

One of the *Rutelæ*, dark green, with three yellow lines on the thorax, was found plentifully by my friend Sir Robert Schomburgh in the flowers of that noble Guiana water lily, the *Victoria regia*.

Areoda and *Pelidnota* are American genera, also found on plants. *Macraspis*, with its large scutellum, is also a New World species. *Piperonota Harringtoni*, is an Indian species, the male of which has a curious hooked spine on the back part of the thorax. *Parastasia* is another Asiatic genus, with many species from the Philippine and other islands of the East Indian archipelago.

Hexodon, a curious flattened Madagascar genus, lives on the sand, but its true history is unknown to me.

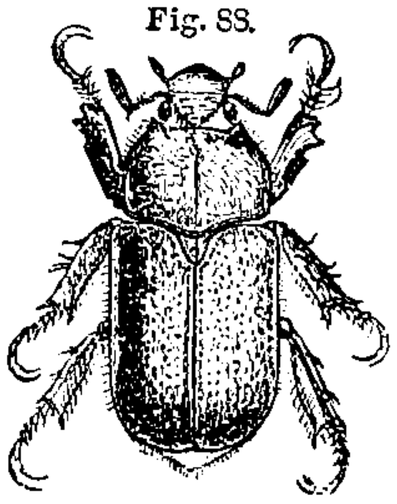
The genus *Cyclocephala* is an extensive one; the species are found in flowers.

Heterosternus is a rare Mexican genus—one of those forms often called "connecting links."

FAMILY—ANOPLOGNATHIDÆ.

These are Australian and Brazilian insects, in which the clypeus conceals the mouth, and the maxillæ have an obtuse lobe. The antennæ are similar, or nearly so, in both sexes. *Anoplognathus* is the typical genus; some of them have a curious yellow and green tinsel-like lustre. *Calloodes Grayianus* is a very fine insect described by the writer, and named out of gratitude to Dr. John Edward Gray, the able keeper of the zoological department in the British Museum. It is figured on Plate 1, fig. 4, *Epididysus Lamprimoides* is from King George's Sound. *Geniates* and *Leucothyreus* are two genera with many Brazilian species. Fig. 88 represents the *Brachysternus*, or *Epididysus Lamprimoides*, a fine insect of a yellowish metallic green, with the thorax and body beneath downy.

Fig. 88.



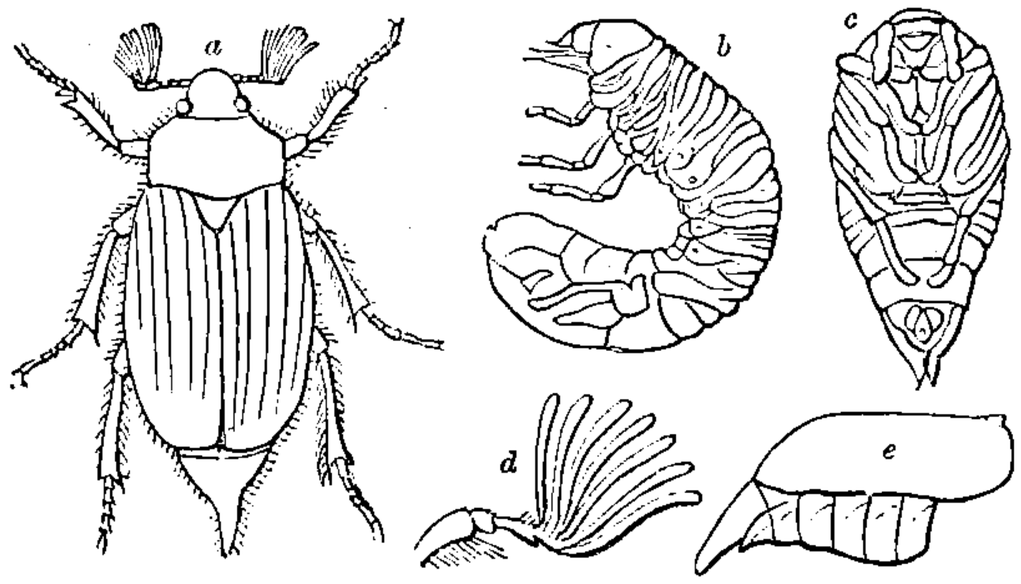
Epididysus Lamprimoides.

FAMILY—MELOLONTHIDÆ.

In this truly leaf-eating family the antennæ in the different sexes vary much; the plates of these organs in the males being at times very large, as in *Polyphylla Fullo*, a common European, but very rare and only occasional British species. The species, as in *Encya* and *Pholidotus*, are often covered with scales, while others of a South African genus are very hairy. In this family the maxillæ are toothed.

Our common Cockchafer (*Melolontha vulgaris*) is a well-known example. It is thoroughly crepuscular, resting on trees during the day. At times they abound and are very destructive to foliage. The larvæ feed on the roots of grass, and continue in the grub state several years. At times these chafers become quite a plague. The cuts, copied from Ratzeburg, show the male of this beetle, with its curved larva and the pupa —fig. 89. Below the larva is a figure of the antenna

Fig. 89.

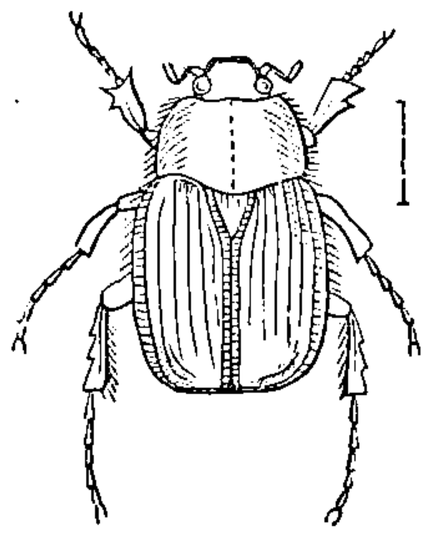


a Melolontha Vulgaris. *b* Larva. *c* Pupa. *d* Antenna of male. *e* Profile of the abdomen.

of a male, with the plates extended. Below the pupa you see a profile view of the pointed abdomen. There are four families—*Rutelidæ*, *Melolonthidæ*, *Scericidæ*, and *Hoplidæ*. The cuts are of the genera *Serica* and *Anisoplia*—figs. 90 and 91.

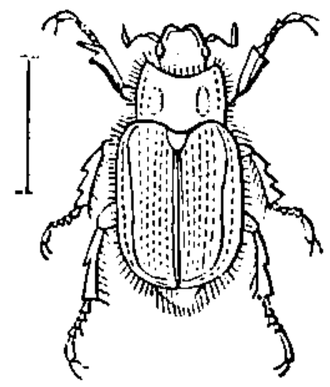
The Hoplia group is very extensive. Many of them are African. *Ceraspis* is a pretty Brazilian genus, with a heart-shaped scutellum.

Fig. 90.



Serica brunnia.

Fig. 91.

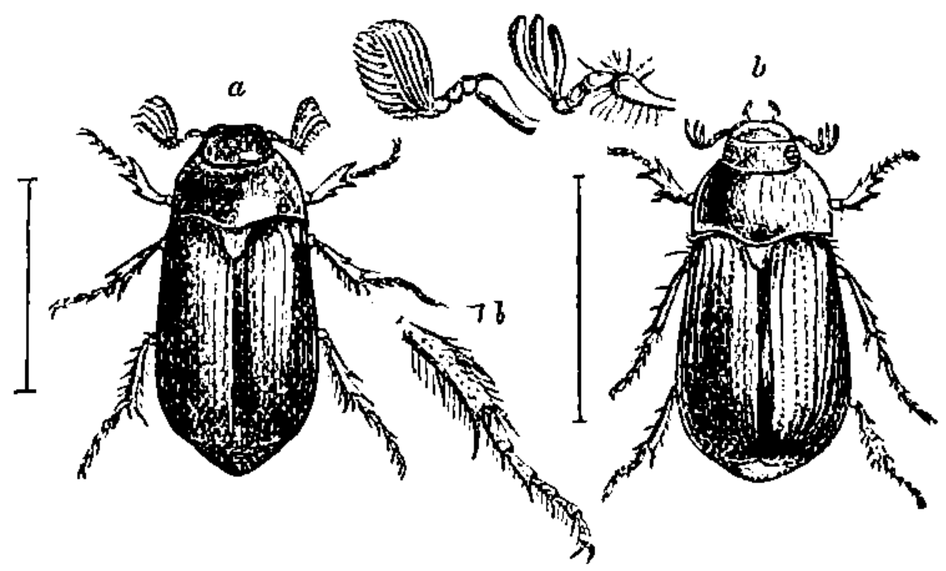


Anisoplia agricola.

Diphucephala is Australian and a metallic-coloured genus; *Pyronota*, a brilliant New Zealand genus, also highly metallic on the surface.

The cuts show the forms of the curious genus *Biphyllocera*, as I named it in Captain Grey's Narrative. Fig. 92, *a*, represents the male, and *b* the female, of *Biphyllocera Kirbyana*, named by the writer after the venerable author of the "Introduction."

Fig. 92.



Biphyllocera Kirbyana—*a*, male; *b*, female.

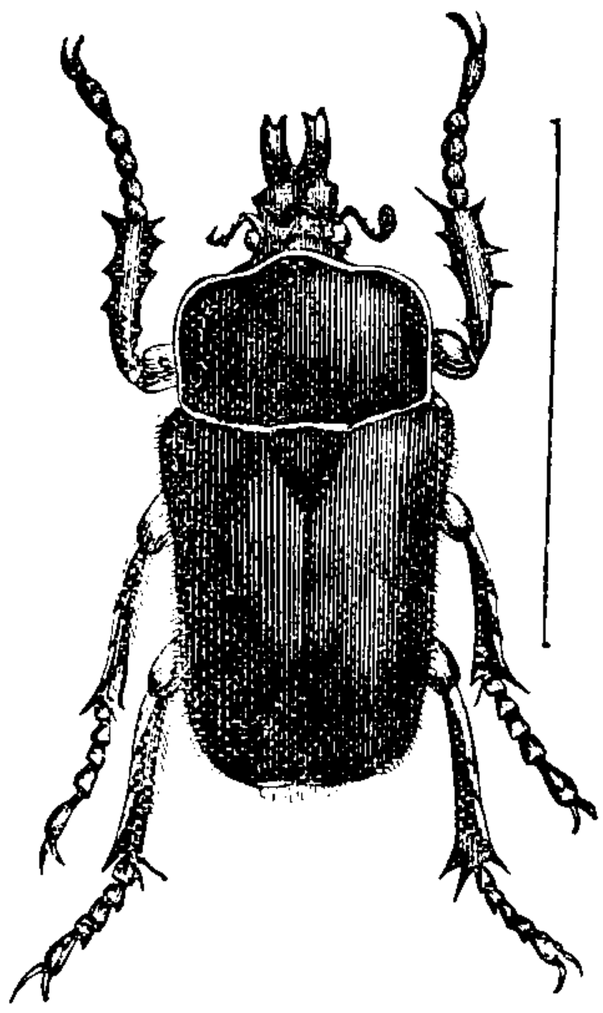
Diphyllocera is the only genus of lamellicorn beetles that I know, which has compound lamellated antenantennæ. It is indigenous to King George's Sound, Western Australia.

The *Melolonthidæ* and other destructive insects are much kept in check by birds, which, especially when young, are chiefly fed on insect food. A cautious observer found a nest of young jays; he noticed that each of the five jays, while yet very young, consumed at least fifteen of these full-sized grubs in one day, and of course would require many more of a smaller size. Say that on an average of sizes they consumed twenty a piece, these for the five make one hundred. Each of the parents consume, say fifty; so that the pair and family devour two hundred every day. This in three months amounts to twenty thousand in one season. But as the grub continues in that state four seasons, this single pair, with their family alone, without reckoning their descendants after the first year, would destroy eighty thousand grubs.* An American species of Beetle, of the same family, and called there the May-beetle

* Anderson's Recreations.

Eudicella E. Smithii, *Amaurodes Passerinus*, and *A. Derbyanus*. The finest *Goliathi* of South Africa are from Mozambique—*Ranzania*. Professor Westwood, in his "Arcana Entomologica," has figured most of the Goliath beetles.

Fig. 94.



Compsocephalus Horsfieldianus.

In Abyssinia is found the genus *Compsocephalus*, one of the species of which fig. 94 is named *Horsfieldianus*.

Another species, *C. Galinieri*, I saw lately in a collection bought by Mr. John Bowring.

Among the Asiatic *Goliathi* I may mention *Cyphonocephalus*, described by Professor Westwood, and *Phædimus Cumingii* from the Philippine Islands, and the genus *Trigonophorus*, in which both males and females have armed heads. On Plate 1, fig. 3, is figured the *T. Hookeri*, named by the writer after Dr. Joseph Hooker, F.R.S., who brought it from the mountains of India.

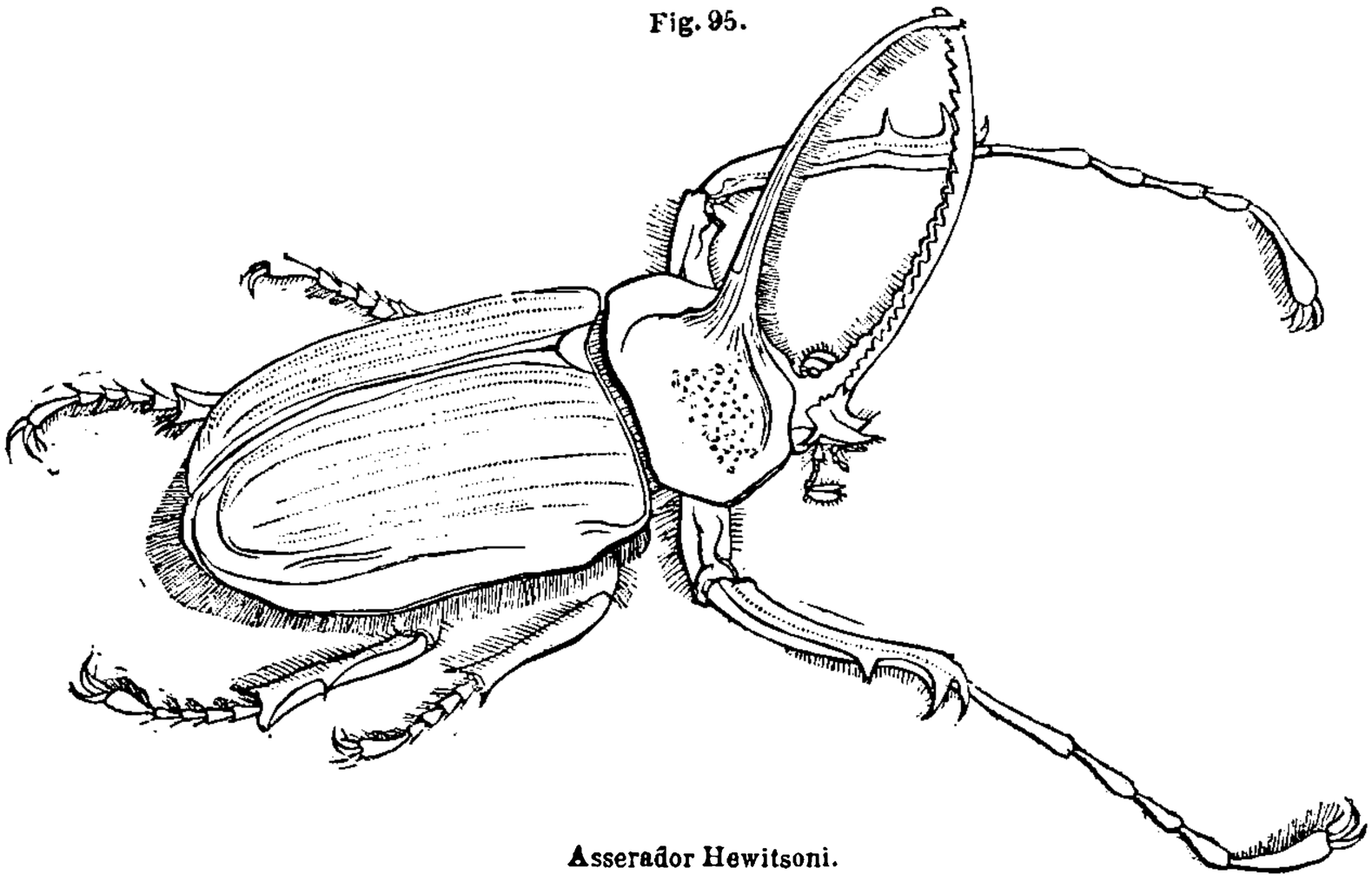
Rhomborhina is a fine genus with squared heads. The Indian and African *Clinteriæ*, with the thorax extended over the scutellum, are small species. One named after Dr. Hoffmeister is figured on Plate 1, fig. 2. He was killed at the battle of Ferozeshah. The writer knew him well, and named this pretty Indian beetle after him.

There are noble *Cetoniidæ* in Madagascar, perfect gems in colour and in polychromatic effect. In New Guinea and other eastern isles are some fine species of a *Pachnoda*, and many fine species of the genus are also found in Africa. The genus *Schizorhina* is especially Australian and other islands to the north, but also occurs elsewhere. I figure the *Schizorhina Emilia*—(Plate 1, fig. 1). On Plate 1, fig. 8, is figured the Australian *S. Bassii*; and on the same plate the Abyssinian *Oxythyrea Helena*.

The *Gymnetis nitida*, one of a large genus confined to the New World, is called in Pennsylvania the "Goldsmith," from its fine colour—(see Melsheimer's Catalogue, p. 5; 1806). The *Epicometis hirta*, a little species of this group all bristled over with hairs, from which it derives its specific name, is noticed in Malta to destroy the apricot blossoms; while another species of this family, called *Cetonia cardui*, pays visits to the beehives and destroys the wax and honey. Those who suffered from the ravages of the last-mentioned put plates of lead over the entrances of the hives, with small perforations for the bees. These perforations were enlarged by the beetles. It has been found, however, that when zinc was substituted for lead the ingress of the Cetonia was prevented.

The *Cetonia inda*, a common species of the family in the United States, is described by Dr. Harris as one of the earliest spring visitors.

Fig. 95.



Asserador Hewitsoni.

FAMILY—DYNASTIDÆ.

A group of insects peculiarly tropical, and many of them gigantic in size. Hence their name, from the Greek word for "power." The males have often long

projections on the head and thorax, as in the great *Hercules beetle* and the even more extraordinary *Asserador Hewitsoni* (see fig. 95). The females are small and without any projections.

In Europe *Oryctes nasicornis* is a common insect, found in the larva state in tan-pits and dung-heaps. It continues four or five years in that state. In this country we have no member of this family.

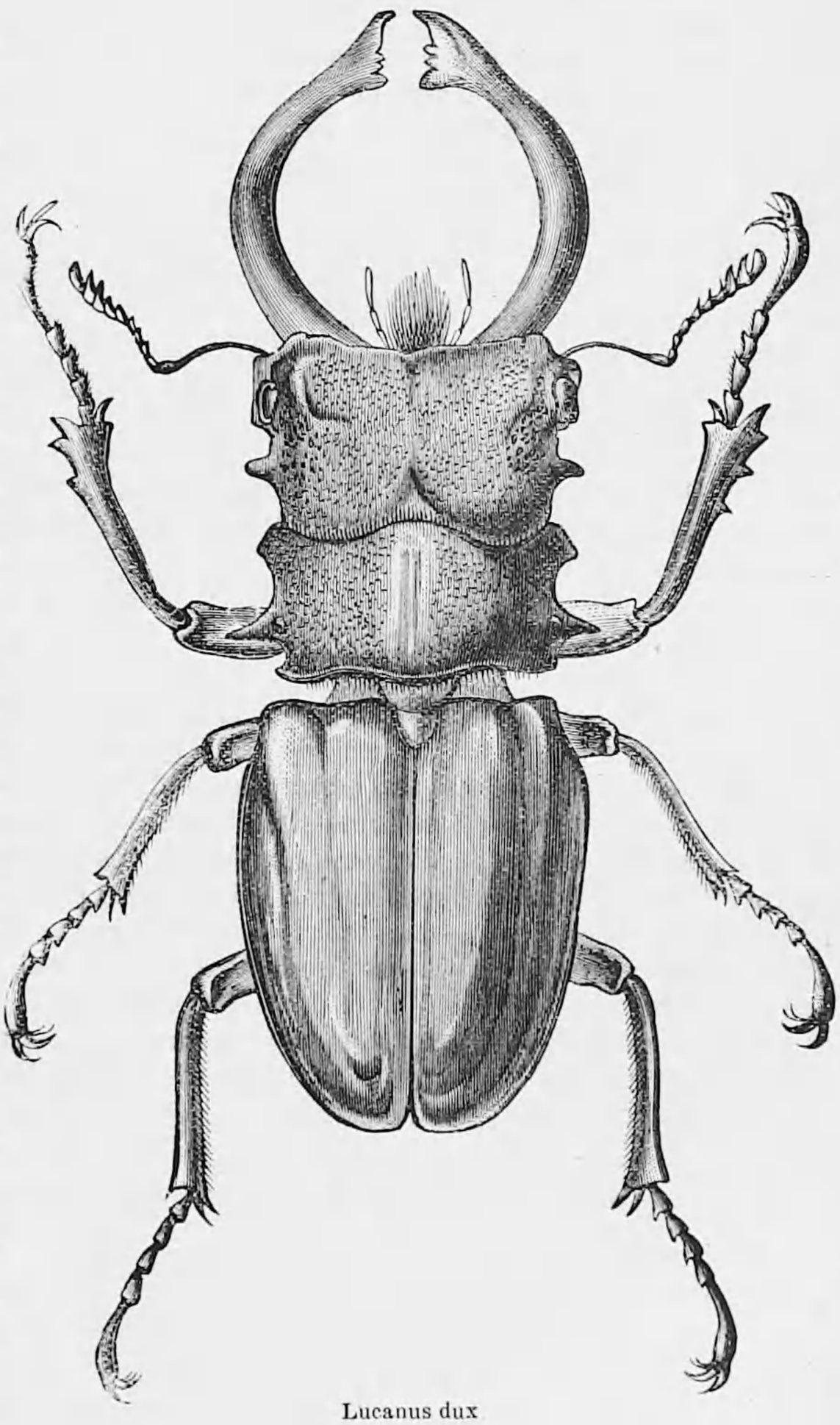
In Brazil and the East Indies the Dynastidæ attain enormous size; for instance, that gigantic Elephant beetle called *Megasoma elephas*, is some inches long, and wide in proportion. It is found in Venezuela and Columbia. The *Megasoma Actæon*, or Actæon beetle,* is another large species common in Brazil and Guiana.

In some of the West Indian Islands the long-horned Hercules beetle (*Dynastes Hercules*) is not uncommon. It has been also named the Rhinoceros beetle in some popular books. In the males the thorax projects in front into a long curved horn, which extends far beyond the head, and has a strong tooth-like projection on the under side, fringed with a brush of brownish-yellow hairs. The head has a long horn also, shorter by far than that on the thorax, but bending up towards it and toothed on the upper side. The uses of these processes to the insect are unknown.

Oryctes Maimon is a species indigenous to the United States. It is of a deep blackish chestnut hue, and is highly polished. The thorax in the male is armed with three horns, one in front and one on each side. Mr. Gosse in one of his letters from Alabama, gives an instance of its great strength of body. He says, "When the insect was brought to me, having no box immediately at hand, I was at a loss where to put it until I could kill it; but a quart bottle full of milk being on the table, I clapped the beetle for the present under that, the hollow at the bottom allowing him room to stand upright. Presently, to my surprise, the bottle began slowly to move and glide along the smooth table, propelled by the muscular power of the imprisoned insect, and continued for some time to perambulate the surface, to the astonishment of all who witnessed it. The weight of the bottle and its contents could not have been less than three pounds and a half; while that of the beetle was about half an ounce, so that it readily moved a weight one hundred and twelve times exceeding its own."† To give a better notion than figures can convey, Mr. Gosse supposes a lad of fifteen imprisoned under the great bell of Saint Paul's, which weighs twelve thousand pounds, and moving it on a smooth pavement by pushing within.

On Plate 1 there are three species represented, the male sex being selected on account of the characteristic mandibles. Fig. 7 shows the *Chiasognathus Grantii*—a fine South American beetle. The late amiable James Francis Stephens first described this curious beetle. It is a native of the island of Chiloe, where it appears to be not common. Its eyes are each divided by a ridge of the head, so that there seem to be four; hence a French naturalist named it *Tetraophthalmus*. Fig. 9 represents our STAG-BEETLE (*Lucanus Cervus*) common in the counties of Surrey and Kent, &c. The females seem scarcer than the males. Fig. 10 represents *Cladognathus Parryi*, a species very common in Silhet. In the Lucanidæ the antennæ are geniculate or elbowed, the first joint being long and the other ten

Fig. 96.



Lucanus dux

FAMILY—LUCANIDÆ (*Stag-beetles*).

Many of the Beetles of this family are of large size. The males have often very large jaws furnished with snags, like a stag; hence their English name.

shorter, the club having the four, five, or six last joints produced inside, so as to have a pectinated appearance. The tibiæ are generally toothed or spined, these teeth helping them greatly in climbing.

It is in the evening that the Stag-beetles fly, although the *Lamprimæ*, metallic green and purple Australian

* Actæon was turned into a stag for looking at Diana; the horns began to bud from the head.

† Letters from Alabama, p. 167.

members of the family, *may be* day insects. The insects feed on the sap exuding from trees. The larvæ are not unlike those of the other Lamellicorns.

We have four species in Britain belonging to as many genera—*Lucanus*, *Dorcus*, *Platycerus*, and *Sinodendron*.

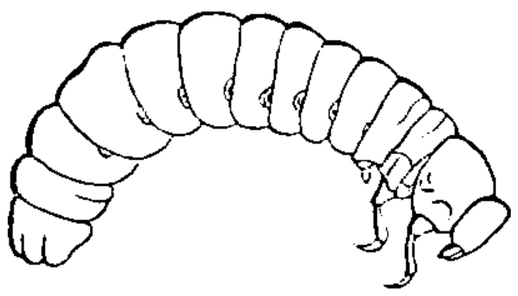
FAMILY—PASSALIDÆ.

The PASSALIDÆ are a strangely parallel and parallelopipedal set of beetles, grooved generally on the elytra and depressed.—(See figure of *Passalus interruptus*, Plate 1, fig. 5.) The largest known species is from Guatemala. There are many species.

The larvæ of this group have the third pair of legs much reduced, so as to be scarcely visible. The antennæ have ten joints, and the segments of the body are smooth beneath.

The *Passalus cornutus* is a common species in the United States. It is of a very deep-brown or black

Fig. 97.



Larva of the Passalus distinctus.

colour, highly polished, and with the elytra furrowed by parallel longitudinal lines. The head has a short blunt horn, curved forwards.

GROUP—SERRICORNIA.

The Serricorn beetles are so named from the antennæ being serrated or pectinated, particularly in the males. They have two maxillary and two labial palpi, and the body is generally long and narrow. Mr. Westwood has changed the name into *Priocerata*, which means in Greek what Serricorn is in Latin. This great group is divided into two—one called *Sternoxi*,* in which the sternum or breast is sharpish-pointed behind and received into a fissure in front of the mesosternum. The legs are generally short and more or less retractile. The second division is named *Malacoderms*,† from the softness of the elytra; in this the sternum is simple.

SECTION—STERNOXI.

Of the *Sternoxi* section, characterized above, we come to the

FAMILY—BUPRESTIDÆ.

A very large family, most of which are exotic. The species of this family abound in the warmer parts of the world. Their eggs are oval and whitish, and laid under the bark of trees or in holes in the wood. The larvæ, when hatched, make great havoc with their redoubtable jaws and insatiable perseverance in gnawing. Our

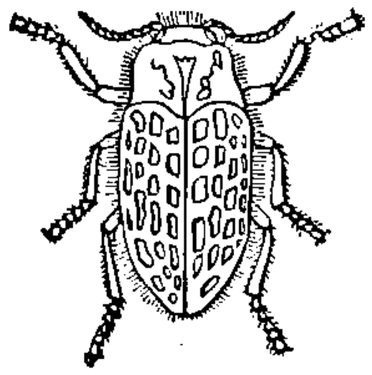
* στερνον and οξυς sharp. † μαλακος, soft, δερμα skin.

Agrilus lives in oak bark, and I took live specimens of the brilliant creature out of a large wart-like excrescence on the bark.

The genus *Julodis* (fig. 98) contains many large African species, often singularly covered with tufts of yellow or grey hairs.

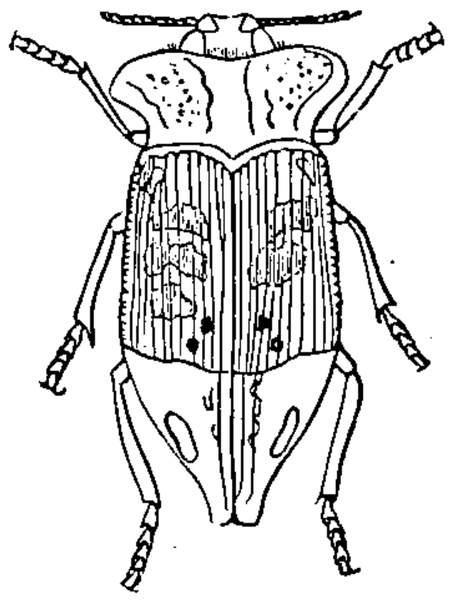
Sternocera is an Indian and African genus. The *S. feldspathica* is a beautifully coloured species from

Fig. 98.



Julodis Rothii

Fig. 99.



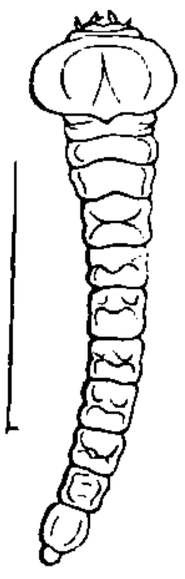
Polybothrys zygæna.

Congo, with a lustre on its elytra something like that on Labrador feldspar—hence the name I gave it. Fig. 99 is that of a Madagascar *Polybothrys*. Madagascar *Buprestidæ* are particularly curious and fine in form and colour. The elytra of some of the showy Indian species of Chrysochroa are worked up and formed into artificial flowers, or into richly-coloured decorative ornament to ladies' articles of dress. On Plate 2, fig. 8, is figured the very showy *Chrysochroa Edwardii*, an Indian species.

In Guiana, one beetle called the Sun Mama beetle, is used, like the Indian Chrysochroæ, to ornament dress.

The species of the genus *Catoxanthæ*, especially one of them, the *C. bicolor*, green above, yellow on the under side,* is one of the largest of the family. The Australian genera *Stigmodera* and *Castiarina* are very numerous, and many of them charmingly pleasing, and even brilliantly coloured.

Fig. 100.



Larva of Lampra rutilans.

The Brazilian *Pœciloptera*, *Pœcilonota*, and other genera; the curious and endless species of *Agrili* and *Anthaxiæ;* the strange, short *Trachys*—(Plate 2, fig. 2, *Trachys minutus*)—I can only allude to; and the genera *Ancylochira*, *Chrysobothrys*, &c., quite eclipse our feebly represented *Buprestidæ*.

Among the Buprestidæ there is one found in the United States, the grub of which bores under the bark and into the solid wood of the apple tree, and thus often does great mischief to the orchards.

Of the family EUCNEMIDÆ there are many fine exotic species and genera very curious and interesting to entomologists. There are only five British species, which belong to the genera *Throscus*, *Cerophytum*, *Melasis*, and *Microrhagus*. Fig. 100 shows the larva of *Lampra rutilans*, an European Buprestis.

* κατα and ξανθος.

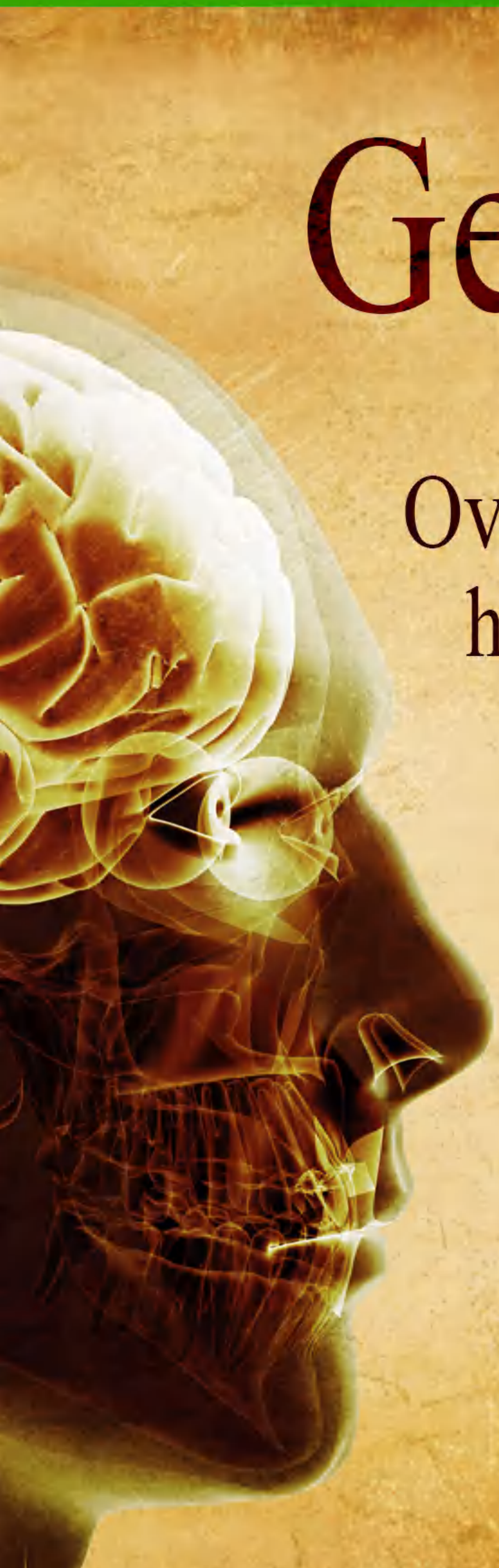


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fig. 9, while others are natives of Australia—one being the pleasing black, *R. mystacina*, prettily dotted with white.

Of the family CYPHONIDÆ there are twelve British species. Some of them can jump, such as *Scirtes*.

FAMILY—LAMPYRIDÆ (*Glow-Worms*).

The phosphorescent organs of the Glow-worms and Fireflies are made up of a mass of spherical cells, filled with a finely-granular substance, and surrounded by many trachean branches. This substance, if substance it can be called, by daylight has a pale-yellow appearance. In the Lampyridæ it fills a portion of the abdominal cavity, and shines on the lower surface of the last abdominal segments through the very thin skin which covers them. Spallanzani regarded the luminous matter as a compound of hydrogen and carburetted hydrogen gas. Some philosophers, from Darwin to Morren, refer the light to the slow combustion of some combination of phosphorus, secreted by an appropriate organization in organs remarkably rich in tracheæ, and entering into combination with the oxygen supplied in respiration. Matteucci made many experiments on the luminosity of the Italian glow-worm. From his researches it would appear that the phosphorescent substance burns by means of the oxygen in the tracheæ, without any indication of the presence of phosphorus.* The luminous substance continues to shine when detached from the insect, but loses its luminous properties after a few minutes. In the Glow-worm the light is not brilliant in the female, and its chief purpose seems to be to conduct the sexes to each other.

There are two British Lampyridæ, both feeding in the larva state on snails and other mollusca—*Lampyris noctiluca* and *Drilus flavescens*, described further on. The *Pygolampsi xanthophotis* is found about Bluefields in May, and is conspicuous for the intensity of its light. Sometimes it is only the last segment but two that shows luminosity; but, when it is excited, the whole end of the abdomen seems to be lighted up with a dazzling glare. Mr. Gosse gave the species the name of *Xanthophotis* or yellow light, from the rich orange colour of its light when seen abroad; when viewed in the light of a candle it appears yellow. The light is intermittent. Mr. Gosse has seen a specimen of this attracted by the glow of a stationary *Photuris versicolor*, fly up and play around it, "when the intermingling of the green and orange rays had a charming appearance." He describes the *versicolor* as being noticeable by its frequent resting on a leaf or a twig in the woods, "when it will gradually increase the intensity of its light till it glows like a torch; then it gradually fades to a spark and becomes quite extinct; it thus remains unseen for some time, but in about a minute, or it may be two, it will begin to appear, and gradually increase to its former blaze, then fade again, strongly reminding the beholder of a revolving light at sea."†

* See Siebold's Anatomy of the Invertebrata, by Burnett, p. 446.

† Naturalist's Sojourn in Jamaica, p. 104.

Southey, in his "Madoc," thus poetically alludes to the fireflies of South America:—

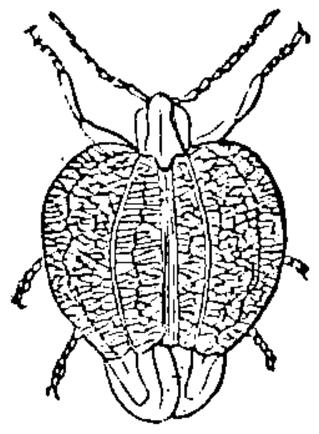
"Sorrowing we beheld
The night come on; but soon did night display
More wonders than it veiled; innumerous tribes
From the wood-cover swarmed, and darkness made
Their beauties visible; one while they streamed
A bright blue radiance upon flowers which closed
Their gorgeous colours from the eye of day;
Now, motionless and dark, eluded search,
Self-shrouded; and anon, starring the sky,
Rose like a shower of fire."

The *Lamprocera Latreillei* is a fine large Brazilian species described by Kirby (Plate 2, fig. 10). The South American species of Lampyridæ are very fine. The antennæ in other allied genera are very remarkable, as in *Megalopthalmus Bennetii* of G. R. Gray.

FAMILY—LYCIDÆ.

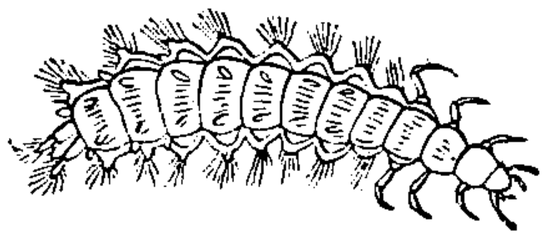
Of the family LYCIDÆ one is figured—the *Lycus appendiculatus*—an African species. Many of the African LYCIDÆ have strangely expanded elytra, especially in the males. Some of the South American *Lyci* are most exquisitely coloured—reddish yellow, and barred with dark steel-blue. On Plate 2, fig. 4, is figured the *Homalisus suturalis*. Of British *Lycidæ* there are but two species, belonging to the genus *Dictyopterus*; one of these is the rare *D. Aurora*.

Fig. 105.



Lycus appendiculatus.

Fig. 106.



Larva of Drilus.

Long ago a foreign naturalist found a queer, hairy, flat grub feeding on the soft body of a snail; he named the creature *Cochleoctonus vorax*, the "Voracious Snail-killer," as the name may be translated into plain English. Another naturalist was able to find this queer deformed creature mated with a little, pretty, softish beetle, with elytra and very pretty antennæ, which naturalists had long known as the *Drilus flavescens*. The female appears to be rarely met with in this country.

There is figured here the larva of a species of Drilus found in Algeria, and described by M. Lucas in his great work on that possession of the French (fig. 106). It lives in the shell of a species of *Cyclostoma*, a circular-mouthed genus of shells, and eats the animal of the said shell.

The male of *Drilus flavescens* (Coleopt.—Plate 2, fig. 3) may be procured by brushing herbage in abandoned chalk pits in Kent, about Dartford or Gravesend. It would be well if some one were to collect a great number of snails and keep them during the winter. In early spring it is more than probable that careful

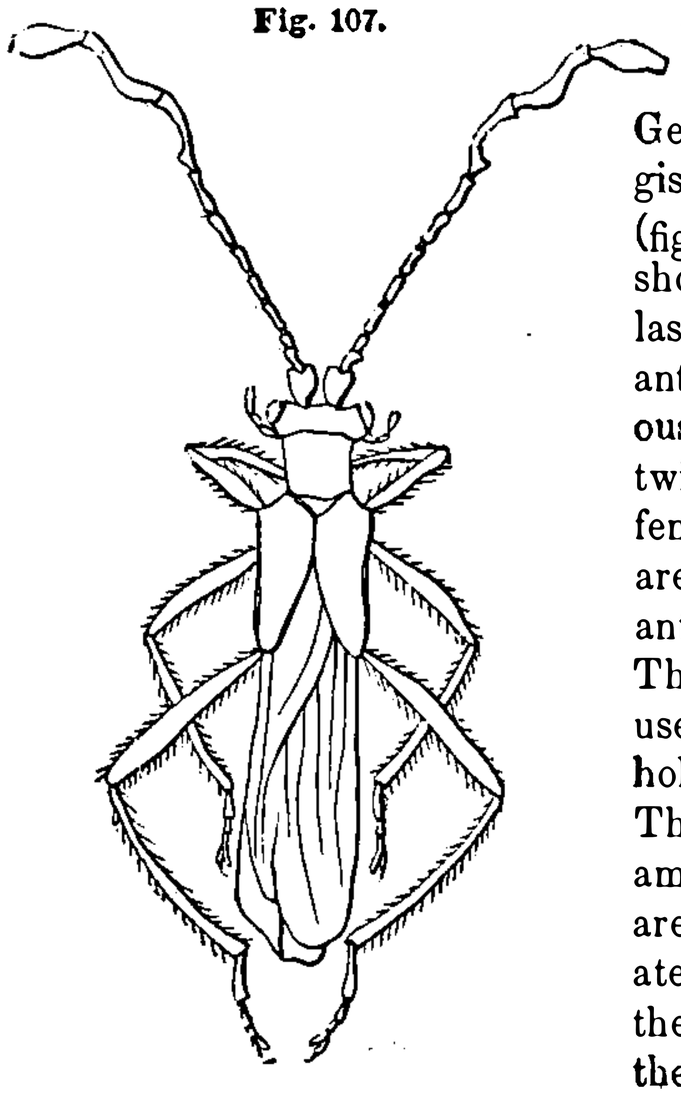
observation would see both male and female *Drilus flavescens* emerge from the shells.

FAMILY—TELEPHORIDÆ (*Soldiers and Sailors*).

In this country every boy knows the insects found so commonly on flowers in summer-time, and called "Soldiers and Sailors." Some of them have pale, soft elytra, with reddish thorax and legs, while others are black, but equally soft and equally agile. They have long antennæ, and are called by naturalists *Telephoridæ*. There are fifty-six British species.

In Venezuela Mr. David Dyson discovered a curious insect of the family, which was lately described by a German entomologist.* The male (fig. 107) has very short elytra, and the last joints of the antennæ are curiously elongated and twisted. In the female the elytra are longer, and the antennæ are simple. These antennæ are used by the male for holding his partner. The wings are very ample, and the legs are long and terminate in simple claws; the third joint of all the palpi is hatchet-shaped. In a pretty group of green and red beetles (*Malthini*) the third joint of the palpi is ovate, and the claws are one-toothed.

Fig. 107.



Lobetus torticollis.

FAMILY—CLERIDÆ.

A large and very showy family (Plate 2, fig. 1) represents one of them—the *Tillus mutillarius*. The larvæ seem to be carnivorous. Fig. 108 shows the larva of *Opilus domesticus*. The Brazilian and Australian species are often large, and almost always showy. So are many from the Eastern islands, whence come *Tenerus*, *Omadius*, *Stigmatium*, and other curious genera.

Fig. 109 is Latreille's beetle (*Necrobia ruficollis*).

The *Necrobia violacea* is most extensively distributed. Mr. Le Conte† observes that it "appears to increase in numbers the farther it is removed from the haunts of men; in the barren regions adjoining the Rocky Mountains, where insects reign in almost undisputed mastery unchecked by scarce a single foe, it may be observed covering the ground under any small piece of animal matter which has been overlooked by the wolves and ravens, or which has defied the power of their teeth and beaks.

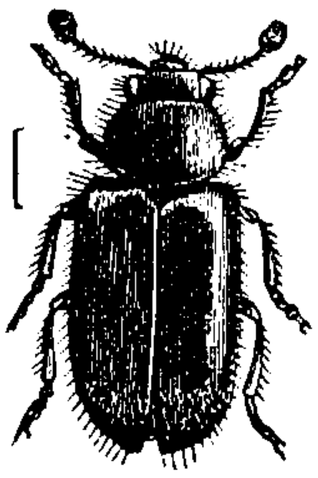
* *Lobetus torticollis*—Kiesenwetter, Monographie der Malthinen: Linnæa Entomologica, vii., 244, t. 1, fig. 1. The beetle is testaceous; the head, excepting the mouth, the joints of the antennæ from the second to the eighth, the wings, and the legs are black: the coxæ and the bases of the femora are testaceous. Its length is three lines and a half.

† Annals of the Lyceum of Nat. Hist., vol. iv., p. 162.

Fig. 108

Larva of Opilus domesticus.

Fig. 109.



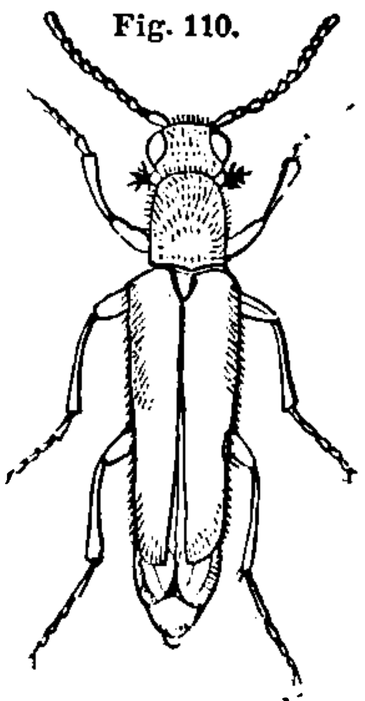
Necrobia ruficollis.

FAMILY—LYMEXYLONIDÆ.

There are but two British species of this family, which has very curiously developed palpi. The species of *Atractocerus*, a long African genus, are allied to them.

Kirby and Spence quote the *Lymexylon navale*, a British insect, as a striking exemplification of the utility of entomological knowledge. In the royal dock-yards of Sweden great quantities of oak-timber were destroyed by the ravages of an insect. The king desired Linnæus to investigate the matter, which the great naturalist did; and finding it was this beetle which caused the destruction, he suggested that the oak-timber should be immersed in water during the time of the metamorphosis of the beetle and its time for depositing its eggs. This suggestion was adopted, and it proved a remedy which effectualy secured the timber from its future attacks. Fig. 110 is *Lymexylon navale*.

Fig. 110.



Lymexylon navale.

FAMILY—PTINIDÆ.

A family of little, generally hairy beetles, with long antennæ and bodies, whose larvæ drill holes in furniture, old cabinets, and all sorts of vegetable substances if dry.

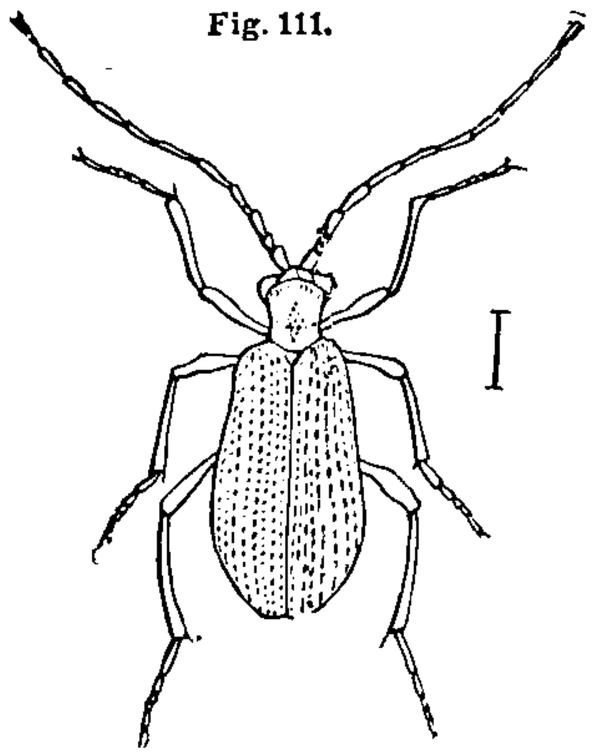
The *Ptinus fur* (Coleoptera, Plate 3, fig. 21), and other species are very common, and often do a great deal of mischief in a small way.

My friend, Mr. W. Horn, drug-grinder, of Belitha Villas, Barnsbury, brought me lately many specimens of ginger root from the East Indies, perforated by the larvæ of the small ptinidous genus *Lasioderma*. The ginger is so destroyed by this small bettle (*L. testaceum*) that the importers calculate their loss annually at upwards of £3000 on ginger from Cochin and Calicut alone.

There are thirty-three species of Ptinidæ recorded

as British. They belong to the genera *Ptilinus*, *Xyletinus*, *Lasioderma*, *Dorcatoma*, *Anobium*, *Dryophilus*, *Ochina*, *Hedobia*, *Ptinus*, *Niptus*—one species (*Niptus hololeucus*), covered with close, golden-yellow pile, has extended over this country in my time—*Gibbium*, and *Scotias*.

Fig. 111.



Ptinus fur—Male.

With a notice of one species I may pass on to another family (*Anobium pertinax*). This little timber-boring beetle can, when alarmed, withdraw a considerable part of its head within the thorax, when it somewhat resembles a monk with its hood. It has been long famed for its pertinacious simulation of death, and indeed has derived its specific name (*pertinax*) from this very pertinacity. Fig. 111 shows the male of Ptinus fur.

FAMILY—BOSTRICHIDÆ.

The *Bostrichidæ* is a family of wood-boring insects, some of them large, cylindrical, and rough, especially Cape species. In this country we have but four species. Under Scolytidæ the habits of this family are described. On Plate 3, fig. 19, the *Apate capucina*, a doubtful British insect, is figured.

With a notice merely of the *Lyctidæ* and small *Cissidæ*, often with very pretty antennæ, I must pass on to another group; and yet, in the economy of nature, in destroying fungi and feeding other insects or birds, like wrens or creepers, the larvæ of these little beetles are no doubt extremely useful.

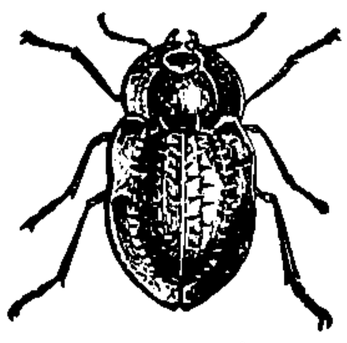
HETEROMERA.

IN the Heteromera, the first two pairs of legs have each five joints to each tarsus, but only four to each of the other legs.

It is a very heterogeneous mass—there being in it, no doubt, many insects belonging to other groups, just as there are heteromerous genera and species in pentamercus and tetramerous sections.

In most of the Heteromera the antennæ are moniliform. In this place I do not attempt to describe the families in their order, and space is wanting to treat even of their names. On Plate 3 a few of the Heteromera are figured, mentioned further on, excepting the curious *Helæus perforatus* (Plate 3, fig. 11), one of a singular group of insects, all indigenous to Australia. The *Helæus echidna* (fig. 112), brought from King George's Sound by Captain (now Governor Sir) George Gray, has the elytra armed with short spines; others, as the species figured, have hairs projecting from the wing cases.

Fig. 112.



Helæus echidna.

We may begin with the great group VESICANTIA, of which our *Meloe* or Oil Beetle is a characteristic example. See its curious history and strange metamorphoses recorded by Newport in the Linnæan Transactions. But space forbids our making extracts from his pages.

There is no member of the order more famed than the "Blister-beetle" or "Spanish-fly" (*Cantharis* or *Lytta Vesicatoria*), and there is probably none that has been more useful to mankind. In the druggists' shops you may see a large drawer or glass jar filled with *Cantharides*. It is a bright green beetle, glossed over with reddish bronze or blue; its elytra are long and softish, and conceal two large wings; the antennæ are longish and thread-shaped. The beetle is sometimes though rarely taken in this country; and some twenty years ago I saw many specimens captured on ash trees near Chelmsford or Colchester in Essex. On the continent of Europe it is a common insect, being abundant in the southern parts of France, Spain, Italy, Germany, and Russia. In France the collectors of Blister-beetles go out during the mornings and evenings of the month of May, when they are less active than they are in the hot sunshine, and get them by spreading a cloth under a tree frequented by them, and shaking the tree or beating it with long poles. When so employed they usually cover their faces, and protect their hands by wearing gloves. The Cantharides are most frequently deprived of life by immersing the cloths in which they are gathered in hot vinegar and water, and then drying them on hurdles covered over to keep them clean. They are imported into this country from Sicily and Russia, the greatest part being sent in barrels or cases from Astracan and St. Petersburg; the Russian cases contain from sixty to seventy pounds. The insects are collected in large numbers in Hungary, and imported into this country by way of Hamburg. Dr. Pereira states that, in 1839, 16,376 lbs. of Blister-beetles were imported into this country, on which a duty of one shilling a pound was paid

The principle in the beetles which causes its vesicatory powers, exists more or less in all the numerous species of the family.

I must here leave the Heteromera, containing the

PSEUDO-TETRAMERA.

IN these the tarsi are apparently four-jointed, although on examination a fifth will be discovered.

RHYNCHOPHORA (*Snouted Beetles*).

A vast set of insects, upwards of ten thousand of which have been described.

Mr. Wollaston has published an interesting paper* on the sounds made by some of the Curculionidæ. He noticed this habit first when in Teneriffe in a species of *Acalles*, and thus narrates it:—"I had been accustomed to find such a number of insects in the dead branches of the various Euphorbias, that my attendant also had discovered, from time to time, the *locus quo* of many a rarity by imitating my method of research; and, to use his own expressions, he was about in this instance to throw away these rotten stems as worthless, when he was arrested by a loud grating or almost chirping noise, as of many creatures in concert; and on looking closer for the mysterious cause, he detected a specimen of *Acalles*, from which it was quite evident that a portion of the noise proceeded. On shaking the hollow stem so as to arouse its inmates, and putting his ear alongside it, the whole plant appeared musical, as though enchanted; and it was evident to him, therefore, that there were more of the performers within—a conjecture which proved to be correct; for on breaking open the branches he captured nearly a dozen of them."

Mr. Wollaston kept three of these alive for several weeks, and as long as they lived it was a constant source of amusement to him to make these creatures stridulate or "sing." It was long before he ascertained how the noise was produced, as they would often stridulate when lying on their sides, with their limbs closely retracted and their head applied to their chest. At length he perceived a minute and rapid vibration of the apical segment of the abdomen, so rapid that to the unassisted vision it was scarcely appreciable. He dissected specimens of the *Acalles argillosus* and the *Acalles neptunus*, and found in this part the structure by which the insects produce the sound.

SECTION I.—ORTHOCERATA.

With all the joints of the antennæ more or less similar.

FAMILY—BRUCHIDÆ.

The family BRUCHIDÆ contains many small insects, which live in the seeds of leguminous plants; and when they abound, as they sometimes do, very great is the extent of their depredations. The body of the perfect insect is oval and convex; the head is bent downwards, so that the wide beak rests on the breast when the insect is not engaged in eating; the antennæ are not very long, and are serrated on the inside; the elytra do not cover the abdomen; the femora of the hind legs are very thick, and are often toothed on the under side. One species attacks the coffee, and, like most of the tribe, is named after the plant on which it is found. The *Bruchus pisi*, the insect figured (117), is

Fig. 117.

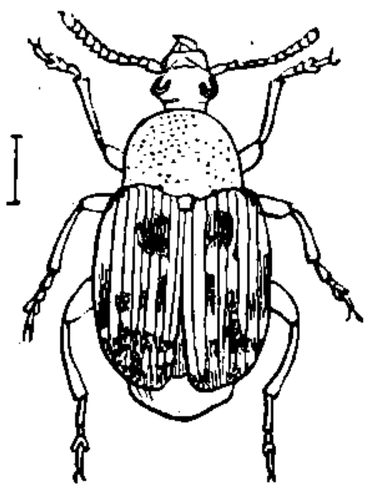
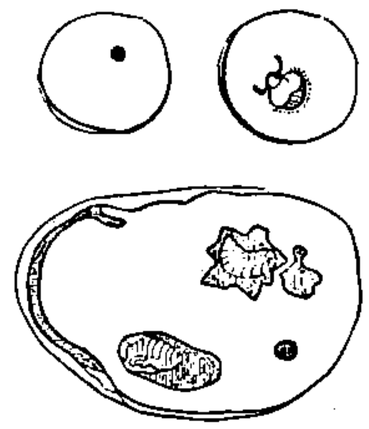


Fig. 118.



Bruchus pisi.

more common in the United States than it is here. It is called there, according to Melsheimer, the Pea-fly (Cat., p. 12). The figures above (118) show two peas and a bean attacked by *Bruchus;* the larva represented much magnified. We borrow Dr. Harris' account of its ravages on the pea:—"Few persons while indulging in the luxury of early green pease are aware how many insects they unconsciously swallow. When the pods are carefully examined, small discoloured spots may be seen upon them, each one corresponding to a similar spot on the opposite pea. If this spot on the pea be opened, a minute whitish grub destitute of feet will be found therein. It is the weevil in its larva form, which lives upon the marrow of the pea, and arrives at its full size by the time that the pea becomes dry. This larva or grub then bores a round hole from the hollow of the pea quite to the hull, but leaves the latter, and generally the germ of the future sprout, untouched. Hence these peas will frequently sprout and grow when planted. The grub is changed to a pupa within its hole in the pea in the autumn, and before the spring casts its skin again, becomes a beetle, and gnaws a hole through the thin hull in order to make its escape into the air, which frequently does not happen before the peas are planted for an early crop. After the peas have flowered, and while the pods are young and tender, and the peas within them are just beginning to swell, the beetles gather upon them and deposit their tiny eggs singly in the punctures or wounds which they make upon the surface of the pods. This is done mostly during the night or in cloudy weather. The grubs, as soon as they are hatched, penetrate the pod and bury themselves in the opposite peas; and the holes through which they pass into the seeds are so

* Annals and Mag. of Nat. Hist., 3rd ser., vol. vi. p. 14; July, 1860.

fine as hardly to be perceived, and are soon closed. Sometimes every pea in a pod will be found to contain a weevil-grub; and so great has been the injury to the crop in some parts of the country, that the inhabitants have been obliged to give up the cultivation of this vegetable." *

Peas are destroyed by the grub of a species of this group (*Bruchus granarius*), the female of which will sometimes deposit an egg in every pea of a pod. But a species indigenous to North America, and also found here, is in the former country at times so alarmingly destructive as to prevent the inhabitants from cultivating pease. Kalm, the pupil of Linnæus, and who travelled in North America, was alarmed on opening a parcel of peas to see that they were infected by the Bruchus, for he feared lest he should be the means of introducing a most destructive insect into Sweden. In France in 1780, the *Bruchi* seem to have been very abundant; for in that year a rumour arose that many had been poisoned by eating pease attacked by worms, and in consequence the authorities would not allow them to be offered for sale in the public market. A Bruchus attacks a leguminous seed called *gram* in India, where it is used when boiled as food for horses. The valuable cacao or chocolate plant (*Theobroma cacao*) has its peculiar Bruchus, as have many other plants.

There are nine British species. The South American Bruchidæ—of the genus *Caryobarus*—are very large. I have seen the larva of one in the hard nut of a palm, which looked no *softer* than ivory.

FAMILY—ANTHRIBIDÆ.

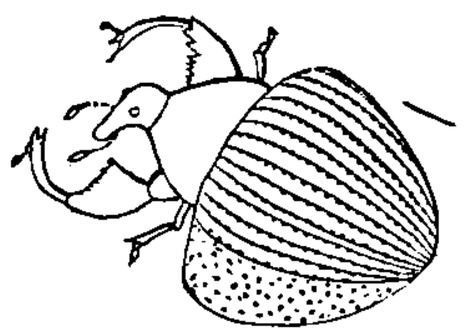
The family ANTHRIBIDÆ, a very large and fine group, but feebly represented in our islands by eight British species, contains insects with broad, flat noses, and often with antennæ of the most wonderful length. Many of the South American genera are very curious, but none are more strange than some of the odd forms sent lately by Wallace from the East. M. Henri Jekel, in the *Insecta Saundersiana*, figured many fine species in the vast collections of W. W. Saunders, Esq. The British genera are—*Brachytarsus*, *Tropideres*, *Platyrhinus*, *Anthribus*, and the curious little jumping *Choragus* described by Kirby.

FAMILY—ATTELABIDÆ.

A large family of the group, of which there are at least ninety-four recorded British species, the great mass of which belong to the genus *Apion*—a race of small beetles so named from their pear-shape; they are attenuated in front, and gradually thickened behind. Look at the figure of the strangely-dilated Brazilian genus *Camarotus* (*Camarotus marginalis*, fig. 119). Many of the family are very destructive to plants, and the Apions are especially destructive to the crops of the farmers.

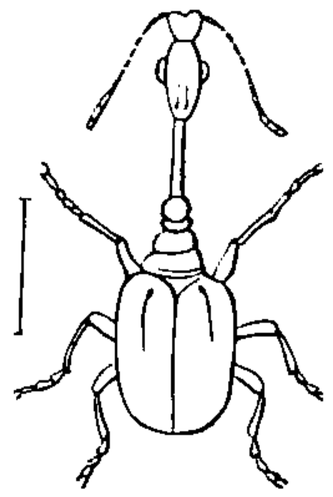
Some of the exotic genera are most strange, such as the enormously long-necked Indian and Madagascar *Apoderi*, and a curious genus from that great African island, called by the writer *Lagenoderus*, from its curious flask-shaped neck. Many of the *Apoderi* are spined. *Antliarhinus* is placed by authors in a separate family,

Fig. 119.



Camarotus marginalis.

Fig. 120.



Antliarhinus Zamiæ.

but we may introduce it here. Fig. 120 shows the form of the *Antliarhinus Zamiæ*.

The species of *Rhynchites* are often beautifully coloured—some brilliant green, others bright purple, and others blue, while all tints decorate others.

I extract from the "Introduction to Entomology" a passage which will explain the habits of some of the genera of this family:—

"The habitations constructed for their future larvæ by the beautiful weevils or long-snouted beetles of the genera *Rhynchites*, *Attelabus*, and *Apoderus*, consist of the whole, or more commonly a part, of a leaf on which they are to feed, rolled up with great art by the mother into a sort of cylinder, sometimes resembling a little horn and at others a wallet more or less elongated; thus giving a singular appearance to the leaves so treated, which, while their basal portion retains its usual form, have their extremities metamorphosed into these odd-looking appendages. A very interesting description of the mode in which these nests are constructed has been lately given by M. Huber of Geneva, who has detailed the procedures of *Rhynchites Bacchus* with the leaves of the vine, of *R. Populi* with those of the poplar, of *R. Betulæ* with those of the beech and birch, of *Apoderus Coryli* with those of the hazle, and of *Attelabus Curculionoides* with those of the oak, of which last, as more fully described by M. Goureau, I will give you a short account. The female having deposited a single egg, which adheres by its natural gluten, near the mid-rib of the end of the upper side of the leaf she has selected, passes to the under surface, and slightly, but repeatedly, gnaws with her small jaws, both the mid-rib and epidermis in every part until both are rendered perfectly pliable. Her next business is to roll up this terminal portion of the leaf, in effecting which she thus proceeds:—First, she folds it together longitudinally so as to cover her egg, the mid-rib forming one edge of the folded part, and its marginal serratures the other. Next, she places herself at a right angle with the mid-rib, towards which her tail is directed, while her head points to the serratures, and fixing the claws of her two hind left legs into the leaf, she employs those of the two fore legs to pull the point of it towards her; and by a repetition of these manœuvres, not easily described, she at last succeeds in rolling the whole into a little

* Insects Injurious to Vegetation, p. 55.

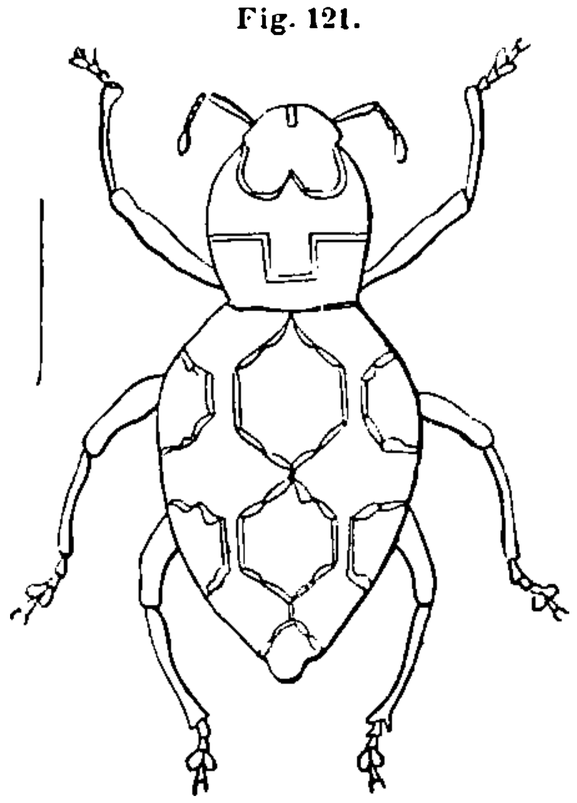
cylinder having at one end the mid-rib, whose spirals then resemble those of the mainspring of a watch, and at the other, which is of a less regular shape, the serratures of the leaf, so pushed in by means of her trunk and fore legs as to retain the whole in its cylindrical form. The larva proceeding from the egg thus deposited towards the end of May is hatched early in June, and never quits the habitation which its provident and truly laborious mother (for each egg requires its separate leaf and the long process above described) has prepared for it, eating in succession the different rolls of its cylinder, till it has attained its full growth." So far for Messrs. Kirby and Spence.

SECTION II.—GONATOCERATA (*Weevils*).

The great division CURCULIONIDÆ or GONATOCERATA, have the first joint of the antennæ generally longer than the others, and geniculated or elbowed. It is divided into many groups. There are the *Brachyderidæ*, with thirty-five British species—some very pretty, as in the genus *Polydrosus;* they have all a short thorax and a short beak.

There are a noble set of Curculionidæ in South America, of which one is figured on Plate 4, fig. 9—the *Cyphus Hancocki;* its fine, soft, green scales and bronzy gold patches are very beautiful. But most

Fig. 121.



Pachyrhynchus orbifer.

of the species of *Cyphus* are fine objects for the microscope. Near it is the genus *Entimus*, containing the well-known Diamond Beetles. The *Pachyrhynchi* are from the Philippine islands, and are perfect gems; one species in particular, with a rich ruby back-ground and round patches on that ground, composed of lovely green, gold, and prismatically coloured scales. Fig 121 shows *Pachyrhynchus orbifer.*

The species of *Naupactus* and *Diaprepes* are often covered with beautiful scales.

Of the group *Cleonidæ* there are thirty-five recorded British species placed in thirteen genera. The typical genus *Cleonus* abounds in species.

Molytes is a small genus of black, fat-looking beetles, while *Phytonomus* is a large genus of smallish-sized weevils, many of them very destructive to plants.

The various species of *Hylobius* are, where they abound, very injurious in forests of the pine tribe, as they often quite destroy the young trees. The larch, now so extensively planted for its useful timber, is at times much destroyed by the *Hylobius abietis.* Mr. Elliott of Wolfelee lately communicated to the Entomological Society some interesting remarks on the ravages of this beetle in Scotland. Mr. Janson has also published in the Proceedings of the same society (October, 1860) a nice account of this insect, chiefly derived from the valuable work of Ratzeburg. This beetle seems to prefer in Germany the *Pinus sylvatica* and *P. abies*, although it attacks all the firs indiscriminately. It is the perfect beetle which is directly injurions. It gnaws the young shoots, thus causing them to wither. "The extremities of a tree thus attacked (the most vigorous and healthy trees are invariably selected by the beetle) several years in succession, sickness and death inevitably ensue, in dry seasons especially; the mischief this beetle occasions in woods where it abounds is almost incredible."

The beetles come out from May to October. The females deposit their eggs, and the larvæ live, either in the stems of sickly, dead standing, or felled trees. They deposit their eggs also in stumps and roots. The forester should therefore grub up all stumps, and clear out all sickly and dead trees, in order to restrain the multiplication of this beetle. The timber should be barked as soon as practicable after it is felled, as the females only deposit their eggs in the bark.

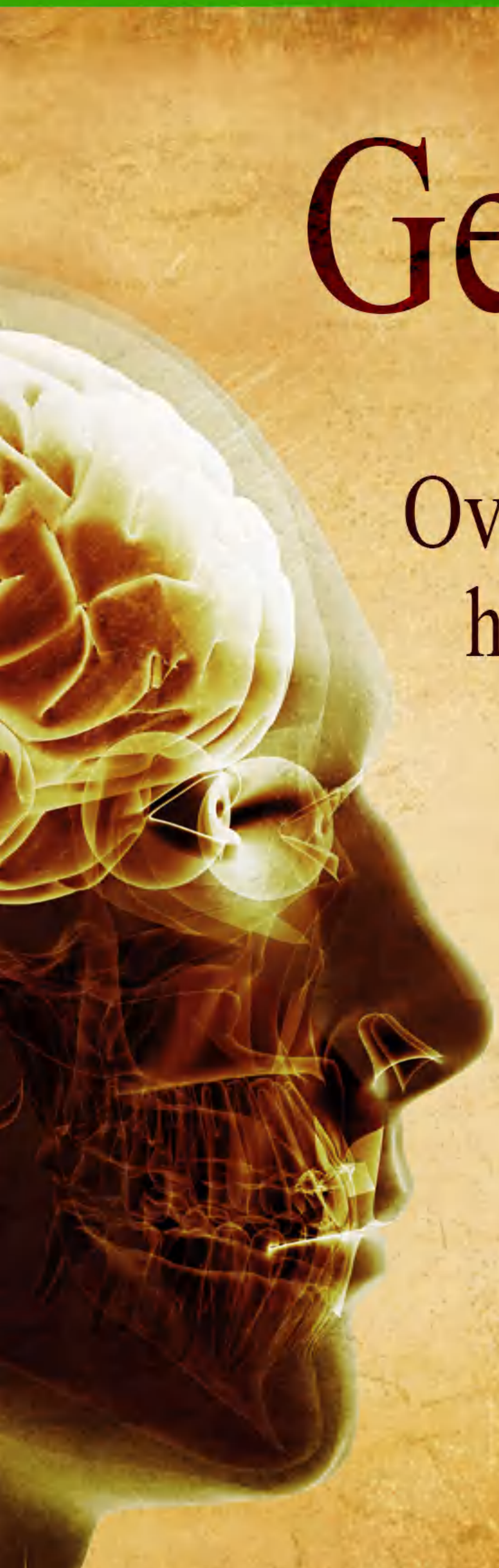
Among the plans mentioned by Ratzeburg for destroying these beetles the most successful seem to be the following: the digging of pits and trenches with perpendicular sides at short intervals round the plantations and along the sides of the paths. Into these the beetles fall or fly, and, being unable to escape, they are taken and destroyed. In Germany they also lay bunches of young fir boughs about the plantations or in the pits. By shaking these daily over cloths, the beetles are collected and destroyed. Ratzeburg says, that as many as two thousand five hundred beetles have been taken daily from one hundred of these bunches. It is necessary to replace those boughs when dry with fresh ones, as they no longer attract beetles in this state. Another method is to strew strips of fresh fir bark about the plantations, with the inner surface downwards. On lifting these, great numbers of beetles are found to have congregated upon and beneath them.

The *Byrsopsidæ* form a curious group, very feebly represented in Britain, where but one species is met with—the *Gronops lunatus.* In South Africa there are many striking species.

In the group *Otiorhynchidæ*, there are thirty-nine British species belonging to the genera *Phyllobius*, *Trachyphlæus*, *Omias*, *Otiorhynchus*, &c.

The genus *Elytrurus* is found in the islands to the north of New Zealand. It has singularly elongated elytra. Fig. 122 represents the *Elytrurus atratus.*

We may briefly refer to the habits of some of the species of Otiorhynchus, a very extensive genus. Some of the most destructive of the weevil tribe belong to the genus *Otiorhynchus.* Among these the *O. sulca-*



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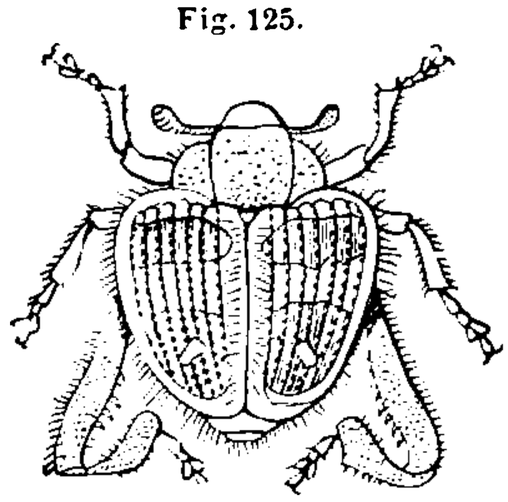
lower part of the leaf by means of the spines on the hind legs. The cut is copied by Mr. Holmes from Sturm's catalogue.

Fig. 125.



Tachyopus Lecontei.

The group *Calandridæ* contains some of the largest, *Rhyncophorus colossus*, *R. longimanus*, and some of the smallest of the weevils (*Sitophilus granarius*), &c.

Rhyncophorus palmarum.*—This beetle is of a dark black; the elytra have five long and a few shorter lateral striæ. The podex is triangular, and fringed with hairs; the beak of the male is furnished with a longitudinal brush. The larva is short, fat, and rusty yellow; the head is brown, as are spots on the thorax and flattened tail. Such is the description of Guilding. This large insect is found in various parts of the tropics of the New World. Its larva perforates dead or injured palms, and hence the specific name of the perfect insect is derived. It is chiefly the Gru-gru (*Cocos fusiformis*), a palm of the same genus as the Coco, which it drills. The larva also occasionally attacks the sugar-cane.

Although a small insect, yet none of its tribe is more destructive than the Corn Weevil (*Sitophilus granarius*) a little snouted beetle of a brownish-red colour, with furrowed elytra shorter than the body. At times vast quantities of corn and other grain are destroyed by this weevil, which attack these seeds when stored in granaries and often occasion very serious damage, as they devour grain both in the grub state and as beetles. It is one of the most prolific of coleopterous insects, if the report is true that a pair of these weevils may produce six thousand in one year. If grain be kept cool and frequently moved, it is not liable to being attacked, for it is when the corn is housed that the female deposits her eggs in it; the young maggots as soon as hatched burrow into the grain, each maggot selecting a different seed, the inside of which it devours; and having undergone their various transformations no time is lost in depositing eggs for another brood.

Rice is attacked by another species allied to the corn weevil, but rather smaller, and having two red spots on each elytron.

The Borer-weevil (*Calandra sacchari*) an insect which commits great ravages on the crops of sugar-cane in Jamaica, is said to have been introduced into that island from Tahiti in 1797. Mr. King of Portlind has described this insect and its transformations. The egg is the size of a small bead, and is partially transparent; the female deposits this within the succulent vessels of the cane, where the adhering footstalk of the leaf keeps the decayed foliage hanging to the germinating joint. The egg is hatched when the eye or growing bud begins to show the active influences of both heat and moisture. The maggot, as soon as hatched, worms its way from the verge of the footstalk into the very body of the succulent and vegetating shoot, where it increases in dimensions. It then occupies the centre of the plant, making its way upwards through the growing cane, but remaining within the sweet and perfected joints, and never ascending to the greener tops to devour the germ and destroy vegetation. It entirely exhausts the saccharine fluid in which it has lodged, filling the excavation it makes with an excrementitious deposit extremely injurious to the cane liquor from the mill; deteriorating it rapidly if it remain untempered while running into the pans. When the canes are cut the maggot has passed into the pupa state. The pupa is inclosed in a cocoon, which is a shroud of decayed trash curiously formed by the maggot. The shreds of which this cocoon is formed are plaited and wound together, and so closely fastened at the ends that the air is excluded. It continues in this state only for a short time. From this comes out the snouted beetle, striped yellow and brown.

Of the group *Cossonidæ* there are eight British species—*Mesites Tardii* (an Irish and South of England insect named after Mr. Tardy), *Phlœophagus*, *Rhyncolus*, and *Pentarthrum*.

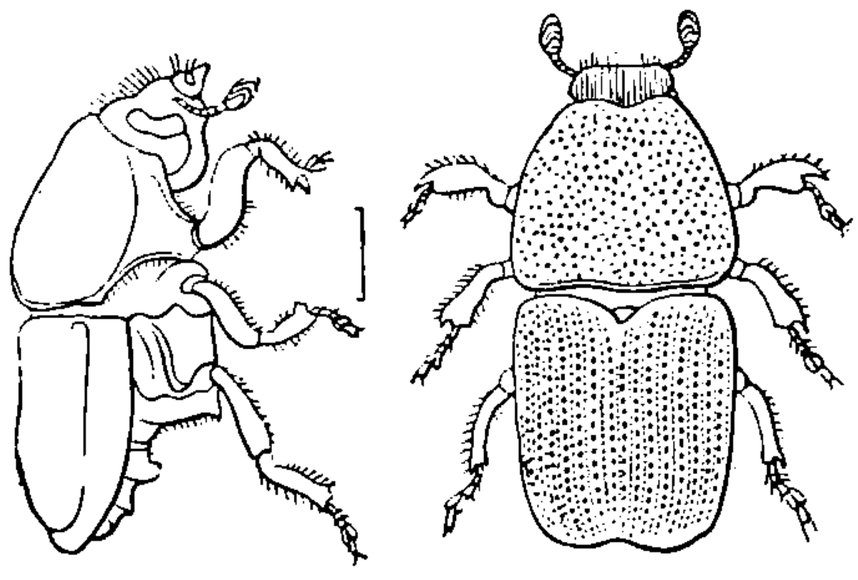
This ends the vast army of Weevils with its sixteen thousand known species.

* Curculio palmarum—Lin.; Calandra palmarum—Fabr.

FAMILY—SCOLYTIDÆ (*Tree-banes*).

Connecting the Rhynchophora, through Cossonus and Rhyncholus, we come to the SCOLYTIDÆ, also called HYLESINIDÆ, small beetles of a brown or rust colour, somewhat cylindrical in form, and rounded both in front and behind. I would propose for them the name of *Tree-bane*, from the damage many of them do to trees. The grubs devour the soft inner parts of the

Fig. 126.



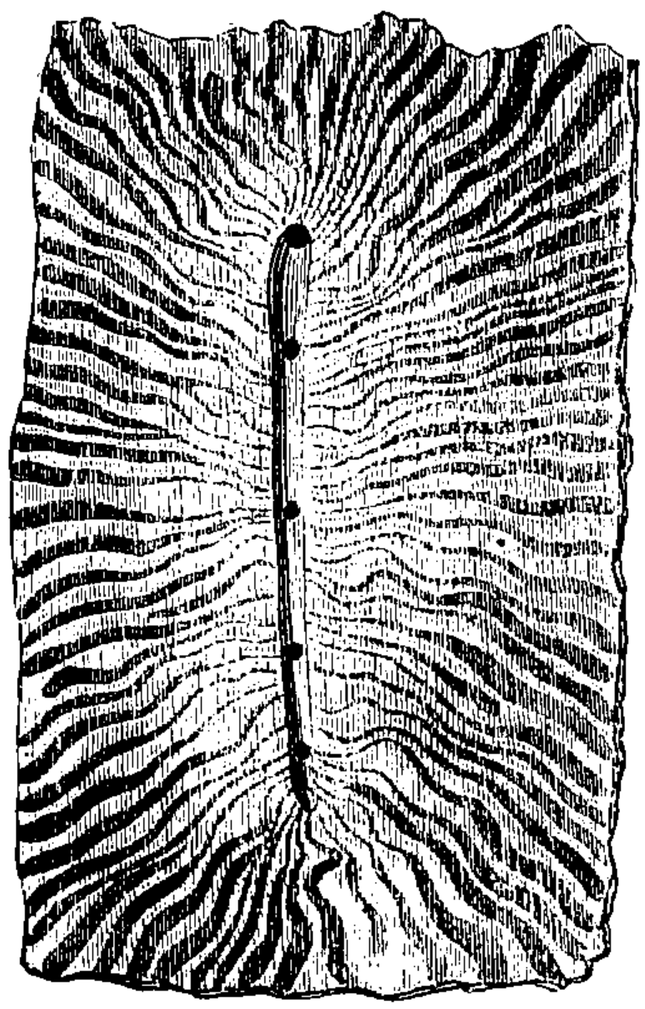
Scolytus destructor.

bark, which they loosen in this way from the wood; and trees attacked by them soon languish and decay. The elms in the neighbourhood of London and Paris have been much destroyed by the *Scolytus destructor*, an insect of this family (fig. 126). In one of the mining

districts of Germany, not supplied with coal like similar districts in our own country, but dependent for fuel on the forests of fir-trees, a species of *Hylurgus* began to increase, about the year 1780, to such an extent as to destroy in a few years whole forests. The working of the mines was in this way materially affected, as the proprietors had no fuel to carry on their operations. Those who wish to see the importance attached to the study of insects, destructive or otherwise to forests on the continent, should consult the handsome quarto volumes of Dr. Ratzeburg,* amply illustrated with figures.

The larvæ of this family of beetles, immediately after being hatched, excavate in the inner bark—as shown in the cut (fig. 127) copied from Ratzeburg—and partly also in the sapwood, "lateral parallel channels more or less sinuous, proceeding on each side from a central one—that in which the eggs were placed—and thus giving to the under side of the detached bark and exposed sapwood that pinnated labyrinthine appear-

Fig. 127.



Excavated bark.

ance and fancied resemblance to letters, which made Linnæus affix to one of these insects the name of *Typographus*." The effect of their ravages is to interrupt the course of the descending sap, and admit wet between the bark and the wood, so that decay of the tree quickly ensues. The *Hylesinus fraxini* attacks the ash, and the *Scolytus pygmæus* the oak. The latter small beetle killed forty thousand trees in the Bois de Vincennes, near Paris.

Entomologists have differed much in opinion whether the Scolytidæ and Bostrichidæ really injure and destroy trees in their growing state, or whether they only attack such as are already diseased. Captain Cox of Canterbury has published papers on the ravages of the Scolytidæ, and suggested the means of arresting their progress. Mr. Alfred Wallace, who took very many species of them in New Guinea and other islands of the Eastern seas, came to the conclusion that they only attacked dead wood, generally in the first stage of drying or decay.* In the course of five years almost daily spent in the forests, he never saw a single individual of either of these families attacking healthy living trees, nor did he find any traces of their having bored into such trees. Whenever a tree falls or is cut down these bettles are the first to attack it. In a few days dozens of small holes may be seen on the trunks and branches, from each of which a little fine wood-dust falls down; and on careful examination some of the insects may be seen pushing out the dust with the truncated end of the elytra. He mentions that he had cut down a large tree in the Aru islands of a kind which contained much milky sap, hardening into a kind of gutta percha on exposure to the air. Upon this tree he found many specimens of Scolytidæ with their abdomens protruding from the holes they had bored, but all dead. They were glued fast by the hardening of the milky sap. The tree could not have been the proper food of this species, or the right place to deposit its eggs. In a hut in Macassar, formed of bamboos and palm, the Scolyti abounded. Mr. Wallace heard their never-ceasing jaws in the stillness of the night as they were at work. Mr. Waterhouse gives the names of thirty-nine species as British. They are in ten genera, the names of which are—*Hylastes*, *Hylurgus*, *Hylesinus*, *Phlœophthorus*, *Scolytus*, *Xyloterus*, *Hypothenemus*, *Cryphalus*, *Tomicus*, and *Platypus*. Most of the names are indicative of their gnawing into wood or bark.

GROUP—LONGICORNIA (*Longicorn Beetles*).

A very extensive and important section of Beetles, most of which are at once marked by the great length of the antennæ. How curious it is to see, as I have seen, a live specimen of the great Harlequin beetle of South America (*Acrocinus longimanus*), with its coat of many pleasing colours, and its immensely long fore legs and long, long, antennæ, crawl up a branch! It places an antenna on the spot where it is about to plant its foot, doing this regularly one after the other. Many are the uses served by these antennæ, and in this tribe they are remarkably varied. Look at the curious serrated edge of the joints in Westwood's genus *Scolecobrotus*, certainly used by that Australian insect in some particular way; then look at the beautifully pectinated antennæ of *Polyarthron*, *Phœnicocerus*, *Petalodes*, and other genera. See the short heteromerons-like antennæ of Spondylis and of some of the *Brenthidæ*. The eyes are, in most, notched or kidney-shaped. But space forbids me entering into particulars about this really magnificent tribe, which varies in size from the minute *Decarthria* to the gigantic *Titanus*, or that immense West African *Prionus* described by Hope, or the beautiful large *Batocera* discovered by Mr. Wallace in one of the Eastern islands. For delicate colour, what can be sweeter than the curiously horned-headed *Phœbe concinna* (Plate 3, fig. 7), with its purplish lavender hues, and the pleasing variety of pale tints which set off these purplish

* Die Forst-insekten.

* Trans. Ent. Soc. London, new series, vol. v. p. 218; 1860.

hues so elegantly! Then, again, the charming yellow and red *Anisocerus dulcissimus*,* found by Bates, is a truly exquisite insect—Plate 3, fig. 8. The Australian *Teloccra Wollastoni*—Plate 3, fig. 4—is curious from the antennæ being dilated at the end. It was named by the writer after Thomas Vernon Wollaston, Esq. *Pascoëa Idæ*—Plate 3, fig. 5—with its strange spined cheeks, was named generically after F. Pascoe, Esq.; the specific name is after Madame Ida Pfeiffer. It belongs to the group *Tmesisternus* and *Coptomma*, a New Guinea, New Zealand, and East Indian Archipelago set of Longicorns. Plate 3, fig. 6 is a curious Longicorn from Lord Howe's Island, which at first I named *Deucalion Wollastoni*. I subsequently constituted a genus *Pyrrha* for it.

Many of the larvæ of Longicorn beetles are eaten by the less civilized races of man. Even the Romans are believed to have used the large juicy grubs of *Prionus coriarius*, *Hamaticherus heros*, and perhaps other species of Longicorn beetles, and included them under the name of Cossus.†

The larvæ of *Stenodontes damicornis*, a large blackish brown prionidous beetle, common in the West Indies and in some parts of South America, are eaten both by white and black people. The *Montac*, the grub of a Longicorn, is found in the Mauritius, and, according to St. Pierre, is dressed and eaten by the white colonists, as well as the negroes. The larva of the *Macrodontia cervicornis*, a South American insect living on the sap of the Bombax, is used as food. In Cayenne the *Titanus giganteus*, one of the largest of beetles, has become rare from the eagerness, so I have heard, with which the negroes and natives search for its fine large sapid grub.

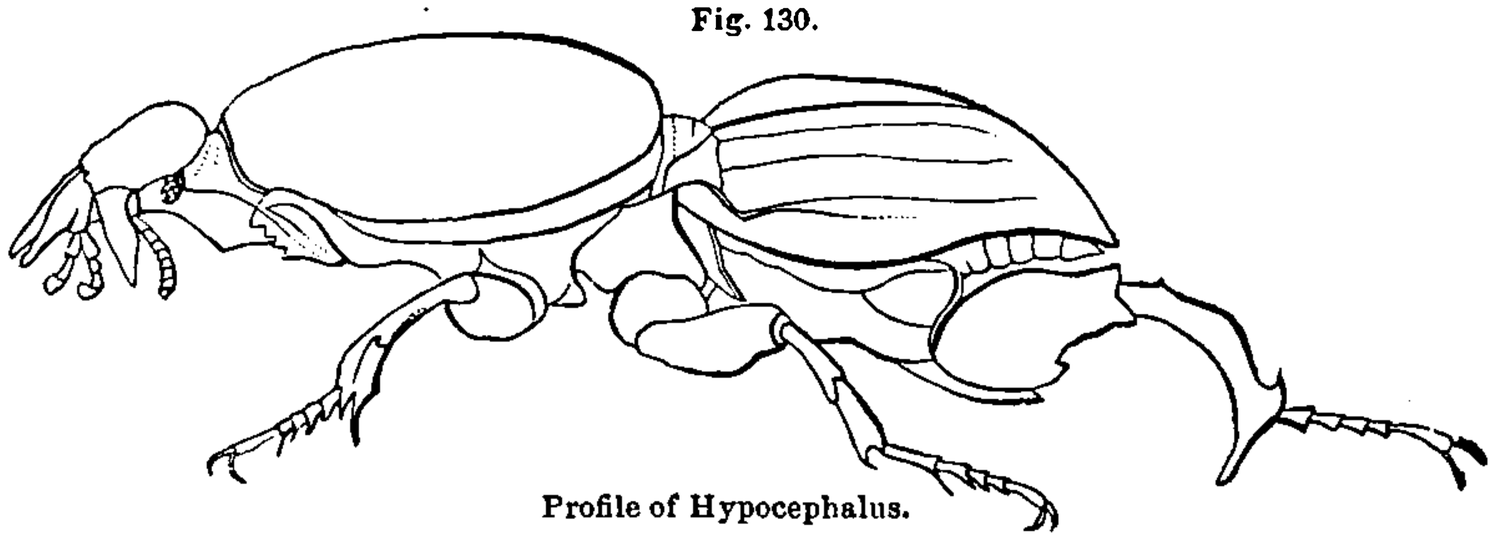
The PARANDRIDÆ are South American depressed, pentamerous, short-horned Longicorns.

The TRICTENOTOMIDÆ are Eastern Longicorns, with heteromerous tarsi and curious antennæ, somewhat like those of *Lucanus*. Mr. George Robert Gray named the genus, and very briefly described its first species (*T. Childreni*).

FAMILY—BRENTHIDÆ.

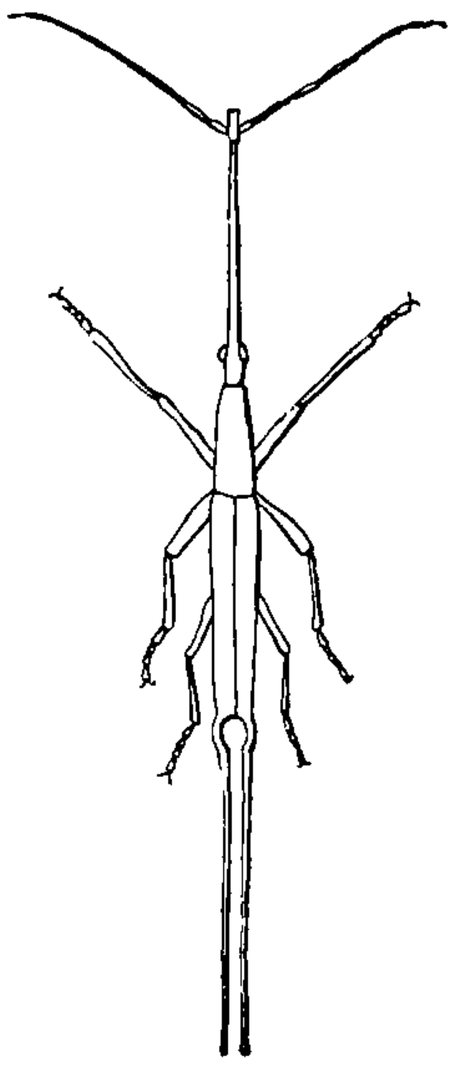
I believe the BRENTHIDÆ, generally placed with the Rhynchophora, to come here. Two curious forms are figured here. Fig. 128 represents *Diurnis furcillatus*, and fig. 129 *Taphroderes Mellii*. The Brentus Temminckii of Java is the most gigantic of the tribe.

Fig. 130.



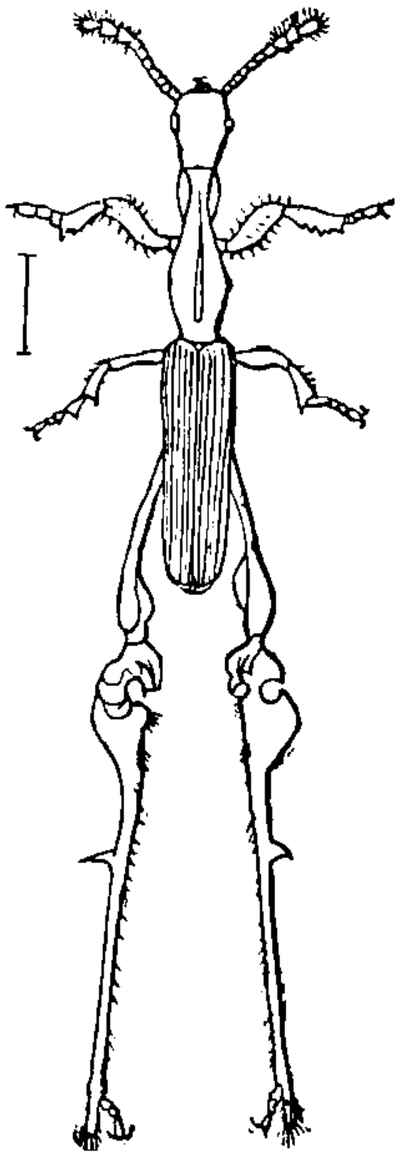
Profile of Hypocephalus.

Fig. 128.



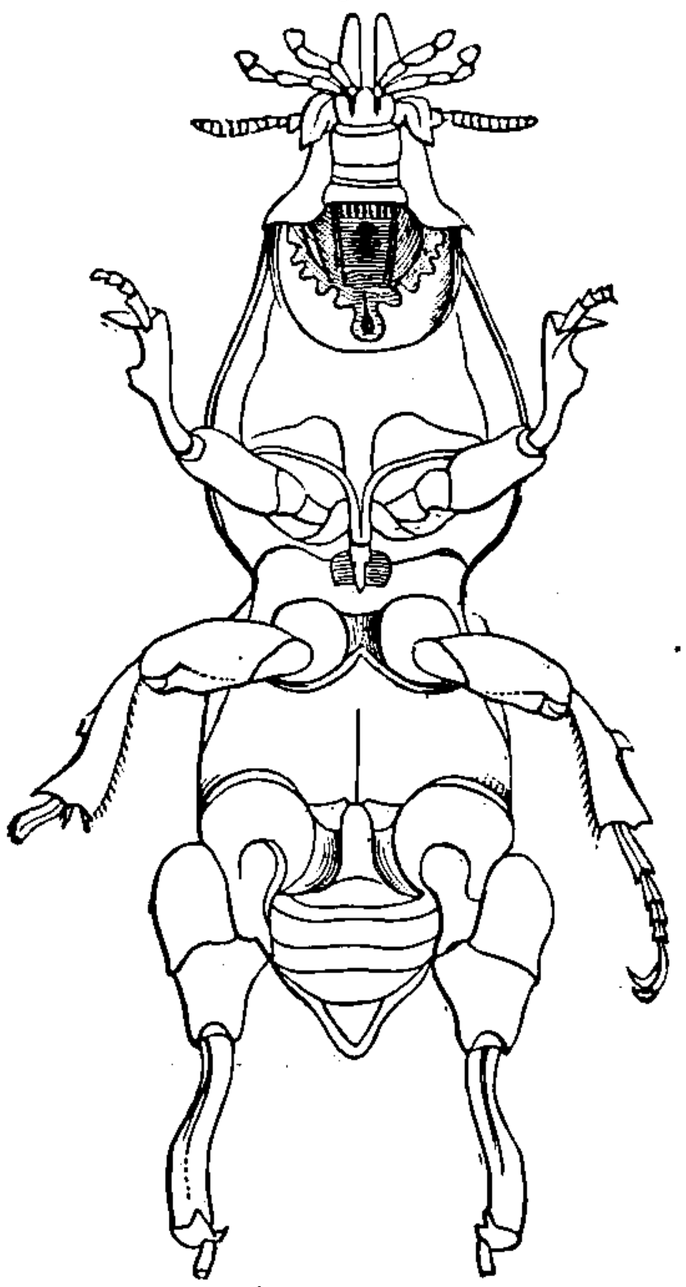
Diurnis furcillatus.

Fig. 129.



Taphroderes Mellii.

Fig. 131.



Under side of Hypocephalus.

The very curious *Hypocephalus*, of which I have seen but one specimen, that in the collection of J. Aspinal

* Hope, Tran. Ent. Soc., vol. iii. p. 133.

† See White's Catalogue of Longicorns in British Museum collection.

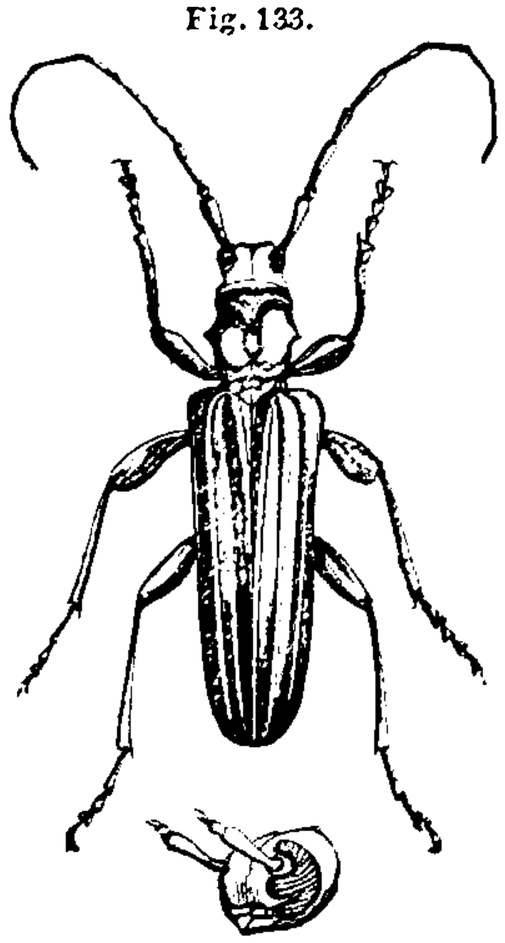
rather from British Columbia, for I believe the specimen came from the continent.

Plate 3, fig. 9, shows a South African species of the fine genus *Tragocephala;* it is the *T. comitessa,* The *Tragocephalæ* are fine African insects. *Phosphorus Lucia* and *Phosphorus Jansoni,* especially the latter, are most striking insects when fresh. The beautifully delicate yellow plush, and the black surroundings, form a fine contrast.

Sir James Emerson Tennent* records the ravages made on the cocoa-nut trees of Ceylon by a large species of Longicornus beetle (*Batocera rubus*), called by the Singhalese *Cooroominya.* The larva of this "makes its way into the stems of the younger trees, and after perforating them in all directions, it forms a cocoon of the gnawed wood and sawdust, in which it reposes during its sleep as a pupa, till the arrival of the period when it emerges as a perfect beetle." Notwithstanding the repulsive aspect of the large pulpy larvæ of these beetles, they are esteemed a luxury by the Malabar Coolies. Sir James quotes a paper by Mr. Capper in the *Journal of the Asiatic Society of Ceylon* for May, 1845, on the ravages perpetrated by these beetles. Mr. Capper had recently passed through several cocoa-nut plantations, varying in extent from twenty to one hundred and fifty acres, and about two to three years old; in these he did not discover a single young tree untouched by this destructive Longicorn beetle.

Of the boring powers of some of the Longicorns I have had most satisfactory proof. I have seen part of a cistern lined with lead, through which a specimen of *Callidium bajulum* had bored. The grub or pupa happened to be in the wood when the cistern was constructed, and the creature with its upward

Fig. 133.

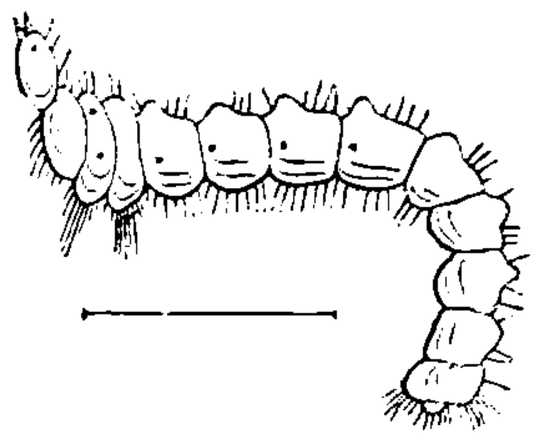


Bardistus cibarius.

tendencies ate through the wood, and actually perforated the lead lining of the cistern. It was only found out by the leaking of the water. The natives of King George's Sound were found, amongst other grubs, to be fond of those of a beetle described by Mr. Newman, and which he named *Bardistus cibarius.* It is represented in fig. 133. According to Captain (now Governor Sir) George Grey, the grub is named *Barde. Bardistus* is a native of King George's Sound, where it seems to be very abundant, forming a favourite article of food with the natives. It is eaten in its imago as well as its larva and pupa states. It is found in the Xanthorhea.

The larva of a Longicorn beetle of the genus *Agapanthia* (*A. suturalis*—Fald) has been observed and described by M. E. Perris.* The accompanying figures (figs. 134 and 135) are carefully copied from his plate.

Fig. 134.



Pupa of Agapanthia.

Fig. 135.

Larva.

This larva lives in the stems of the *Melilotus macrorhiza,* one of those yellow trefoils which grow in the clayey and rather moistish parts of Belgium. It is of a yellowish-white colour, and is distinguished by the dorsal protuberances and pectoral swellings from others of the genus which have been observed. The perfect insect comes out in June. The female deposits a single egg on the tender stem of the trefoil. The young larva, when hatched, pierces its way with its jaws into the medullary canal, and hollows out a gallery, eating its way. This gallery it traverses with great ease; the protuberances of its back act as legs or props, wherewith to push against the wall. In April or May it turns into the nymph or pupa state, and escapes by a round hole which it pierces in the plant. The perfect insect is a narrowish, greenish bronze beetle, the suture and side margins of the elytra being clothed with greyish-yellow downy hairs.

The apple-tree in the United States suffers much from the attack of the yellowish or white cylindrical grub of the *Saperda bivittata,* so called from the white stripes on its elytra.

Dr. Asa Fitch† tells us that the Winged beetle appears early in June. Among the means provided by the Author of nature for destroying this borer, and keeping it from becoming unduly multiplied, the Woodpeckers, especially the Downy woodpecker, *Picus pubescens L.,* stands conspicuous. And yet another American writer‡ insists on the necessity of the orchard-keeper carrying on a war of extermination against this bird, which, from the account of Dr. Fitch, appears to be in reality one of his most useful friends.

* Ceylon; an Account of the Island, Physical, Historical, and Topographical, &c., vol. i., p. 249.

* Mémoires de la Societé royale des Sciences de Liége, vol. x. p. 244, Pl. 5, figs. 37, 46; 1855.

† Report on the noxious, beneficial, and other insects in the State of New York, p. 13. Albany, U.S., 1855.

‡ Kirkland; Zoology (Ohio), p. 179.

FAMILY—LEPTURIDÆ.

The family LEPTURIDÆ have generally round eyes, and are often attenuated in the elytra, and also in the beak or front of the head. It is a very large family. Many of the *Lepturæ* (true), *Strangaliæ*, and *Grammopteræ* are essentially insects of the temperate or colder parts of the world. Mr. Waterhouse places *Molorchus* (Coleoptera, Plate 3, fig. 2), with its abbreviated antennæ, among them. Here also comes the genus *Rhagium*, of which we have three species, marked like the bark of some trees, and mottled and barred irregularly (see *Rhagium mordax*—Coleoptera, Plate 3, fig. 1). I may specify the curious genus *Nemotragus*, long and parallel, and those interesting Australian genera, *Stenoderus* and its allies. The curious *Mastododera*, from Madagascar, is a note-worthy genus, allied to our *Toxotus*.

There are fifty-five recorded British Longicorns; but many more are occasionally met with, imported by ships.

GROUP—PHYTOPHAGA (*Plant-eating Beetles*).

These Beetles, as the name implies, are all livers on plants, and eaters of their leaves and other parts. Some of them, especially in the family *Galerucidæ* are at times very destructive to our creps. Few of them are very large. The *Sagridæ*, thick-legged clumsy beetles, coming out of a hardish cocoon, are among the largest.

In the phytophagous beetles the head is generally immersed in the thorax up to the eyes; the parts of the mouth, except in a few, are not prominent. The *Donaciæ*, frequenting water plants; the strange, often strong jawed, large-headed *Clythridæ;* those lovely ruby and emerald gems, the brilliant species of *Lamprosoma*—South American insects. Here come the strange species of *Chlamys*, some like pieces of clay knobbed; others like a glowing ember; the species are chiefly South American, but a few are met with in the Old World.

If the reader wishes to study the *Hispidæ*—a well-marked and very numerous fine family—he must procure Mr. Baly's work on it.

The great work of Boheman of Stockholm on the CASSIDIDÆ is indispensable, as well as his very useful catalogue with new species, published by the trustees of the British Museum.

The *Halticæ*, are a very extensive family of insects with thickened saltatorial hind legs; our readers may study the descriptive catalogue of the Rev. Hamlet Clark. The numerous papers of Stahl and of Baly on *Doryphora* and other chrysomelidous groups must be consulted.

FAMILY—CRIOCERIDÆ.

Here come *Sagra*, *Donacia*, *Megalopus*, and its allies, a fine group, chiefly from the New World. The strange and rare *Carpophagus* and *Megamerus*, Australian genera very like *Bruchidæ*, are placed here; and here indeed the Bruchidæ, perhaps, should be naturally registered.

The *Crioceris merdigera* is a species found on the water-lily.

In Asparagus beds is frequently found that pretty striped member of the family, *Lema asparagi.*

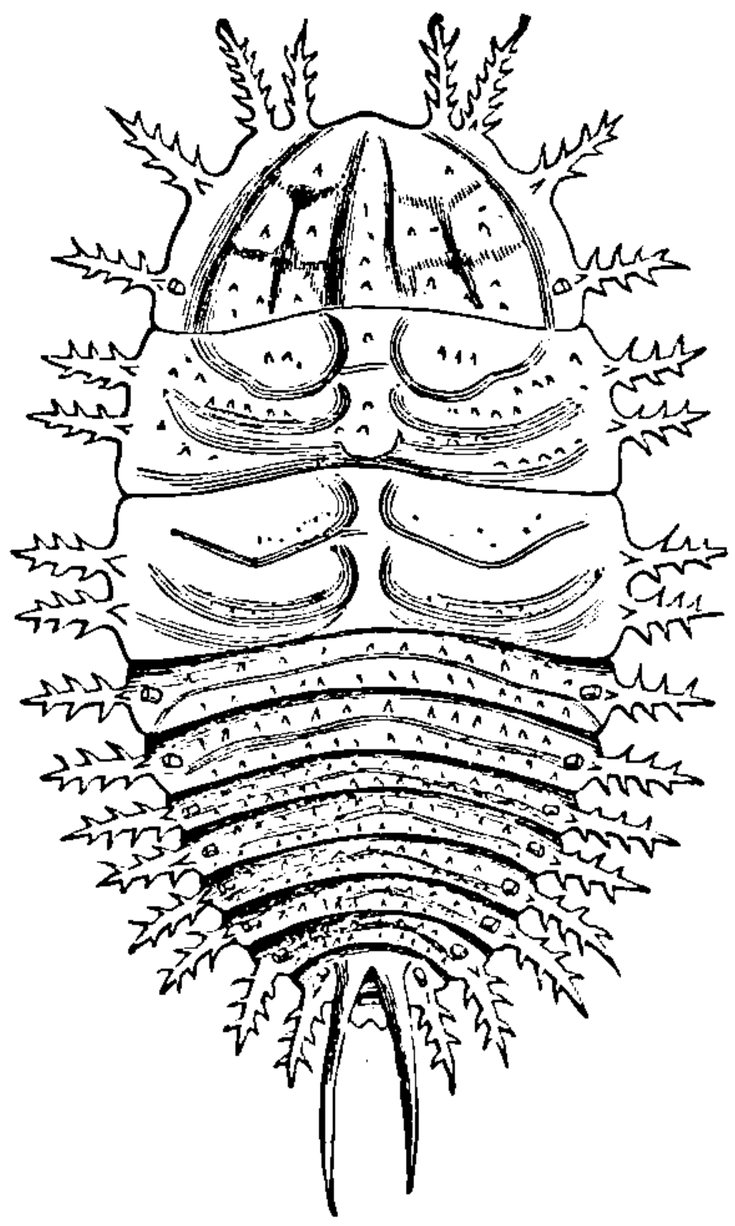
Professor Babington of Cambridge found many specimens of the *Macroplea Zosteræ* amidst a dense mass of leaves and stalks of the pectinated leaved pond-weed, *Potamogeton pectinatus.* They were always under the water.

FAMILY—CASSIDIDÆ (*The Tortoise Beetles*).

A very extensive family of Beetles, with highly-developed elytra—(see figure of the curiously perforated *Selenis spinifex*, Coleoptera, Plate 3, fig. 14). It is a native of South America. See also figs. 12 and 13 of the same plate, where is figured a Tortoise beetle, named kindly after the writer by Professor Boheman of Stockholm *Prioptera Whitëi.* Fig. 12 represents the perfect insect and its antennæ, while fig. 13 is, as I believe, that of its larva just changing into the pupa, drawn from a specimen sent home by Mr. Fortune. In this country we occasionally find, on thistles, green species of *Cassida* very common.

Many of the exotic species—such as the species of the genera *Aspidimorpha* and *Coptocycla*, which in cabinets are dull yellow, with cruciform brown marks, or dotted and circled or half-circled with black—when alive have the most glorious vivid golden hues pervading them.

Fig. 136.



Larva of Cassida rubiginosa.

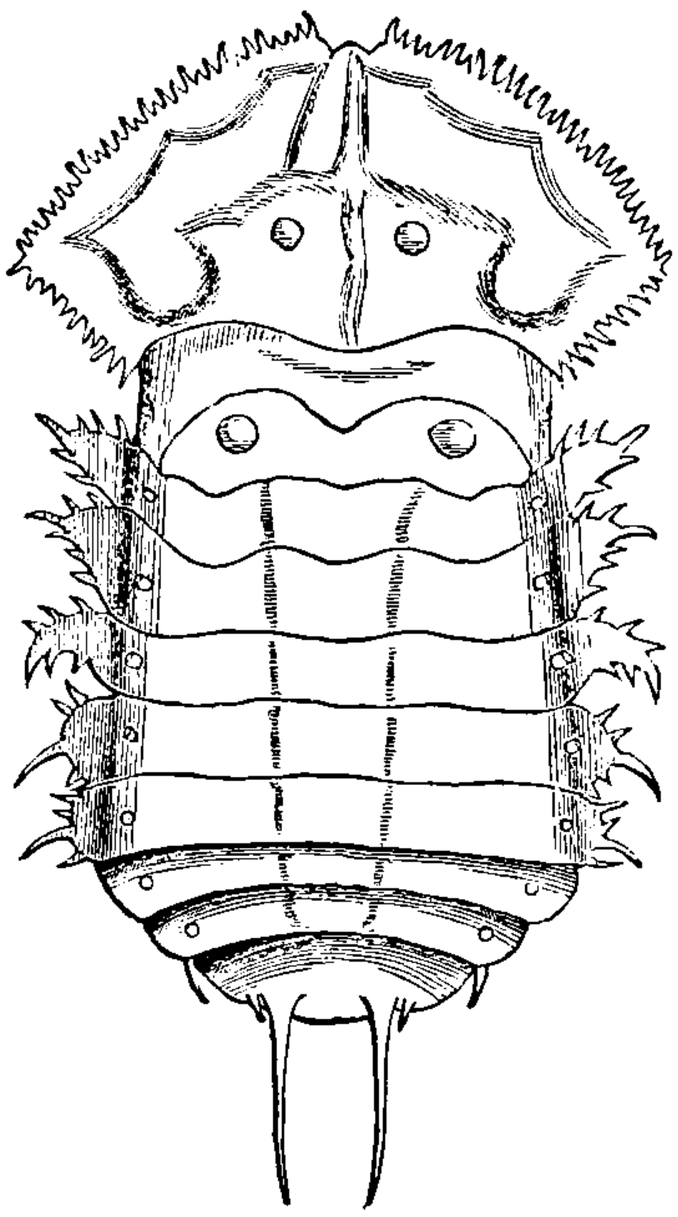
Mr. Smith kept a specimen of the *Aspidimorpha sanctæ crucis* alive for several weeks, the common Indian species from Bombay, and most gloriously deco-

rated it was with golden hues, which before death became bronzy. Some of the Hong Kong species are most beautifully marked, and so are the Ceylonese, as the rare *Coptocycla Balyi.*

Coptocycla is a very extensive and beautiful genus, generally small and mostly from the New World. They retain their hues in alcohol.

The larvæ of the Tortoise beetles shelter themselves under an umbrella of their own excrement, and this covering they can elevate or depress in such a way as to shade or shelter them more or less effectually. They effect this by means of a forked instrument, which Kirby has called a *fœcifurk.* On this they place the excrementitious matter. It is sometimes turned up and lies flat on the back; sometimes it forms an acute, sometimes a blunt angle, with the body; at others, is unbent and in the same direction with it. Figs. 136, 137, show the larva and pupa of a Cassida, copied from the

Fig. 137



Pupa of Cassida rubiginosa.

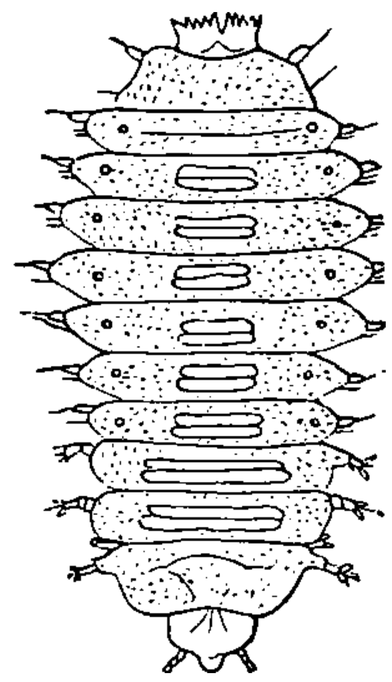
Stettin Entomological Society's journal. The excrementitious matter is sometimes formed into very long branching filaments, as in the *Calopepla Leayana*, a species of the family found in India, in which this stercoraceous parasol, as observed by the late General Hardwicke, much resembles a dried sea-weed or lichen.

FAMILY—HISPIDÆ.

The larvæ of these are, in some respects, related to the wood-feeding larvæ of the Longicorn beetles, whilst in habits they resemble those of the leaf-mining caterpillars of certain moths. The late Professor T. W. Harris of the United States first recorded this. Want of space forbids me entering any further on the group.

The cut (fig. 138) represents the larva of *Hispa testacea*, discovered by Mr. Perris abundantly on the *Cistus salvifolius*, a plant growing on the sandy heaps

Fig. 138.



Larva of Hispa testacea.

of the Landes of France. He found that the larva lives on the parenchyma of the leaves, without attacking the epidermis.

FAMILY—GALERUCIDÆ.

This is a most extensive family of insects; many of them are beautifully coloured, and have remarkable antennæ.

Fred. Val. Melsheimer, minister of Hanover, York county, who published a catalogue of the insects of Pennsylvania in 1806, states that the Cucumber fly is "the pest of gardens," and is destroyed or driven off by tar and sulphur.

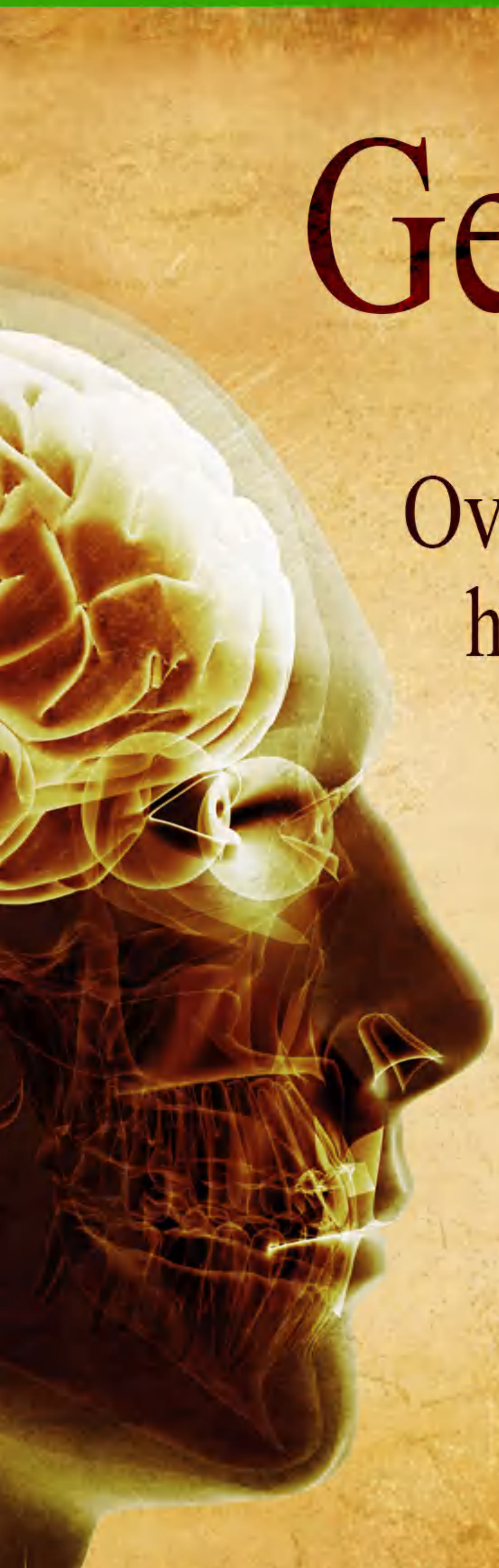
Our turnips are subject to the attacks of several insects; few are so destructive to these crops as the little jumping beetles (*Haltica Nemorum*), called by farmers "the fly" and "black jack." Kirby and Spence record that in one year in Devonshire these insects did damage to the turnip crops, which was estimated at £100,000.

FAMILY—CHRYSOMELIDÆ.

A very extensive family of generally brilliant green, blue, or bronzed beetles. I remember a fine species, very common on plants at the foot of Salisbury Craigs, striking the attention of a youthful collector of insects in 1833.

The larvæ are six-legged, with also an anal leg. On heaths and commons you may often meet with a small convex black beetle "crawling solemnly about." This beetle (*Timarcha coriaria*) is about the third of an inch in length, and in its larva state is exclusively a vegetable feeder. There is another species found in this country which is of larger size, and being smoother than the other, is named *Timarcha lævigata.* Both species, if you take them up, in self-defence exude a red-coloured liquid from their mouth, whence they have obtained the vulgar, but very characteristic name, of "bloody-nosed beetles."

On Plate 4, fig. 6, is figured the *Australica Curtisii,*



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duction" the occurrence is thus mentioned: "One morning I observed on my study window a little Lady-bird, yellow, with black dots (*Coccinella punctata*). 'You are very pretty,' said I to myself, 'and I should like to have a collection of such creatures.' Immediately I seized my prey, and not knowing how to destroy it, I immersed it in geneva. After leaving it in this situation a day and a night, and seeing it without motion, I concluded it was dead, and laid it in the sun to dry. It no sooner, however, felt the warmth than it began to move, and afterwards flew away. From this time I began to attend to insects."*

CONSPECTUS OF EUROPEAN GENERA OF LADY-BIRDS (from Thomson's *Coleoptera of Sweden*).

Family COCCINELLIDÆ. Maxillary palpi with the last joint securiform; all the coxæ subtransverse, not much exserted; thorax closely applied to the elytra; elytra not striated.

SECT. I. *Forehead, before the eyes, dilated, covering the base of the antennæ; mandibles concealed.*

Genus *Chilocorus*, Leach (type *C. renipustulatus*, Scriba).—Clypeus notched at the tip; labrum distinct; tibiæ before the middle armed with a little tooth.

Genus *Exochomus*, Redt (type *E. 4-pustulatus*, Linn.)—Tibiæ unarmed.

Genus *Platynaspis*, Redt (type *P. villosa*, Muls.)—Labrum concealed; body above pubescent.

SECT. 2. *Forehead not flattened out before the eyes; antennæ free at the base.*

DIV. 1. *Mandibles free at the tip, extending beyond the transversely linear labrum; body semi-globose, above pubescent; tibiæ with obsolete spurs; antennæ not contiguous to the eyes; forehead in front of the eyes notched.*

Genus *Epilachna*, Redt (type *E. globosa*, Schneider).—Claws of the tarsi bifid; body winged.

Genus *Cynegetis*, Redt (type *C. impunctata*, Linn.)—Claws with a basal tooth; epipleura of the elytra behind the posterior coxæ, with a fovea receiving the tip of the femora.

DIV. 2. *Mandibles concealed.*

Phal. 1. *Eyes entire, rounded; body very often pubescent above; pygidium often exposed; tibiæ with obsolete spurs.*

Genus *Rhizobius*, Steph. (type *R. litura*, Fabr.)—Prosternum keeled in front; antennæ nearly of the length of the thorax; thorax narrowed towards the tip.

Genus *Coccidula*, Kug. (type *C. rufa*, Herbst.).—Thorax at the base narrower than the elytra, with the posterior angles right-angled.

Genus *Scymnus*, Kug. (type *S. ater*, Kug.)—Antennæ shorter than the thorax; elytra with humeral tubercles; pygidium exposed.

Genus *Hyperaspis*, Redt (type *H. reppensis*, Herbst).—Body above rather smooth; elytra without any humeral tubercle.

Phal. 2. *Eyes in front somewhat notched; body above smooth.*

Genus *Hippodamia*, Muls. (type *H. 13-punctata*, Linn.)—Posterior coxæ little distant; metasternum triangularly cut out behind; femora extending beyond the margin of the elytra.

Genus *Coccinella*, L. (type *C. 7-punctata*, Linn.)—Posterior coxæ widely distant; metasternum behind slightly notched.

Genus *Halyzia*, Muls. (type *H. ocellata*, Linn.)—Prosternum in front tuberculated; mesosternum in front slightly notched: tibiæ with obsolete spurs.

Genus *Micraspis*, Redt (type *M. 12-punctata*, Linn.)—Scutellum scarcely conspicuous; labrum transversely linear.

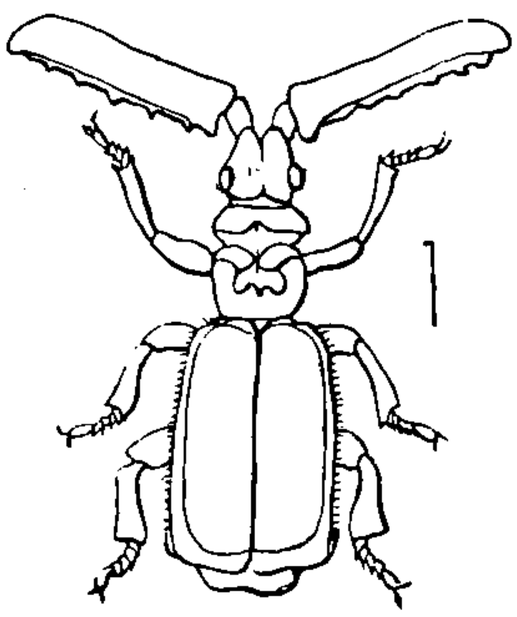
* Introduction—ii., p. 187.

I come now to a family of doubtful position, but with pentamerous tarsi. I place them here provisionally:—

FAMILY—PAUSSIDÆ.

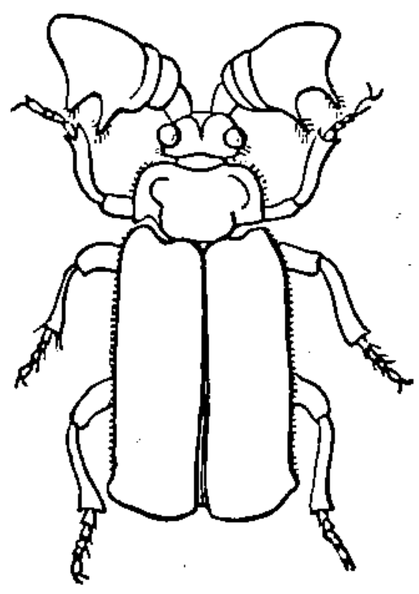
The PAUSSIDÆ are a family of beetles of rare beauty in the eyes of an entomologist. The Paussidæ have strange, swollen antennæ, and truncated elytra, while their thorax is often curiously grooved and knotted. Professor Adam Afzelius of Sierra Leone, shortly after it was founded, was sitting one evening in January, 1796, when, having just lighted his candle and taken up his pen, he remarks, "I observed something dropping down from the ceiling before me upon the table. It remained for a little while quite immovable, as if stunned or frightened, but soon began to crawl very slowly and steadily." The insect he afterwards described as *Paussus sphærocerus*, and a curious creature it is, with a light reddish-brown body and legs, and a strange white ball or berry at the end of each antennæ.

Fig. 140.



Paussus Latreillei.

Fig. 141.

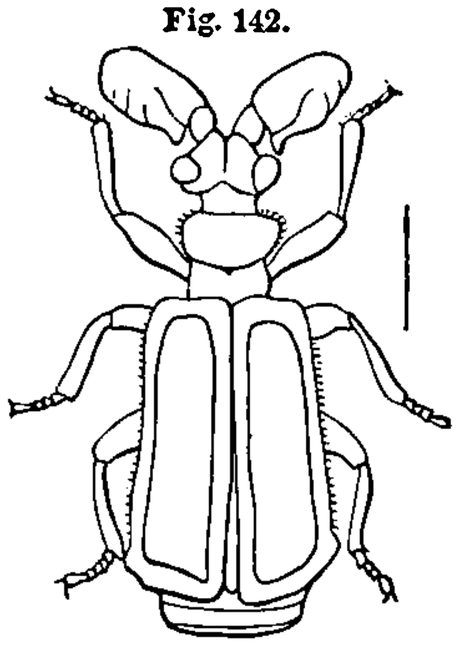


Platyrhopalus aplustrifer.

He took none after February, and before that several flew into the candle, so that he concluded it was nocturnal. Our two figures (figs. 140 and 141) represent *Paussus Latreillei* from Sierra Leone, and *Platyrhopalus aplustrifer* from Bengal.

From Mr. Westwood's well illustrated monograph in the "Arcana Entomologica," our figures of the Paussidæ are derived.

Fig. 142.



Paussus Hearselanus.

As my friend Major-general Sir John Hearsey, when colonel in the East India Company's service, was inspecting some invalid troops in India, he noticed a *Paussus* on the jacket of one of the Sepoys and went up and secured it. Westwood named the species after him, *Paussus Hearseianus;* it is reddish-brown, with a broad black stripe down each elytron, and is not rare, apparently, at Sultanpore, near Benares. Fig. 142 shows this species.*

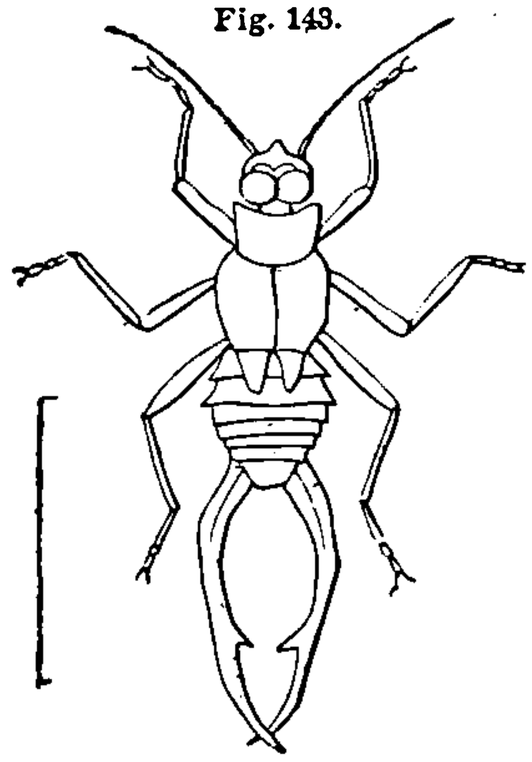
* Westwood, Arcana Entomologica, p. 189.

Dr. Burmeister first showed that the PAUSSIDÆ were allied to the *Carabidæ* in the structure of their mouth and wings, such as the arrangement of the nervures and their way of folding them; and one group containing *Ozæna*, interesting beetles from the New World, with curious elytra with a boss at one end, closely resemble some of them. Professor Lacordaire* brings them in between the Palpicorns and Brachelytra.

SUB-ORDER—EUPLEXOPTERA.

THERE is a large number of species of this sub-order as yet included in one family, that of the Earwigs or FORFICULIDÆ. These insects have a considerable resemblance to the Rove Beetles or staphylinidous Coleoptera. Fig. 143 is the representation of an Eastern island species named *Forficula brachynota*. Their first or elytroid wings are leathery and very short, and have a strait suture. They are large enough nearly to cover up the very delicate hind wings, which are ample, and have many radiating nerves which act as the ribs of a fan, and besides their longitudinal, have transverse, crumpled folds. It is seldom that you see the earwig fly, except the little species, which I have seen not uncommonly using its wings. The mouth has transverse jaws; they are short but strong, while "the maxillæ are elongated, the inner lobe being armed with small spines at the inner margin; the outer lobe forms a small galea or sheath." The abdomen ends in a pair of caudal pincers—(Plate 5, fig. 1, *Forficula auricularia*). These insects, called *earwigs* by us, *perce-oreille* by the French, and *öhrenwurm* by the Germans, are disliked everywhere. Their specific name, as well as their vulgar names in the European languages are derived from the fallacious opinion that they are specially addicted to creeping into the ears of people. They live chiefly on the petals of flowers, and eat fruit and other vegetable substances.

Fig. 143.



Forficula brachynota.

The Rev. Hamlet Clark found many fine species in Brazil. Mr. Cuming brought some remarkable species from the Philippine Islands. There are seven British species of Earwig arranged in four genera—*Labidura*, *Labia*, *Forficula*, and *Apterygida*.

ORDER—ORTHOPTERA.

A VERY striking order of insects, most of which are large, and none of which, unless the Perlæ be orthopterous, are known to be aquatic. The fore wings or tegmina are of a leathery consistence, large, and often veined thickly like leaves, and overlap at the tip.

Their name *Orthoptera*, or Straightwings, is derived from the large hinder wings, which are beautifully netted with longitudinal and transverse reticulations, and fold straight like a fan. The antennæ are generally long and of many joints. The mandibles are strong and much toothed, the teeth on one side fitting into holes on the other.

The maxillæ have a dilated outer lobe or galea.

The anus is often furnished with short appendages. The larvæ very much resemble the perfect insects, except that they are smaller and have no wings.

Many of the Orthoptera are eaten by man. In Australia, for example, the aborigines sometimes feast on the large species which form so remarkable a feature of the fauna of that country. Over the whole of Africa, and in some parts of the East, the inhabitants find occasionally fattening supplies in the countless flocks of locusts.

SECTION—CURSORIA.

These insects are so called from their well-developed running legs.

FAMILY—BLATTIDÆ (*Cockroaches*).

Some of the BLATTIDÆ are of great size, especially the South American and West Indian species. Some of the Eastern kinds are large and repulsive-looking. Several of the Australian species are apterous, such as the prettily marked *Blatta pulchripes* described by the writer in the appendix to Captain (now Governor) Grey's narrative. The species of *Phoraspis* are often elegantly coloured or striped with red or yellow; they are found on plants in blossom.

One genus of *Blattidæ* can roll itself into a ball, another is long and narrow and apterous.

Their eggs are very curious, being in a large horny case, open at one side.

On Plate 5, fig. 2 is figured *Blatta Lapponica*, a species which sometimes abounds in the huts of the Laplanders to such an extent, as to destroy great quantities of their provisions.

The COMMON COCKROACH of the kitchen (*Blatta orientalis*), commonly called "the Black Beetle," is much relished by the hedgehog, and this spine-covered animal is sometimes kept in kitchens to reduce their numbers. Mr. Newman announces that the cockroach seeks with diligence the bed bug and devours it. For this purpose it is known to climb up the curtains of

* Coleopteresii, p. 1; 1854.

beds and to run along the testers in pursuit of that disagreeable creature.

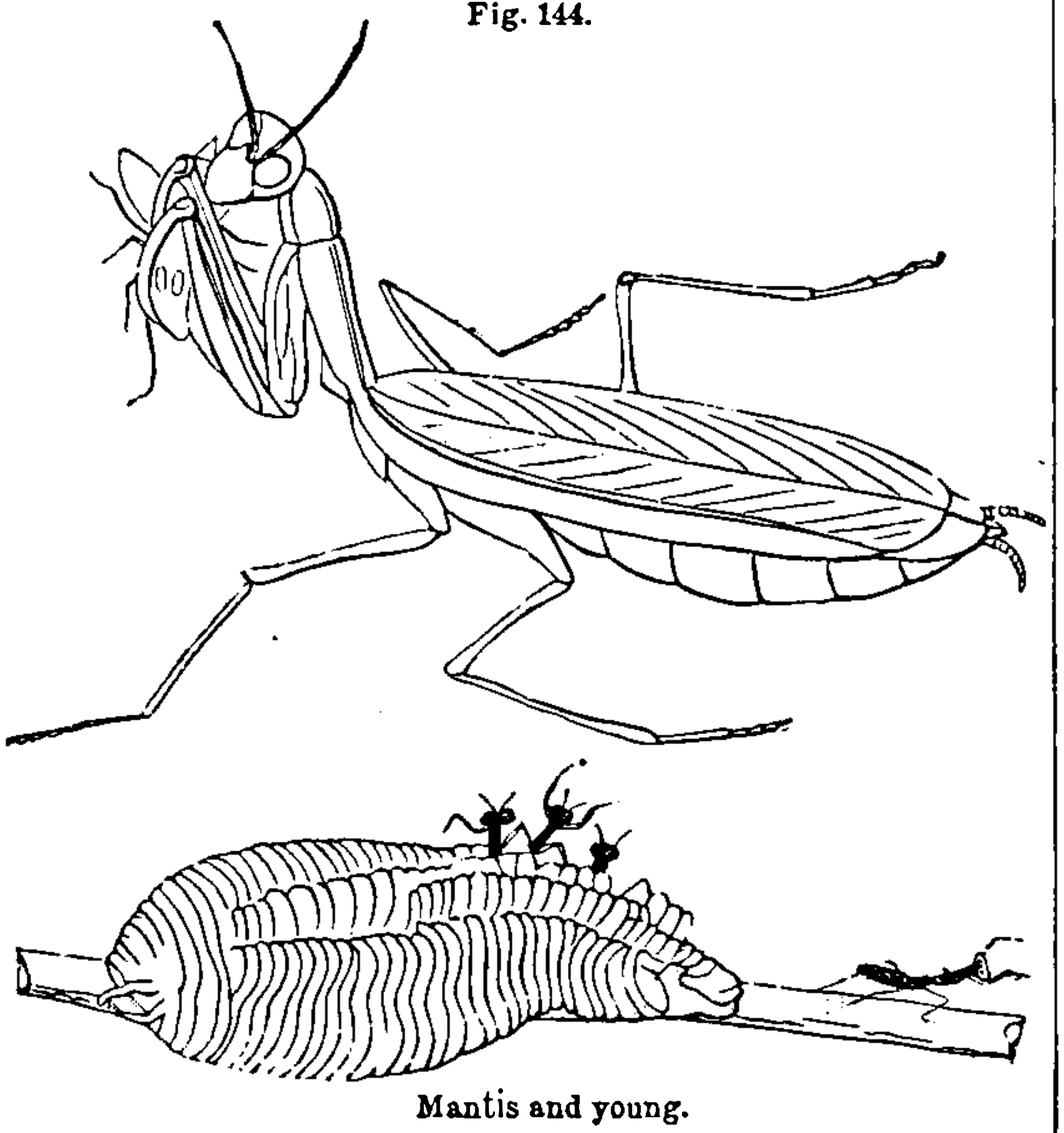
In the British islands we have eight or nine recorded species of *Blattidæ*. Several of these, however, have been introduced, and two or three of them have not become indigenous. For instance, the *Blaberus giganteus* and *Panchlora maderæ* are only occasionally seen about our dockyards.

Tschudi describes two Cockroaches he met with in Peru* as being exceedingly numerous and troublesome. They are well known there, and are named *Cucaracha* and *Chilicabra*. The former is found more particularly in the deep regions of the forest. It is an inch and a half long, is reddish-brown, and has a yellow thorax. The *Chilicabra*, though smaller, is much more numerous and mischievous. They get into the huts of the natives, where they destroy provisions, &c. It is impossible to resist their tormenting attacks. A small reddish-yellow ant called *Pucchusisi* by the Indians, pursues and destroys them. A very elegant little bird, like our wren, and described by Tschudi under the name of *Troglodytes audax*, wages war against these cockroaches. The Indians find the sound to resemble closely the words "*Acabe la tarea*," which in their language means "My task is finished;" indeed, they have given this name to the Troglodytes as a mark of their observation of its usefulness in destroying the cockroaches.

SECTION—RAPTORIA.

Of this section there is but one family. The raptorial legs of the insect sufficiently distinguish the section.

Fig. 144.



Mantis and young.

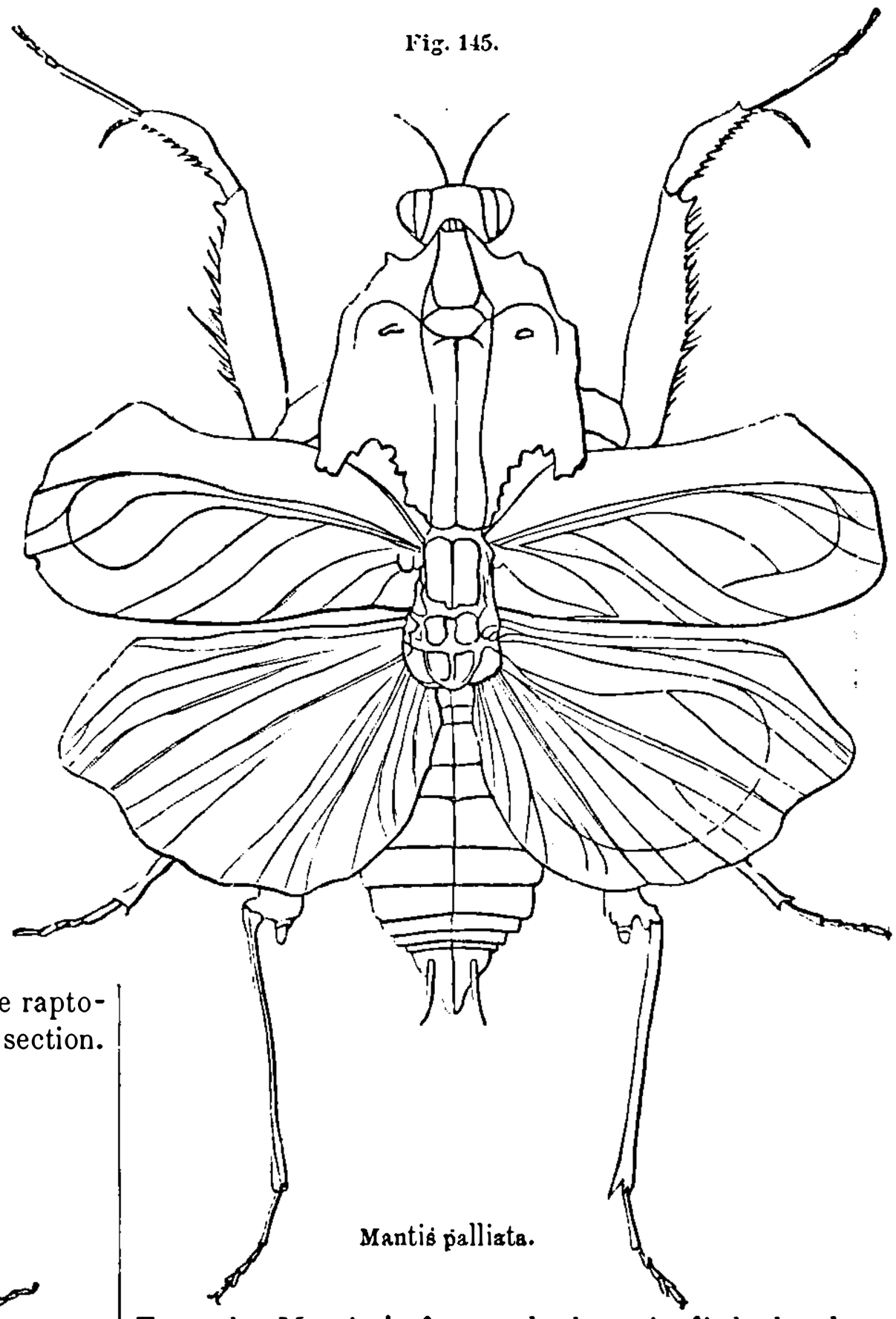
Fig. 144, copied from Rösel, shows the Mantis eating its prey, and a case of the eggs with the young coming out.

* Travels in Peru, translated by T. Ross, p. 439.

FAMILY—MANTIDÆ (*Soothsayers*).

The Mantidæ are most frequently of a green colour which, as they hang on the trees watching for their prey, so closely resemble foliage that it is difficult at times to distinguish them from the leaves. In the East, the Mantis is frequently kept in little bamboo cages, and two are placed together by the natives, as they are very pugnacious, and cut at each other with their formidable fore feet. Fig. 4, Plate 5, represents the *Mantis religiosa* in profile.

Fig. 145.

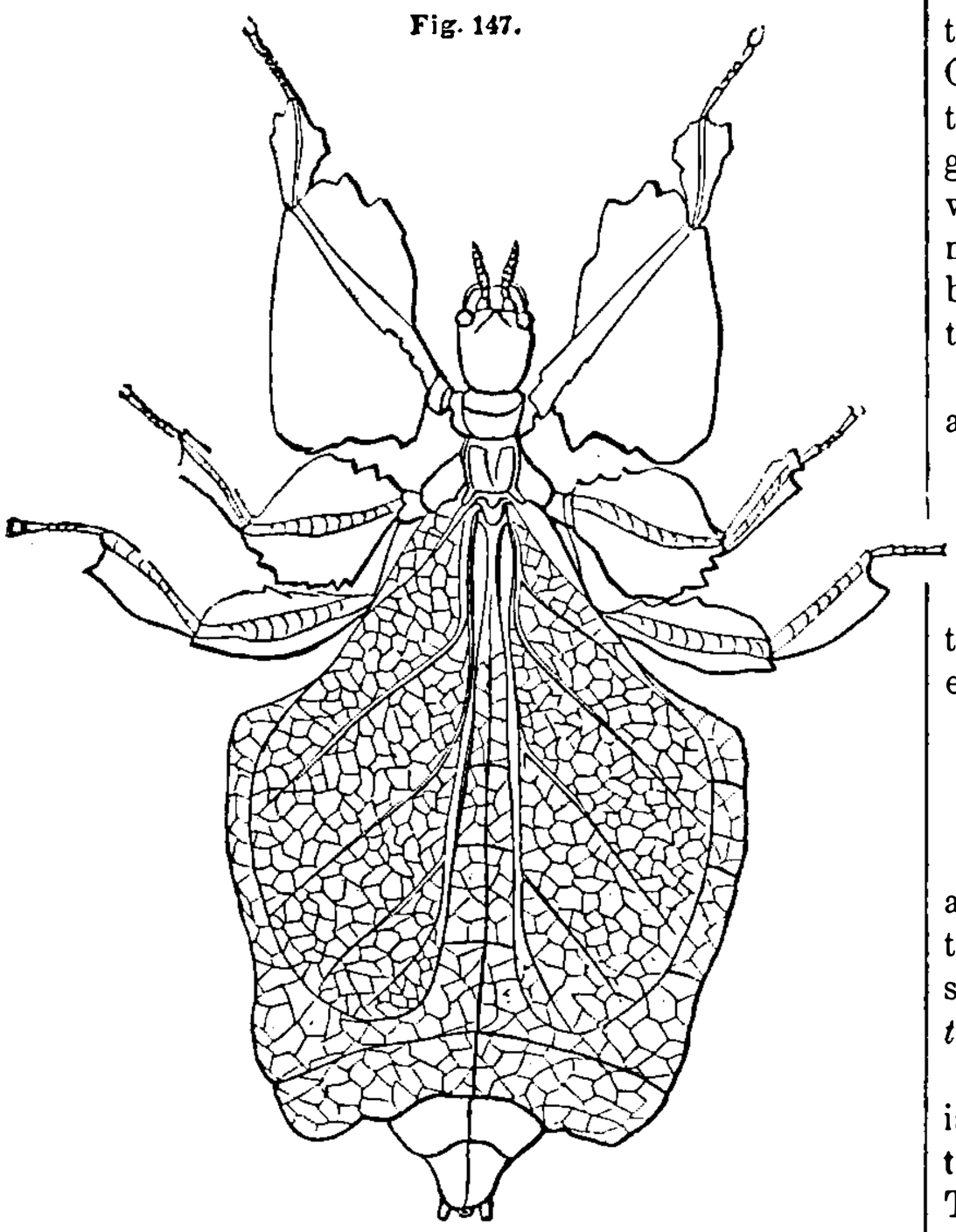


Mantis palliata.

Roland Trimen, Esq., in an interesting letter from Cape Town, dated July 18th, 1860, thus records the history of the oviposition of a Mantis which he took in May. During the two months it constructed four nests of eggs, at intervals of about a fortnight. He says—"I had the pleasure of seeing her construct one of these, and was rather surprised at her method of proceeding. I used to fancy that the eggs were arranged first, and the structure coated over with cement afterwards, but I found this to be a great mistake." The species he describes is grass-green; has scarlet jaws, and the fore tibiæ and tarsi are yellow; a band along the abdomen, crimson and white. He adds—"The nest is constructed all in a mass, that is to say, the eggs as they emerge are completely embedded in a frothy cement so as to be invisible. The emission of

pulchrifolium (fig. 147) from the islands of Borneo and Sumatra, which are nearly as large as little continents. The antennæ of the Leaf-insect, in the sex figured, are short; in the male they are very long. The female is

Fig. 147.



Phyllium pulchrifolium.

wingless—at least has only the upper wing-cover, while the male has short wing-covers and large light wings, like gauze, adapting him the better for a roving wanderer.

These Leaf-insects are said to have formed articles of traffic at one time. The poor inhabitants of the Sychelles islands reared them, and sold them as curiosities to sailors. Some twenty-three years ago they were very rare, but the arrival of boxes of insects from Silhet and other mountainous parts of our Indian possessions made us familiar with them. We are indebted to a lady, Mrs. Major Blackwood, for having enabled scientific men to rear a specimen of the Leaf-insect in this country.

Mrs. Major Blackwood was struck with the economy of the Leaf-insect (*Phyllium Scythe*—G. R. Gray) in Assam, and twice tried to introduce the singular insect into her native country, but without success. A third attempt, however, succeeded; the eggs were forwarded to Edinburgh in the spring of 1854, and, by keeping a very careful watch over them, this enterprising lady-naturalist was delighted to find that two of her nurselings emerged from their ribbed seed-like eggs—one on the 9th, and a second on the 10th of May. A few came out every week till the end of May, when the cold weather, so common and so suddenly intervening in this country at that fine time of year, retarded the egress of the unhatched eggs. In the beginning of the "leafy month of June," the Leaf-insect bantlings came out in great numbers. Mrs. M'Nab, when the little creatures were hatched, tried them with a Fusehia; but Asiatic insects were not likely to care for an American plant, belonging, too, to a very different order of the vegetable kingdom to that on which they lived. Our excellent friend tried the common Myrtle, and on this it stayed; for the insect never sought to leave the glossy-leaved sweet shrub till it was full-grown and winged. On this shrub many a one saw it and admired it. When the wings were developed, a muslin bell-shaped cover was placed over the plant to prevent the little insect from flying away.

Mr. Arthur Adams observed a Phyllium in Java, and mentions that it feeds on the foliage of the Guava.

SECTION—SALTATORIA.

Insects with elongated hind legs, which enable them to leap. Our Cricket and Grasshopper are familiar examples.

FAMILY—ACHETIDÆ.

In this family the antennæ are very long and slender, although in *Tridactylus paradoxus* (Plate 5, fig. 3) these organs are not long. There are only six British species, contained in four genera, *Gryllotalpa*, *Œcanthus*.

The genus *Cylindrodes*, figured by Mr. G. R. Gray, is a singular long parallel insect of Australia, with the two bind pairs of legs situated above the usual plane. This enables the insect to keep hold in the reeds or stems in which, though a Mole-cricket, it lives. The *Cylindrodes Campbelliæ* is a native of Australia.

There is an insect not uncommon in England, and particularly abundant about Aldershott in Hampshire; and yet so well does it keep to its place, which is the earth, into which it burrows like a mole, that the MOLE-CRICKET (*Gryllotalpa vulgaris*—Plate 5, fig. 7), when found above ground, excites surprise.

FIELD-CRICKET (*Acheta campestris*).—The reader who is not familiar with the delightful and instructive account of this insect given by Gilbert White, in one of his letters to the Hon. Daines Barrington, will be glad to have it in the very words of the author of the charming "Natural History of Selborne." In that part of Hampshire they abound in a steep, abrupt pasture-field interspersed with furze, consisting of a rocky, dry soil, and inclining to the afternoon sun. White, attracted by their cheerful summer cry, often went down to the Short Lithe, as they call this field at the back of his village, to study their mode of life; but they are," he adds, "so shy and cautious that it is no easy matter to get a sight of them; for, feeling a person's footsteps as he advances, they stop short in the midst of their song, and retire backward nimbly into their burrows, where they lurk till all suspicion of danger is over. At first we attempted to dig them out with a spade, but without any great success; for either we could not get to the bottom of the hole, which often terminated under a great stone, or else in breaking up the ground we inadvertently squeezed the poor insect

to death. Out of one so bruised we took a multitude of eggs, which were long and narrow, of a yellow colour, and covered with a very tough skin. Where violent methods will not avail, more gentle means will often succeed, and so it proved in the present case; for though a spade be too boisterous and rough an implement, a pliant stalk of grass, gently insinuated into the caverns, will probe their windings to the bottom, and quickly bring out the inhabitant; and thus the humane inquirer may gratify his curiosity without injuring the object of it. It is remarkable that, though these insects are furnished with long legs behind, and brawny thighs for leaping, like grasshoppers, yet when driven from their holes they show no activity, but crawl along in a shiftless manner, so as easily to be taken; and again, though provided with a curious apparatus of wings, yet they never exert them when there seems to be the greatest occasion. The males only make that shrilling noise, perhaps out of rivalry and emulation, as is the case with many animals which exert some sprightly note during their breeding time; it is raised by a brisk friction of one wing against the other. They are solitary beings, living singly, male or female, each as it may happen; but there must be a time when the sexes have some intercourse, and then the wings may be useful, perhaps during the hours of night. When the males meet they will fight fiercely, as I found by some which I put into the crevices of a dry stone wall, where I should have been glad to have made them settle; for though they seemed distressed by being taken out of their knowledge, yet the first that got possession of the chinks would seize on any that were obtruded upon them, with a vast row of serrated fangs. With their strong jaws, toothed like the shears of a lobster's claws, they perforate and round their curious regular cells, having no fore claws to dig, like the Mole-cricket."

They never offer to defend themselves when taken up in the hand, although they have such formidable jaws. They eat indiscriminately of such plants as grow near their holes, and White observed that they dropped their dung on a little platform close at hand. In the day-time they seem to keep close to their homes, never stirring more than two or three inches from them. They chirp all night and day at the entrance of these burrows from the middle of May to the middle of July, and are particularly vigorous in hot weather, making the hills echo with their noise.

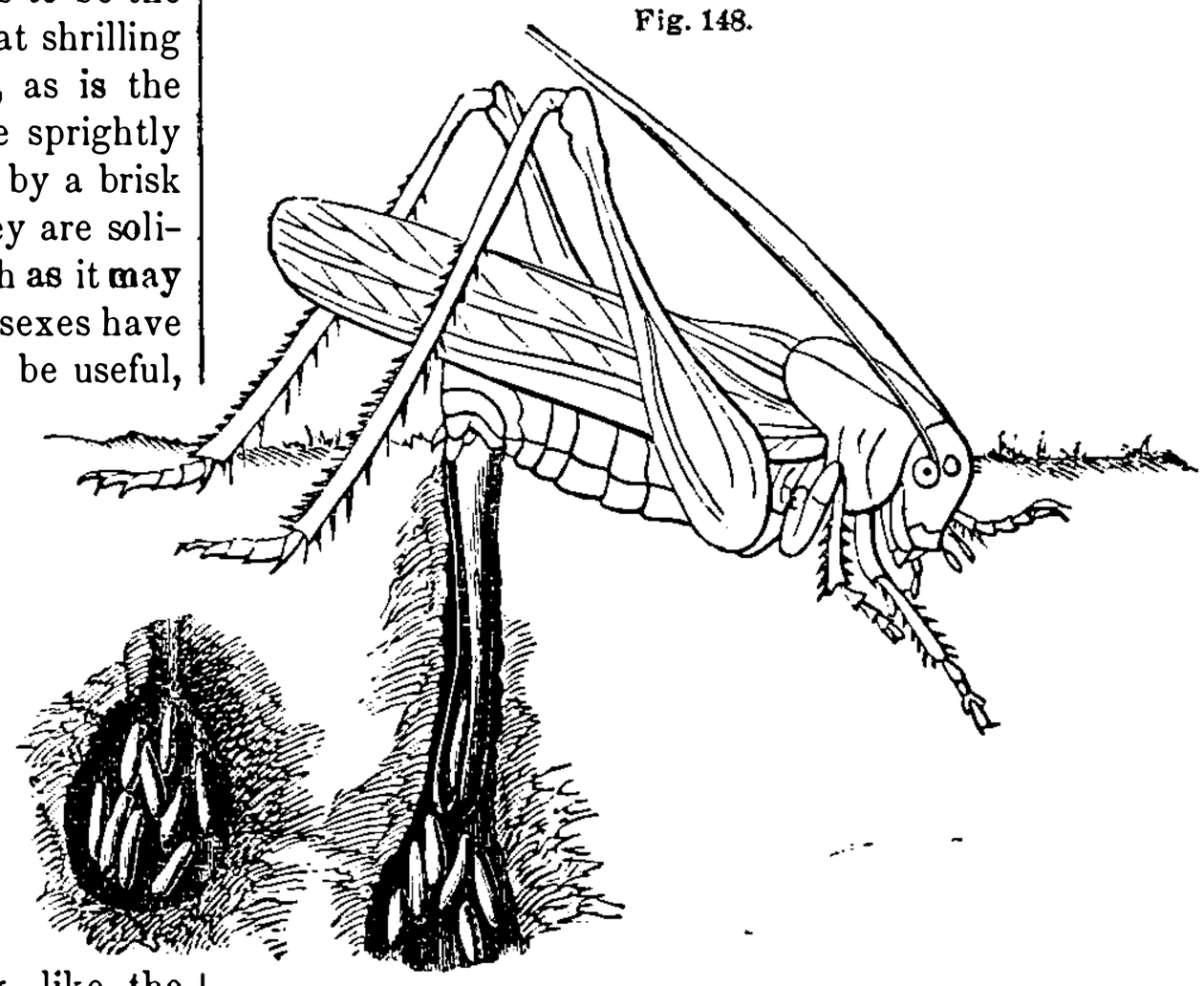
THE HOUSE CRICKET (*Acheta domestica*). Many who are not troubled with this insect, fancy that it is lucky to have them in a house; and where there are only two or three, there is certainly something cheerful in the sound of "the cricket on the hearth." They are of a pale colour, and are particularly fond of warmth, preferring kitchens and bakers' ovens. As would be inferred, they are a thirsty race, like the black beetles; and where they abound, many may be taken by leaving on the floor shallow pans of water, or other fluid. At times they increase to such a degree as to become a perfect nuisance; flying to the lights, and dashing into people's faces.

Acheta Smeathmanni. Mr. Smeathman, who made large collections of insects, and observations on their habits, when he resided at Sierra Leone shortly after its formation as a British colony, informed Drury, his correspondent in London, that a species of *Acheta* was used as food. The children there in his time were engaged at the proper season in digging the females of this *Acheta* out of the ground when they were full of eggs. On these they make an agreeable repast. They roast the whole insect, but only eat the eggs, which they deem to be very delicate food.

FAMILY—GRYLLIDÆ.

The insects of this family have very long antennæ, and in the female the ovipositor is very long. Fig.

Fig. 148.



Decticus verrucivorus.

148 represents the female of the *Decticus verrucivorus* depositing her eggs in a hole in the ground. This insect is met with in the south of England, and was so called by the great Swedish naturalist, from a habit of his countrymen in employing it to bite at the warts on their hands. These peasants suppose, and very likely they are right, that the fluid ejected by the Decticus corrodes the warts. I have seen very commouly in the Isle of Wight, and in the borders of Berks and Oxfordshire, the fine large *Phasgonura viridissima*, a big insect, whose bite assuredly is not to be despised.

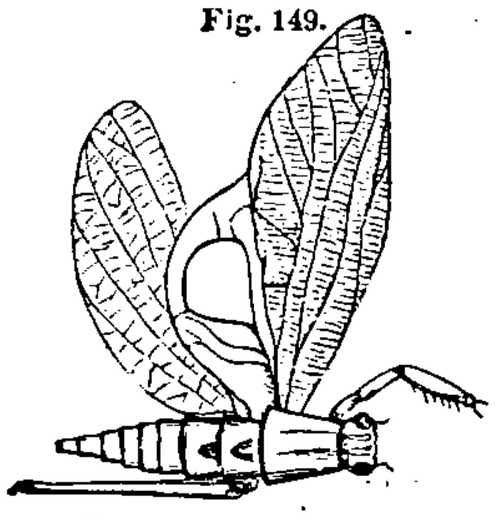
I have described a very large New Zealand Tree cricket, the *Deinacrida heteracantha*. It is a large, strong-jawed, strong spiny-legged creature, whose bite is much dreaded by the Maouries.

There are ten British species, arranged in the genera *Odontura*, *Meconema*, *Xiphidium*, *Phasgonura*, *Thamnotrizon*, *Platycleis*, and *Decticus*. It is, however, in the warmer countries of the world, that these creatures abound. Some of them are very gigantic, especially some from New Guinea and the adjoining islands.

The *Anostostoma*, a genus established by Mr. G. R. Gray, is a most formidable-looking insect. Its

hideous mouth must be capacious enough to hold, and strong enough to destroy, an insect of considerable size.

Fig. 149.



Tympanophora pellucida.

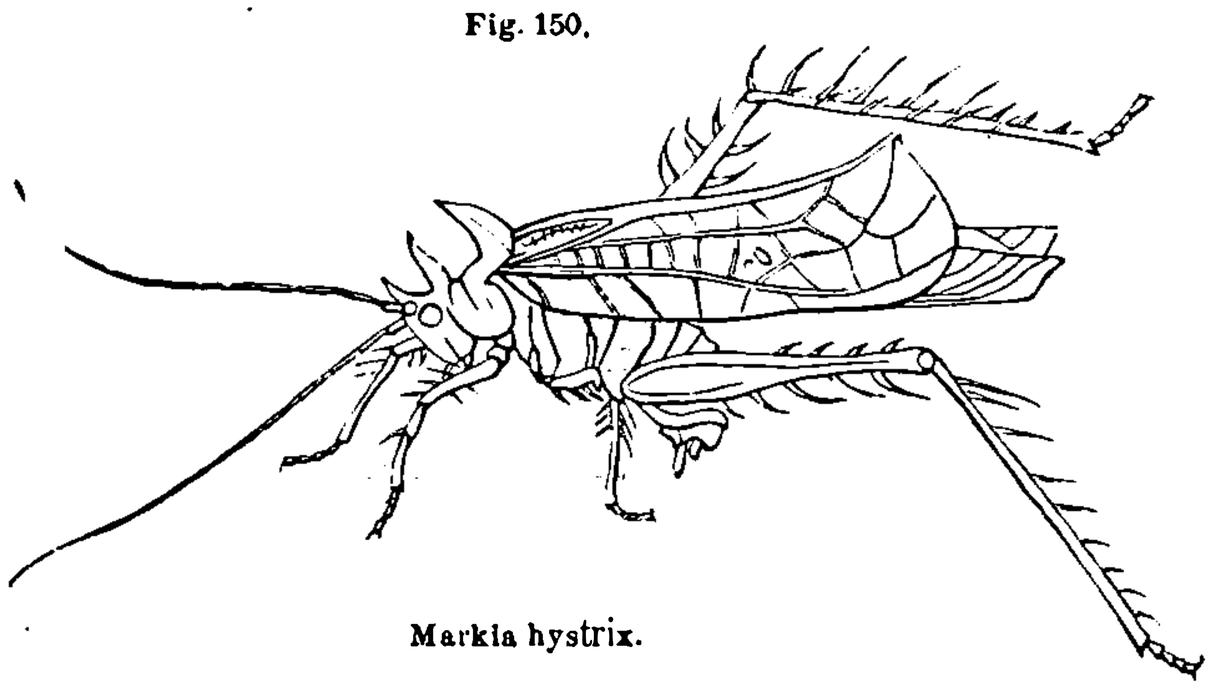
Some, like the *Pterochroza*, where the first pair of wings are sometimes green, sometimes brown, and blotched with red, like leaves in spring, in summer, and in autumn. The delicate greens, purples, violets, and reds of some of them, are most fascinatingly beautiful. The *Acanthodis imperialis* (Plate 5, fig. 5), is also a most handsome creature, varied so finely with black and green; the streaks on its black wings are very curious. It is a native of the mountains of Silbet.

Tympanophora pellucida (fig. 149) is a curious green insect from King George's Sound, described by the writer in Captain (now Governor Sir George) Grey's "Narrative," vol. ii., p. 468.

Fig. 150 is that of the *Markia hystrix*, or *Phaneroptera hystrix* of Westwood—"Arcana Entomologica," vol. ii., pl. 70, fig 2.

I have separated this from Phaneroptera, owing to its general form differing, especially in the erect spine on the head, and the back of prothorax having two spines.

Fig. 150.



Markia hystrix.

The posterior legs are armed within and without with long sharp spines. The fore wings or tegmina are sharp angled on the inner tip. It is a very pretty insect, and says plainly, "Dinna meddle wi' me." I have named it in compliment to Edward W. Mark, Esq.

On the same plate of the "Arcana" Mr. Westwood figures another orthopterous insect with the back of the prothorax saddle-shaped, and with wing-like appendages to the legs which are not spined. He places it in the genus *Phaneroptera*. The ovipositor is short and bent. I propose for this insect and a second species, the generic name of *Dysonia*, the type being *Dysonia albipes* (Westw. spec). The name is out of respect to the memory of my friend, the late Mr. David Dyson, who collected in Venezuela and Honduras, whence he sent and brought back with him magnificent zoological collections. He was attached at the time of his death to the Salford Museum. I hope elsewhere to give detailed descriptions of these and other genera of Orthoptera.

Mr. Gosse in Alabama found the Katydid (*Pterophylla concava*) abundant. They lodge in the trees, and no sooner has the night come than they commence their incessant ringing note, which they do not leave off till the morning light comes in. In the "Letters from Alabama," Mr. Gosse says, "This sound has been heard but a few weeks, beginning, not gradually, but as it were in all places at once, or nearly so, and bursting forth into full and vigorous chorus." He shows that this is caused by these insects attaining their perfect state almost simultaneously. He proceeds—"I think it will give you a pretty correct notion of the tone and character of the particular concert in question, to fancy a score or two of people with shrill voices divided into pairs, each pair squabbling with each other. The organ producing this sound consists of a hard, glassy ridge in front, which, on being crossed by its fellow, creaks sharply, making the crink that is heard in the trees. There must, however, be three distinct but rapid crossings to make the whole sound represented by the word 'Katedid,' which it can produce as quickly as one can pronounce the word. Occasionally it gives but a single impulse, which we may call uttering only one syllable of the word, but usually the three are heard, then an interval of a second, and again the word, and so on. Behind this ridge there is a transparent membrane, which appears tightly stretched over a semicircular rim, like the parchment of a drum, and which no doubt increases the sound by its vibrations."*

To this group of insects belongs the Katydid (*Thliboscelis camelifolia*) of North America, so often mentioned in the poetry of the West.

The gregarious Orthoptera are everywhere dreaded. I have seen a note from Gueinzius, a German naturalist, who collected insects largely in South Africa, complaining sadly of the ravages of a wingless cricket allied to Bradyporus, and which gnawed the insects off his setting-boards—a habit not natural to them surely, and not likely to be acquired from either Bushmen or Hottentots having been in the habit of making insect collections. It indicates that they can eat, like cockroaches, animal as well as vegetable substances.

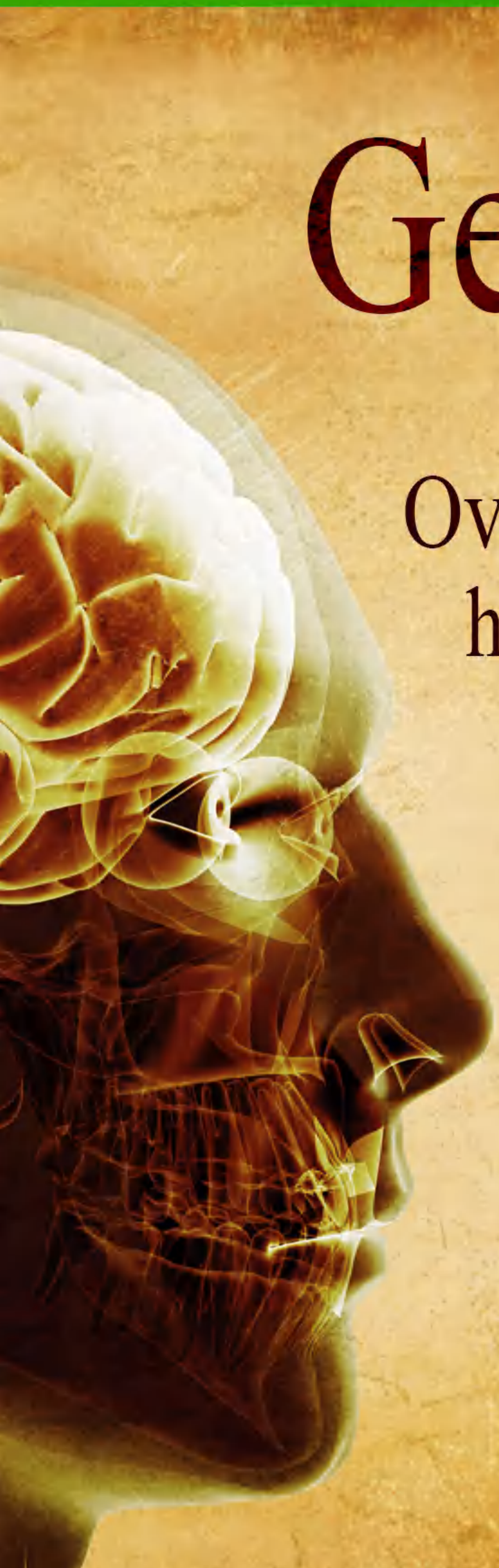
FAMILY—LOCUSTIDÆ (*Grasshoppers and Locusts*).

These insects have not an exserted ovipositor; the first pair of wings or tegmina, and the second, are deflexed, and the antennæ are generally short. Here come our common Grasshoppers.

The Rev. Mr. Methuen during his travels in South Africa,† thus alludes to a swarm of locusts which passed overhead; he describes them as being "thick as the flakes in a snow-storm. Of the myriads contained in the flight, it would be impossible to form any correct estimate; its breadth exceeded my scope of vision, and its passage through the air occupied nearly half an hour, though the insect is a smart-flying one. Stragglers, or deserters from the main army, which with a rushing noise passed swiftly above us, alighted in such abundance as to cover the ground; yet the vast host

* Letters from Alabama, pp. 182–185.

† Life in the Wilderness by Rev. H. H. Methuen, p. 263.



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digging long trenches, two or three feet deep, into which the *Saltones* are driven, *nolentes volentes*. When the trenches are half filled with the young insects, the earth is shovelled back on them and they are buried. Myriads are driven into rivers and drowned.

Every fifty years the Chapulin is said to appear in myriads, and their devastation lasts from five to seven years, when it entirely disappears. There is no doubt that, like other insects, these periodical visits are useful in a moral, and may be in a physical way as well, to the inhabitants. The insect is from two and a half to four inches long, and specimens have been met with five inches in length.

The *Petasida ephippigera* is a grasshopper from North Australia, of a bright brick colour dotted with blue. The thorax is much dilated behind, being projected over the base of the wings somewhat like a saddle; from this circumstance its specific name is derived—*ephippiata*, saddled. The species was first obtained on the voyage of the *Beagle*, when engaged on the survey of the north coast of Australia. At first sight this insect has a strong external resemblance to some of the African grasshoppers, but it belongs to quite a distinct genus, which may be known by the above mentioned character. The insect is nearly two inches long, and is "the grasshopper" referred to at p. 481 of Dr. Leichardt's "Journey."

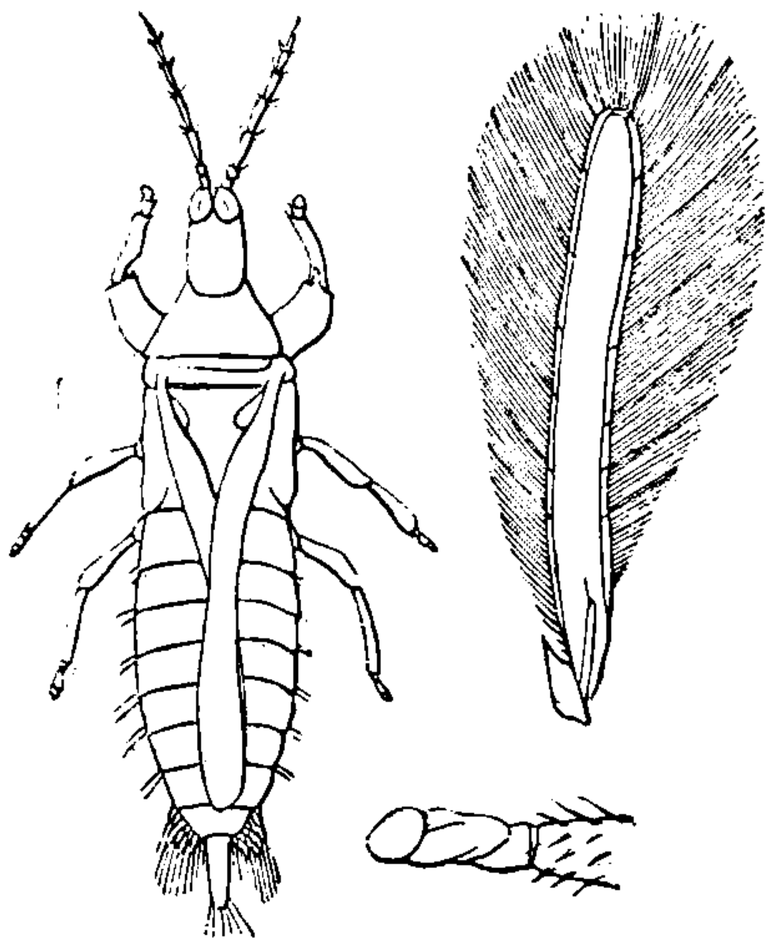
There is figured, in the great work on the Dutch East India Possessions,* a curious insect, the *Chorœtypus gallinaceus*, a native of Sakoembang. It has the thorax, or at least the pronotum part of the thorax, produced as far as the last dorsal joint; its posterior angle is very sharp. In this subgenus the anterior margin of the prosternum does not surround the mouth. A genus where that part does not surround the mouth is named *Hymenotes*.

Fig. 8 of Plate 5 shows the *Acrydium bipunctatum* or *Tettix bipunctata*, in which the prothorax is greatly developed posteriorly. It is a British species. There are twenty-six species recorded as British.

SUB-ORDER—THYSANOPTERA.

THIS order of insects contains a host of minute creatures, which, both in their perfect and larva state, frequent flowers, or live under the bark of trees. They are nearly all of very minute size, very few of them exceeding a line in length. The figure in the margin shows one of these highly magnified. The largest are some Australian species of Idolothrips, one of

Fig. 151.



Thrips, greatly magnified.

which is four lines or more in length. The body is elongated and depressed. The following characters are those of the order:—The wings are generally four, alike, long, narrow, membranous, without reticulations, the edges with long ciliæ; when at rest these wings are laid horizontally along the back. The mouth is situated on the underside, and has two setiform mandibles, two broad adpressed palpigerous maxillæ. The tarsi are two-jointed, and vesiculose at the tip,† and without claws. The antennæ have few joints. De Geer noticed that when the Thrips presses the vesicle of its feet against the surface on which it walks, it expands and appears concave, which led him to imagine that it acted like a cupping glass.

The pupa and propupa, as Mr. Haliday calls the two states the insect passes through after leaving its larva conditions, are slower in their motions than the perfect insects.

The Thysanoptera are found on various plants, some of them being exceedingly injurious, particularly in hot-houses. The leaves of vines and other plants on which they muster are marked with small decayed patches.

One species (*Limothrips cerealium*) infests our wheat crops, and destroys them at times. The Rev. Mr. Kirby described this insect under the name of *Thrips physapus*. It takes up its place between the inner valve of the corolla and the grain, and seems to fix its beak in the bottom of the seed. By extracting the moisture it causes the seed to shrivel up, and become what the farmers call "pungled." This species, it would appear, also gnaws the stems above the knots, and causes the abortion of the ear. In 1805, about a third of the wheat crop in Piedmont is said to have been destroyed by this insect; and in the same year, the same crops suffered much in this country from a similar cause.

In Tuscany, another species of Thrips proves very injurious to the olive-tree. It fixes itself on the under-

* Verhandelingen over de Naturlijke Geschiedens, &c.—Orthoptera, by W. De Haan and Hagenbach; p. 165, Pl. 22, fig. 5.

† Dumeril, from this structure, gave these insects the name of *Physapoda* (Zool. Anal. p. 268). Mr. Haliday, who first characterized the order, gave it the name *Thysanopoda*, but substituted Dumeril's name for it in a synopsis of the order given in Walker's Homopterous Insects, in the collection of the British Museum, p. 1094.

side of the leaves. Passerini describes the Thrips as depositing in the month of April four or five eggs on each bud, and as the insects breed to the end of autumn, their numbers become excessive.

Dr. Harris speaks of the peach-trees in the United States suffering at times severely from the attacks of a species of Thrips. They are found beneath the leaves in little hollows, caused by their irritating punctures.

The following arrangement of the order is derived from Haliday's latest views of the group, published at the end of the Catalogue of Homopterous Insects in the British Museum (part iv.; 1852). Four well filled plates accompany this, which contain figures and dissections, and metamorphoses of the various genera.

Mr. Haliday thus divides them:—

FAMILY I.—TUBULIFERA.

Abdomen furnished with a tubular segment in both sexes, the female without a borer. Antennæ eight-jointed. The insects walk slowly, and do not leap.

Genus *Idolothrips* contains three species, natives of Australia. They are furnished with three ocelli, the anterior of which is distant from the others. One of these (*I. spectrum*) is the largest of the group, being four lines and more long. It is figured on Pl. 5, fig. 10.

Genus *Phlæothrips*; nine species are described, some of which live in flowers, and others in clusters under bark. The ocelli are equidistant.

FAMILY II.—TEREBRANTIA.

The females are furnished with a borer, which is compressed, sharp, and four-valved; it is concealed in a ventral cut of the last segment of the abdomen. The antennæ are generally nine-jointed. The insects of this family leap.

In the first tribe (*Stenoptera*), so called from the slenderness of the wings, the borer of the female is curved inwards.

The genus *Heliothrips* contains one species (*H. hæmorrhoidalis*), which is brown, and has the tip of body reddish. This is the insect often called by nurserymen the "Thrip." It is most destructive in hot-houses, attacking the leaves of plants.

The genus *Sericothrips*, so called from its downy body, contains a very active species (*S. Staphylinus*), often met with in the flowers of the Whin.

In the genus *Thrips* the body is smoothish. Mr. Haliday subdivides this into five sub-genera. One of these (*Aptinothrips*) has not the slightest trace of wings. It was long before he found the male of this insect, and was almost induced to think that, like *Cynips*, the insect might be unisexual. At length, at the season of hay-harvest, he discovered the male, though it is so excessively rare that there is perhaps but one to several hundreds of the female.

The *Limothrips cerealius* and its ravages have been alluded to above.

Of Thrips proper, twenty-three species are described by Mr. Haliday; one of these (*T. urticæ*) he describes as being very partial to yellow flowers, such as the Buttercups, Eschscholtzia, &c.

In the second tribe (*Coleoptrata*) the hemelytra are of the length of the abdomen, and are blunt and coriaceous; hence the name. The borer of the female is recurved.

The genus *Melanthrips*, so called from the deep black colour of the species, has the antennæ with nine distinct joints. In the genus *Æolothrips* there are five joints.

ORDER I.—NEUROPTERA.

THIS is a rather large and important order of four-winged insects, containing the voracious Dragon-flies, with their aquatic larvæ; the curious Ant-lions, the pitfalls of whose larvæ are so interesting; the Lace-winged flies, whose larvæ are so useful in reducing the numbers of plant lice; the strange Scorpion flies, and other families. The following are the leading characters of the order:—The mouth is furnished with transversely movable jaws. The wings, which are four in number, are generally large and beautifully netted with numerous areolets (hence the name *Neuroptera*); the hind pair are very seldom folded, and generally similar to the first pair. The larva has six jointed legs, and the pupa is various in the different families. In some it is quiescent, and has the limbs folded over the breast; in others it is active, and resembles more or less nearly the perfect insect. These insects have no sting, and the body is generally long and slender, and of a soft consistence. Mr. Westwood, taking the transformations as the ground of the distributions of these insects, forms them into two primary divisions:—

DIV. 1.—BIOMORPHOTIC NEUROPTERA.—This division contains the Neuroptera with an active pupa, which undergo what Mr. Macleay has called a subsemi-complete metamorphosis. To this belong the *Psocidæ* and *Termitidæ*, the larvæ of which are terrestrial, and the *Libellulidæ*, *Ephemeridæ*, and *Perlidæ*, which are aquatic in their preparatory states.

DIV. 2.—SUBNECROMORPHOTIC NEUROPTERA.—This second division contains those Neuroptera which have quiescent and incomplete pupæ, acquiring, however, the power of locomotion shortly before they assume the perfect state. This division contains the families of the Ant-lions (*Myrmeleonidæ*), Lace-winged flies (*Hemerobiidæ*), and the *Sialidæ*, *Panorpidæ* or Scorpion flies, *Raphidiidæ*, and *Mantispidæ*.

FAMILY—TERMITIDÆ (*White Ants*).

The White ants have been formed by some authors into a separate sub-order called *Isoptera*, from the wings being of equal size. They form a strange family which has been lately monographed by Dr. Hagen of Königsberg. Each species of these insects is

of three kinds—males, females, and neuters; the males and females are winged, the neuters are apterous. They are oblong, depressed insects in their winged state. The wings easily fall off.

The nests of the Termites are very various in structure. Some build nests in trees as large as a sugar-hogshead, and formed of gnawed fibres of wood cemented with gums; others raise columns over their subterranean galleries, these columns being surmounted by a dome or projecting roof. Such columns and their roofs are formed of clay collected by the larvæ and pupæ; they are full of cells, and many are often found together, looking like a group of gigantic toadstools. The nest of the *Termes bellicosus* consists of two or more conical towers, which soon multiply, and at last they touch each other and become cemented together into a hillock five or six yards high, and nearly as much in diameter. The pyramid of Cheops, one of the loftiest works of man, is four hundred and eighty feet high—that is, about one hundred times the height of a man; while the pyramid of the termes is at least a thousand times higher than the insect.

In the "Travels in Central America during 1843 to 1847," and Plate 2 of it, Count Francis de Castelnau, known to entomologists by his name Laporte, has given a scene on the Serra da Mantiquerra in Brazil, where the nests of the Termites tower over the mules and passing traveller, like columns or boulders; giving as distinctive a character to the landscape, as the immense jointed cactus or the palm trees in the same plate. This species seems to be the *Termes cumulans.*

The *Termes flavicollis* is a large white ant, common in the districts watered by the upper Amazon. Mr. Wallace describes it as inhabiting holes in the earth about the roots of rotten trees. It is much in request with the great ant-eater, *Myrmecophaga jubata*—a great gourmand of ants, as his name implies. The Indians also highly esteem this species as food. Mr. Wallace adds, that the insects are also eaten alive or roasted; but it is not the abdomen in this case which is used, but the enormous head and thorax, which contain a considerable mass of muscular and other matter. To the European these insects are not agreeable, on account of a bitter taste which they generally have; but this taste seems to constitute part of the relish to the Indian when eating them.

Some of the Brazilian White ants form conical hillocks, but not with the broad base and tapering point of the African species. The nests of the Termites are occasionally overturned by the slaves, who scoop out the hollow wider, and use the structure as an oven in which to parch Indian corn.

In cities they are sometimes very destructive—hence every Brazilian lady keeps her fine robes in tin boxes; and each gentleman who pretends to a library must often look at it to see if the *Cupim*, or White ant, has not become a most penetrating reader of his volumes.

Captain Burton, who lately travelled among the lake regions of Central Equatorial Africa, refers to the ant hills of Somaliland forming an important feature in the landscape. He alludes to one species, called by the natives *chhungu mchwa*, as abounding in the sweet red clay soils and in cool wet places, where it acts as scavenger; he adds, "Indeed, without it the country would be rendered impassable."* He found that it avoids heat, sand, and stone. In some districts this species is most destructive. A mud bench will be pierced and drilled by an army of these insects in a single night; and heaps of reeds, placed under bedding, are in a few hours converted into a mass of mud. Captain Burton says that the natives take the largest and fattest kinds of White ants, and after boiling them in water with a little salt, the mess is eaten as a relish with their insipid *ugali* or porridge. He observes that in these districts the White ants seem to have within themselves a cistern of living water: in the driest places they find no difficulty in making a clay paste for their galleries. Writers have explained this by a conjecture, that their Creator has given them vital force to combine the atmospheric oxygen with the hydrogen of their food. Our traveller noticed these insects rising on their wings from the ground in masses, which resembled thin curls of smoke. It was generally at eventide. After flying a few yards the wings drop off.

In the West Indies Mr. Gosse has seen one of the parrots, the yellow-bellied Parroquet, build its nest in the deserted nest of a White ant. Snakes and lizards take refuge in them, and deposit their eggs there. The substance of the nest forms an excellent fuel, as it burns readily, with a flame and glowing brightness little inferior to coal. Mr. Gosse adds, "As no ammoniacal smell proceeds from it, and as it consumes into a clear white ash, I conjecture that the substance is of vegetable origin. It is sought after in those districts and seasons in which the mosquitoes make a more than endurable pest, in order to be burned in a chafing-dish; as it gives out a good deal of smoke, which is the only weapon that those formidable, though minute warriors fear. The smoke clears the house of the insect-hosts in a few seconds, and is much preferable to that of wood, because far less painful to the eyes."†

Swarms of the winged males and females enter the houses in Jamaica in the spring, much to the annoyance of the inmates. They flock to the lights, and cast their wings voluntarily.

Mr. Arthur Adams‡ noticed in Borneo a species of White ant which builds a large hemispherical nest on the trunk of trees, formed of finely-comminuted leaves and mud. The interior consists of great numbers of *cancelli*, separated by walls and passages, which are thronged with the small soft-bodied inhabitants. "On being disturbed the big-headed soldiers make absurd and impotent attempts to defend their queen and helpless workers, who immediately retire within the recesses of the city." When viewed from a little distance, this nest looks like a great vegetable excrescence, or wen, growing from the bole of the tree.

Lieutenant-colonel James Campbell,§ formerly of the 48th and 50th regiments, and who for several years held a high command in Ceylon, published an interesting work on Ceylon. He refers to the fearful ravages

* See Proceedings of the Geographical Society, p. 117; 1860
† Naturalist's Sojourn in Jamaica.
‡ Voyage of Samarang, vol. ii., p. 410.
§ Excursions, Adventures, and Field Sports in Ceylon, vol. ii., p. 365.

the Pteronarcys resembles an amphibious animal in its habit of life, and may be designated "an Insect *Proteus* among the winged Articulata—the representation in structure, as it appears to be in habit, of the *Proteus* of Vertebrata. Its organs of respiration fully justify us in instituting this comparison. The true *Proteus* has both lungs and branchiæ; and a similar conformation of structure exists in *Pteronarcys*, in so far as the ramified tracheæ being the direct recipients of atmospheric air, are to be regarded as the representatives of lungs."—Linn. Trans., vol. xx., p. 433.

Most of the Canadian Perlidæ in the daytime retreat to the cracked fissures of decayed trees. Mr. Barnston noticed that the species called *Capnia vernalis* comes out of the water in the nymph state in the cracks of the ice, and casts its skin there; this it does when the thermometer indicates that it is freezing.

FAMILY—EPHEMERIDÆ (*May Flies*).

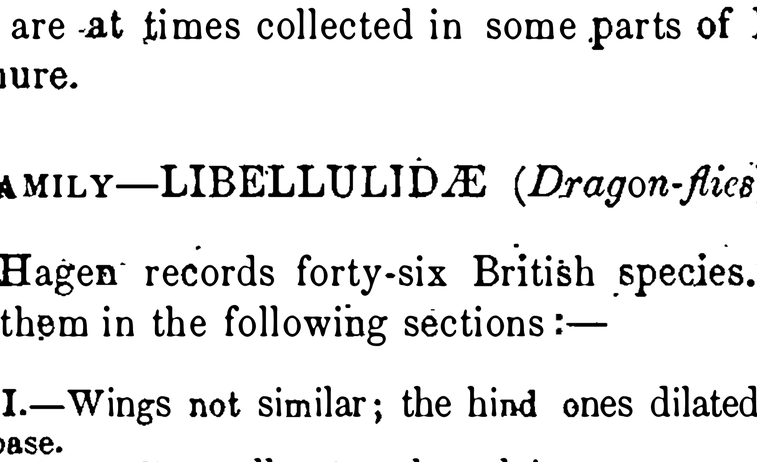
This is a family of important insects, seeing that they furnish much food to fresh-water fishes. The antennæ are very small (Plate 6, fig. 9, *Ephemera vulgata*). The mouth is nearly obsolete in the perfect insect; indeed, in that state they only live a few hours; hence their name *Ephemera*. The metamorphoses of these insects are very interesting; but space prevents me from entering on the detail. They abound in New Zealand. One species, *E. albipennis*, with white wings, is common in Europe. Swarms of this species are often met with: they resemble in this state a fall of snow. The dead bodies are at times collected in some parts of Europe as manure.

FAMILY—LIBELLULIDÆ (*Dragon-flies*).

Dr. Hagen records forty-six British species.* He places them in the following sections:—

TRIBE I.—Wings not similar; the hind ones dilated at the base.
DIV. 1.—Lower lip smaller than the palpi.
1. Sub-family LIBELLULINA. Eyes simple, not prolonged posteriorly. Larva of *Libellula depressa*, figured Plate 6, fig. 3.
Genus *Libellula*, with thirteen species.

Fig. 153.



2. Sub-family CORDULINA. The eyes with a slight prolongation backwards.
Genus *Cordulia*, with four species.
DIV. 2.—Lower lip larger than the palpi.
3. Sub-family GOMPHINA.—Eyes not contiguous, or scarcely so.
Genus *Gomphus*.—Eyes remote; lower lip rounded at the tip. Three British species.
Genus *Cordulegaster*.—Eyes slightly contiguous, lower lip cleft at the end. One British species.
4. Sub-family ÆSCHNINA.—Eyes completely contiguous.
Genus *Æschna*.—Anal angle of hind wings sharp in the male and rounded in the female. Seven species. Of these, one species (*Æ. borealis*), previously to its being taken in Scotland by M. De Selys during a short visit, was not known as British; so that the entomologist who examines carefully the mountainous parts of this country, may expect to meet with species of Dragon-flies not yet recorded as British.
Genus *Anax*.—In this genus the anal angle of the hind wings is rounded in both sexes. One British species.
TRIBE II.—The fore and hind wings in this tribe are similar.
DIV. 1.—Antecubital nervures numerous.
5. Sub-family CALOPTERYGINA contains the larger species of the tribe.
Genus *Calopteryx* contains two species found in Britain.
DIV. 2.—With two antecubital nervures.
6. Sub-family AGRIONINA contains the smaller species of the tribe.
Genus *Platycnemis*, with one British species, may be known by the tibiæ being dilated.
Genus *Lestes*, with five British species.—The tibiæ are cylindrical, and the stigma of the wing is large and oblong. Plate 6, fig. 1, represents the *Lestes sponsa*.
Genus *Agrion*, with nine British species.—This genus has the tibiæ cylindrical, and the stigma of the wing is small and rhomboidal.

The wings of the Dragon-flies are nearly equal in size and form—a complete and beautiful piece of network, which resembles the finest lace, with the meshes between filled with a pure, transparent, glossy membrane. Some of the genera have wings always expanded, even when the creatures are resting, so that they can on being disturbed take flight in an instant, there being no necessity for them to unfold their wings. These insects can fly in all directions without turning—backwards and forwards, and to the right or left, so that to those inexperienced in their habits they are very difficult of capture. The smaller Dragon-flies are equally alert. Specimens are sometimes taken at sea at great distances from land; thus Mr. Davis mentions* one which flew on board the vessel in which he sailed when she was five hundred miles from land.

The figure (Plate 6, fig. 2) represents a fine New Zealand species of Dragon-fly named *Petalura Carrovei*.

The species *Calepteryx* and the allied *Agrions* are often very beautiful. Here come

> "The beautiful blue damsel flies
> That fluttered round the jasmine stems,
> Like winged flowers or flying gems."

to which the poet Thomas Moore refers.

Mr. Gosse, when in Alabama, noticed a large dragon-fly actually try to get some fish out of a shallow pool. The dragon-fly had been hawking to and fro over the brook some time; at length he dashed down into the water where a few of the fry were swimming, and made quite a little splash, but did not go under. He rose again immediately, but without success evidently, as he continued his hawking as before. The fry darted away in all directions from the intruder's attack, of course, but soon reassembled and came to the surface as before. The dragon-fly, not discouraged by failure, presently made another pounce, and now succeeded

* See his Synopsis in Stainton's Entomologist's Annual for 1857, p. 39.

* Entomological Magazine, vol. v., p. 251.

better, for he instantly settled for a few minutes on a twig on the bank, as their manner invariably is when they take prey, to eat it.

FAMILY—MYRMELEONIDÆ (*Ant-lions*).

A large and important family of insects, the larvæ of which are called Ant-lions, from their digging pits and laying in wait for ants or other insects, which, passing near the edge of their pitfalls, often tumble down, and when they try to escape are often brought into the very jaws of the former by the shovelling up of sand directed against them when beating a retreat. Plate 6, fig. 5, represents the common European species *Myrmeleon formicarius* and its larva, pupa, and its globular cocoon.

The African Ant-lions, and some of the Indian species, are very large, and have spotted wings.

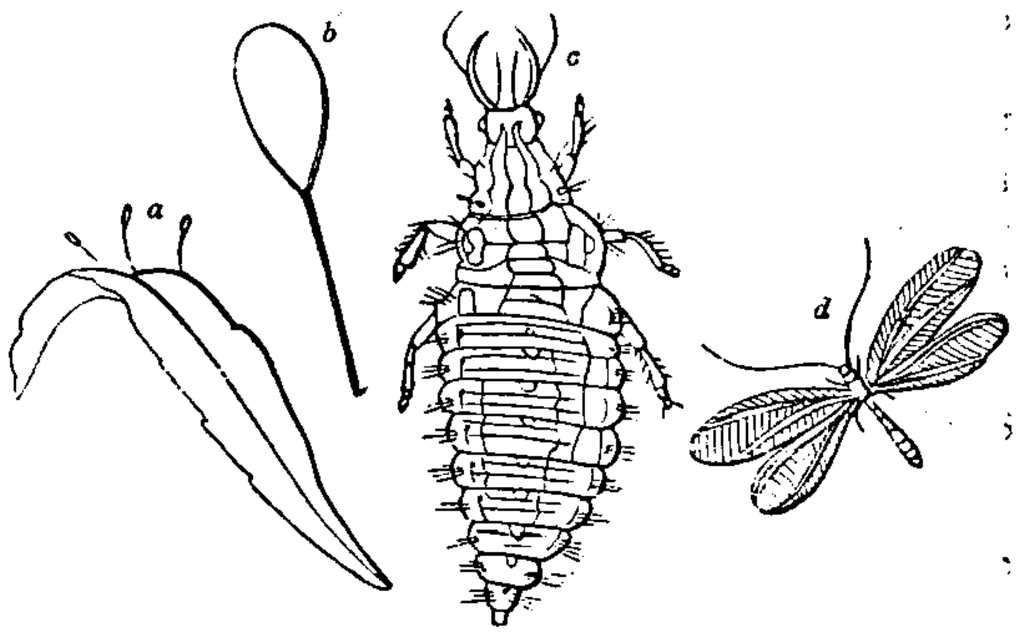
The genus *Ascalaphus*, has long clubbed antennæ. Plate 6, fig. 3, represents the *Ascalaphus barbarus*, a species of this very distinct genus.

FAMILY—HEMEROBIIDÆ (*Lace-wing Flies*).

There is a family of insects, the grubs of which are famed for their wholesale destruction of those noisome insects, the plant-lice. This family, the *Hemerobiidæ*, are generally of a pale-green colour, with four large wings delicately netted with veins, from which they have obtained the name of Lace-wing flies. Their eggs are large and projecting, and have a brilliant golden hue, whence the insects are often called Golden-eyed flies. Pretty as they are, when taken in the hand, they emit a most disagreeable smell not easily got rid of. The eggs are raised on a longish thread. Dr. Fitch has thus described the process of their oviposition. "Nature has furnished these insects with a fluid analogous to that which spiders are provided with for spinning their webs, which possesses the remarkable property of hardening immediately on being exposed to the air. When ready to drop an egg, the female touches the surface of the leaf with the end of her body, and then elevating the latter, draws out a slender thread like a cobweb, half an inch long, or less, and places a little oval egg at its summit. Thus, a small round spot resembling mildew is formed upon the surface of the leaf, from the middle of which arises a very slender, glossy, white thread, which is sometimes split at its base, thus giving it a more secure attachment than it would have if single."* The grub leaves the egg in less than a week after it is deposited; several of these eggs may often be seen together, after the larvæ are hatched. Dr. Fitch has shown, that when first hatched, these grubs feed chiefly on the eggs of insects, and in this way must destroy great numbers of noxious creatures. This, too, accounts for the reason why the female places her eggs on these hair-like pedicels; it is to keep them from the attacks of their own kind. As they increase in size, the larvæ become truly "aphis-lions," laying hold of the plant-lice, and sucking out their juices. The jaws of these grubs are long, and sickle-shaped, and well fitted to probe the often narrow crevices and fissures in which their prey lurks. Some of the species cover themselves with the skins of their victims, which are supported on their backs by the radiating bristles which clothe them. When the larva has attained its full growth, it becomes inactive, and spins a cocoon; the tail exuding a glutinous secretion, which hardens on exposure to the air. The larvæ contract and compress themselves into cocoons scarcely one-fourth their size, and from these cocoons come flies double the size of the larvæ; as Dr. Fitch remarks, it is like a full-grown hen hatching from an ordinary sized egg.

* Dr. Fitch's Report on Noxious and Beneficial Insects, p. 71.

Fig. 154.



Hemerobiidæ
a Leaf with eggs. *c* Female Lace-wing.
b An egg magnified. *d* Male of do.

M. Guerin-Meneville named a most lovely species of Hemerobius *Chrysopa Marionella*, after Marion Frances, the youngest of the writer's daughters.

Dr. Hagen gives the names of thirty-two species of Hemerobiidæ as British. These are placed in seven genera as follows:—

Osmylus, *O. Chrysops*, a pretty, brown insect, with the wings spotted with black; it is met with in the month of June, and appears to prefer stony rapid streams which are fringed with alders. The larva lives partly in water; the cocoon is of irregular form, and composed of spun-silk. In this genus there are ocelli visible.

Chrysopa, fifteen species. In this genus the ocelli are wanting; the larva feeds on Aphidæ; the cocoon is in the form of a barrel, and is composed of thick spun silk. For the names and characters of the species the reader is referred to Dr. Hagen's Synopsis, as we cannot give them here.

Sisyra, two species. The larva lives in water, and has been described by Westwood under the name of *Branchiostoma spongillæ*.

Micromus, three species.

Hemerobius, seven species. The larva of the species of this genus preys on Aphidæ, and clothes itself with the empty skins of its prey; the cocoon is oval, and of a gauzy silken texture.

Drepanopteryx, *Coniopteryx*; the species of the latter are small, and covered with a white mealy powder. The larvæ live on fir-trees, the Aphidæ frequenting which trees are their food; the cocoon is

oval, and of close-spun silk. The species are from three to four lines in expanse.

In the family *Sialidæ*, which includes Raphidia, Dr. Hagen quotes five species as indigenous to our island, and characterizes the family as having the wings deflexed; the subcosta unites with the costa before the apex of the wing; the labial palpi are three-jointed; the anal area is present, though in Raphidia it is very small. The larva has the mouth formed for biting, and is always carnivorous.

FAMILY—SIALIDÆ.

The *Sialis lutarius* is a dingy, blackish insect, very common on the banks of ponds and streams. They deposit their eggs in patches on the rushes. The flies must afford great store of food to many of the smaller fresh-water fish. Anglers who use artificial flies in pursuing their sport, frequently imitate the general appearance and form of the Sialis. Its brownish wings have a multiplicity of veins; the fore-wings are yellowish at the base.

Raphidia, four species. In this family comes the great long-jawed *Corydalis cornuta*. Our figure is that of *Raphidia ophiopsis var notata* (Plate 6, fig. 4). In the family *Panorpidæ*, Dr. Hagen quotes five species as British. The family is thus characterized:—The wings are horizontal, narrow; the subcosta unites with the costa before the tip of the wings, the mouth is prolonged like a beak, the labial palpi are two-jointed; the anal area is wanting. The larva lives underground, and feeds on plants; the pupa is quiescent, and is without a proper cocoon. In the genus *Boreus* the wings are wanting; in *Panorpa* they are present.

Boreus hyemalis, is sometimes found on snow.

Panorpa, four species. Our figure shows the *Panorpa communis* or common Scorpion-fly (Plate 6, fig. 7).

The Scorpion-fly can lord it over the Dragon-fly. Lyonet mentions that he saw a scorpion-fly attack a dragon-fly ten times larger than itself. The Panorpa brought him to the ground, pierced him repeatedly with his proboscis; and but for the eagerness of the naturalist who parted them, there was no doubt but that the Scorpion-fly would have destroyed the Libellula. In this family comes the strange genus *Nemoptera*, one of the species of which is figured on Plate 6, fig. 6, *Nemoptera filipennis*; the figure, as in several other instances, is copied from one of Mr. Westwood's. In this family, too, comes the genus *Bittacus*, with its long legs and very great raptorial tarsi. These insects seize and hold other insects with their great claws.

FAMILY—MANTISPIDÆ.

A family with raptorial fore legs, looking like a miniature Mantis.

On lately opening a nest of the curious Wasp, *Myrapetra scutellaris*, from Monte Video, I was much delighted to get a considerable number of a curious Mantispa alive. In the former nest which I had described, wings of this species, which I alluded to as *Hemerobius*, occurred. These Mantispæ jerked and jumped about in the strangest manner; when they fell on their backs they righted themselves most curiously. They eagerly ate any small insects offered to them. They were evidently parasitic in the nest, as they occurred in great numbers. I described this insect at a meeting of the Entomological Society of London, December 2, 1861.

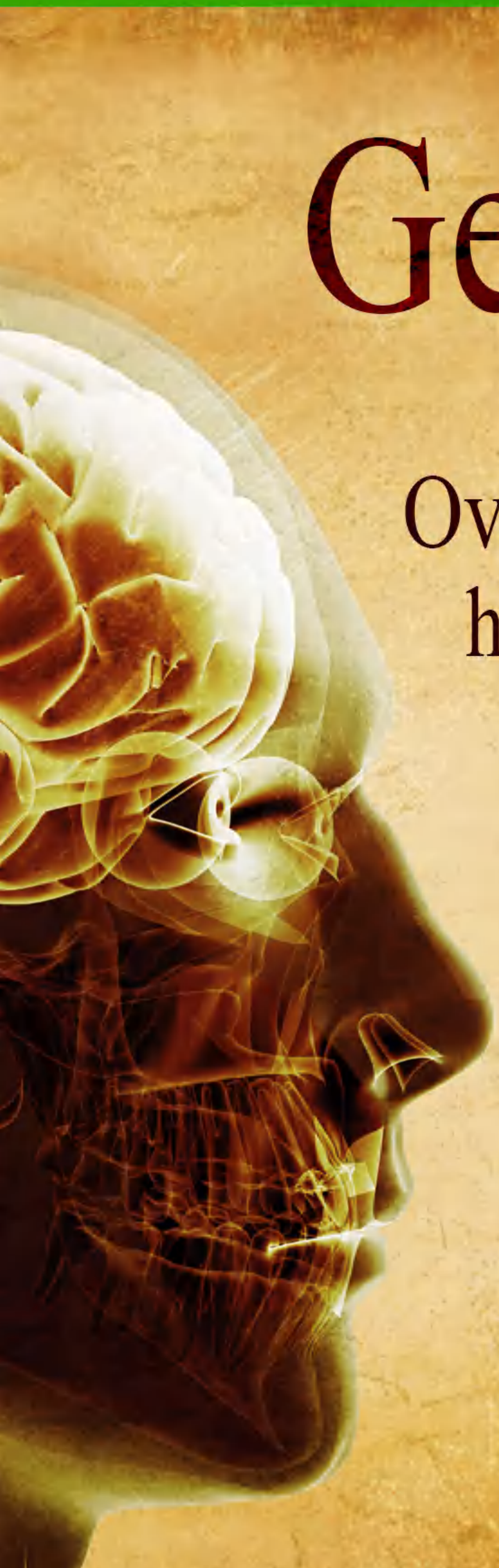
SUB-ORDER—TRICHOPTERA (*Caddis-worm flies*).

THIS group of insects was regarded by Kirby as forming a distinct order from the Neuroptera, to which he gave the name of *Trichoptera*, or hairy wings, from the hairs with which they are usually covered. Westwood and other authors regard them also as distinct from the Neuroptera; we follow Dr. Hagen in considering them merely as a subdivision of that order.

Trichoptera in their early stages are aquatic, and inhabit cases which are constructed of various materials, according to the species or genus of the order. Some employ grains of variously coloured sand to cover these cases; others use small fresh-water shells, and thus carry about with them a little museum of the coverings of aquatic mollusca of different kinds; others form the outside lining of their case with small fragments of branches or reeds. These cases are usually open at the ends. In their pupa state they become torpid; but before becoming pupæ, the larvæ, to keep out their enemies, and at the same time to allow free ingress to water, so necessary for their very existence, form a grate across the mouth of the case. This portcullis, as it has been well called, is spun across each end, and is formed of a silk spun from the anus of the larva. Degeer has described one of these grates. It is formed by a small, thickish, circular lamina of a dark-coloured silk, which becomes hard, and exactly fits the end of the case, being fixed a little within its margin. It is pierced all over with holes, arranged in concentric circles, and separated by ridges which run from the centre to the circumference, somewhat like the spokes of a wheel. Although for a considerable time quiescent in their pupa state, about the close of it they can move; they are furnished with an apparatus to pierce through the grating which imprisons them, otherwise they must perish in the water. The head of the pupa is furnished in front with two hooks; with these, before their last change, they make an opening in the grate. Having escaped from this, the pupa mounts in the water to the surface, and emerges from it. She then creeps up some plant, her antennæ and legs each inclosed in a separate envelope; the perfect insect then gradually bursts from her case.

Plate 6, fig. 10, shows one of the Trichoptera with the Caddis-worm.

In North America, Brazil, Australia, New Zealand,



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butterflies of the British Museum" is also an excellent work.

The late George Newport, F.R.S., showed clearly by many experiments, that if insects were injured accidentally or intentionally in their larval or chrysalidal states, these insects showed traces of the injury in their perfect state. For instance, if a foot was injured in a grub, or the place where the wing or antenna would be developed in the pupa, the foot, the wing, or other organ, was defective in the perfect insect. Several series of experiments were made on *Vanessa urticæ* and *Vanessa Iö*, with complete success; as the result of these experiments, the perfect insects, with their diminutive and newly-formed limbs, were produced. Some of these specimens are now deposited in the cabinets of the British Museum, and others in the Hunterian Museum of the Royal College of Surgeons. The details of the experiments have been published; so that this physiological question may now be regarded as completely settled.

Many of the Lepidoptera, when emerging from the chrysalis, discharge a red fluid from their anus. This fluid, when the numbers of the insects have been considerable, has looked like, and been taken for, a shower of blood. In 1553, it is recorded that a vast number of butterflies swarmed over a considerable part of Germany; and where they abounded, plants, buildings, and even men were sprinkled with red drops, as if there had been a shower of blood. The cause was apparent, and men's minds were at ease. Not so, however, at Aix in 1608, when the suburbs of that town and the country adjacent seemed to be covered with a shower of blood. The inhabitants of all classes were alarmed, and most of them began to regard the appearance as the precursor of some impending calamity. Reaumur records that M. Peiresc, a philosopher of the place, allayed the fears that began to prevail. He had a chrysalis, which he watched. On hearing a fluttering he looked into the box, and found that the insect had emerged from its pupa state and had left behind it a red spot. This be compared with the spots of the so-called bloody shower, and found them to be exactly alike; he observed, also, that at the time a great number of butterflies were flying about, and that the drops were not found on the tiles nor on the upper surface of stones, but chiefly in places where rain could not easily come. The naturalist was able to dispel the fears and terror which his fellow-townsmen's ignorance had occasioned.*

The Ettrick Shepherd, as personified by Christopher North in one of his fine imaginary conversations, full of poetry and criticism, and often mantling with fun as well as *occasional* pawkiness and prejudices, introduces insects into his picture of a calm summer day:†—

"Perhaps a bit bonny butterfly is resting, wi' faulded wings, on a gowan no a yard frae your cheek; and noo, waukening out o' a simmer dream, floats awa in its wavering beauty, but, as if unwilling to leave its place of mid-day sleep, comin' back and back, and ronn' and roun', on this side and that side, and ettlin' (intending, attempting) in its capricious happiness to fasten again on some brighter floweret, till the same breath o' wund that lifts up your hair sae refreshingly catches the airy voyager, and wafts her away into some other nook of her ephemeral paradise."

The Shepherd goes on to speak of other inhabitants of the mountains. "Mony million moths; some o' as lovely green as the leaf of the moss rose, and others bright as the blush with which she salutes the dewy dawn; some yellow as the long steady streaks that lie beneath the sun at set, and others blue as the sky before his orb has westered. Spotted, too, are all the glorious creatures' wings—say rather starred with constellations! Yet, O sirs, they are but creatures o' a day! . . .

"Gin a pile o' grass straughtens itself in silence you hear it distinctly. I'm thinking that was the noise o' a beetle gaun to pay a visit to a freen' on the ither side o' that mossy stane. The melting dew quakes! Ay, sing awa, my bonny bee, maist industrious o' God's creatures! Dear me, the heat is ower muckle for him; and he burrows himsel' in amang a tuft o' grass, like a beetle, panting! and noo invisible a' but the yellow doup o' him."

Among artists we find not a few who have derived excellent hints from the colouring and variegated shading of the wings of Butterflies. Vandyck kept a collection of the finer exotic Butterflies, and Stothard, the Royal academician, kept a collection for the same purpose.

Mrs. Bray mentions two Butterflies of which Stothard was very fond—the species named *Vanessa Iö* and *Vanessa urticæ* by naturalists; they are alluded to in the following extract from her "Life of Stothard:" About 1794, the year in which he was elected a Royal academician, Stothard "painted a picture which gave rise to a new and delightful combination in his studies of colour for his works. The circumstance which led to it deserves not to be forgotten. He was beginning to paint the figure of a reclining sylph, when a difficulty arose in his own mind how best to represent such a being of fancy. A friend who was present said, 'Give the sylph a butterfly's wing, and there you have it.' 'That I will,' exclaimed Stothard; 'and to be correct, I will paint the wing from the butterfly itself.' He immediately sallied forth, extended his walk to the fields some miles distant, and caught one of those beautiful insects; it was of the class (species) called the Peacock. Our artist brought it carefully home, and commenced sketching it, but not in the painting-room; and leaving it on the table, the servant swept the pretty little creature away before its portrait was finished. On learning his loss, away went Stothard once more to the fields to seek another butterfly. But at this time one of the tortoise-shell tribe crossed his path, and was secured. He was astonished at the combination of colour that presented itself to him in this small but exquisite work of the Creator, and from that moment determined to enter on a new and delightful field—the study of the insect department of natural history. He became a hunter of butterflies; the more he caught, the greater beauty did he trace in their infinite variety, and he would often say that no one knew what he owed to these insects; they had taught

* Kirby and Spence, i., p. 28.

† Noctes Ambrosianæ, vol. i., p. 158; 1855.

him the finest combinations in that difficult branch of art colouring."*

From the same book another anecdote may be given, which shows Stothard's love of butterflies in an entomologist's aspect. When painting the great staircase at Burleigh for the Marquis of Exeter, among the visitors " was a certain dignitary of the church, who often joined Stothard on his summer evening rambles. On one occasion he happened to go out with his nippers and his net to catch butterflies and insects, when his clerical friend thought it became him to read him, very gravely, a lecture on the cruel and unchristian-like practice to which he was addicted. This reproof was received with meekness; when going on a little further they came to a piece of water. The fish were making bubbles and rings in it by darting up to the surface to catch the flies. "Bless me!" exclaimed the divine, "how plenty the fish are here; I wish I had my rod with me." Are you an angler, Mr. Stothard?" "No," replied Stothard, "I have some doubts about angling, whether it may not be a cruel and unchristian-like practice, when we think of the worm, the hook, and the fish."*

The profusion of species of Butterflies on the Amazon about Ega and Santarem, where Mr. H. W. Bates has collected for many years, is surprising. Some of these Butterflies, such as the green *Celænis Dido* and the tailed *Thecla Marsyas*, are in profusion, while others are seldom met with to excite the attention or reward the diligence of the collector, who watches newly-opening flowers to catch such rarities as may settle on them.

LEPIDOPTERA DIURNA—RHOPALOCERA

(*Butterflies or Day-flying Lepidoptera*).

THE first great section of the Lepidoptera contains the Butterflies, which are known to everybody by head-mark. Naturalists know them by many characters, the chief of which is that the antennæ gradually thicken into a club at the end, whence they have derived one of their names—*Rhopalocera*.†

The following lines, written by Wordsworth in 1801, and placed in the edition of 1841 among the poems referring to the period of childhood, express much that every child has felt, though it took a great poet, but a simple-minded man, to write them:—

" Stay near me—do not take thy flight—
A little longer stay in sight.
Much converse do I find in thee,
Historian of my infancy.
Float near me, do not yet depart,
Dead times revive in thee;
Thou bring'st, gay creature as thou art,
A solemn image to my heart—
My father's family. . . .

Oh! pleasant, pleasant were the days—
The time when in our childish plays
My sister Emmeline and I
Together chased the butterfly:
A very hunter did I rush
Upon the prey. With leaps and springs
I followed on from brake to bush;
But she, God love her, feared to brush
The dust from off its wings."

FAMILY—PAPILIONIDÆ.

In the family *Papilionidæ*,‡ of which the Swallow-tail butterfly (*Papilio Machaon*) is a characteristic indigenous species, the wings are ample, and the discoidal cells are always closed; the median nervule has apparently four branches, and the anterior tibiæ have a stout spur about the middle, two characters which are found in no other family. The larva is furnished with two retractile tentacula on the prothoracic segment, which the creature has the power of extending when irritated, evidently for the purpose of defence, as at that time they emit an aromatic but generally disagreeable odour. The chrysalis is braced, with the head bifid, square, or rounded, but never pointed.

The finest and largest of the group have been placed in a genus named *Ornithoptera*, the species of which are found chiefly in the eastern Asiatic islands. The larva and pupa of the genus were first made known by the venerable Dr. Horsfield, who resided so long in Java, and did so much to investigate the natural history of that fine island. The pupa has the peculiarity of not being surrounded by a transverse band, but is supported by a silken thread on each side, which is attached to a small lateral tubercle.

In this genus comes the noble *Priamus* butterfly, the male of which has the front wings of a rich velvet black, with splendid satin green markings, the green varying in different lights; the hind wings are green, with orange and black markings. The females of this, and indeed of most of the species, are brown, with dull white or yellowish markings. It is a native of Amboyna.

P. Poseidon is a closely allied species, which was found on the voyage of H.M.S. *Fly* by Messrs. Jukes and John Macgillivray. It flew very high amongst the groups of cocoa-nut trees on Darnley Island between New Guinea and Australia. The specimens they obtained are now in the British Museum. They were procured from the natives, who catch them and secure them by one end of a long thread, while they fasten the other end of the thread to their hair, allowing the butterflies to flutter round their heads. Mr. Gray has very lately described, under the name of *Crœsus*, a very fine Butterfly, in which, among other characters, the green of the *Priamus* is replaced by a fine yellow, which in certain lights is shot with tinges of green.

* Life of Thomas Stothard, R.A., with personal reminiscences by Mrs. Bray, pp. 31, 32.

† Ῥωπαλον, a club; and κερας, a horn.

‡ The characters and much information about the various families of Diurnal Lepidoptera are derived from Doubleday, Hewitson, and Westwood's Genera of Diurnal Lepidoptera.

* Life of Thomas Stothard, &c., p. 38.

This species was found by Mr. Wallace on the island of Batchian among the Molucca islands. Some of the species have the wings black, marked with pale streaks; the hind wings being of a rich yellow, bordered, spotted, or lined with black. The *Ornithoptera Brookeana* is figured—Plate 9, fig. 2. Speaking of the species of *Papilio* proper, good authorities refer to them as being insects of rapid and powerful flight; it is certainly the case with our British species. They take long circuits, and return after the lapse of a few minutes in the same direction, and often precisely in the same track on which they set out.

A very interesting genus of the family is *Parnassius*, a genus of white Butterflies with rings of pinkish red on the wings. They are found on the mountains of Europe, Asia, and America. The abdomen in the female terminates in a horny pouch or plate. The larvæ feed on sedums, saxifrages, and such like alpine plants; as befits residents in a cold region, they are pubescent. The flight of the perfect insects is described as being slow and graceful until disturbed. When pursued, *P. Apollo* and *P. Phœbus* are capable of great speed.

When full grown, the caterpillar of our Swallow-tail butterfly no longer eats, but rests quietly on the stem of the plant, sedate and motionless. They sometimes are for two days in this position, when, with a small white web spun from the creature's mouth, the tail is fixed. With this foundation made, the larva makes a fine white silken thread, the ends of which are fixed, one on each side, near the head. Harris has well described the after process:—"I could not help admiring with what care and pains he worked to make it strong: rubbing with his mouth backward and forward with such a motion as the shoemakers use in waxing their ends. When finished, he put his head under or through it, and the thread then fell across his back; but the thread now appeared too big for him. After this he remained two days more, during which time he shortened and grew thicker, and at length changed into the chrysalis." In May and June the butterfly appears.

The family *Pieridæ* is readily known from the preceding by the want of the spur on the anterior tibiæ, and by the abdominal margin of the posterior wings forming a distinct channel for the reception of the abdomen. The larva is more or less pubescent, has no tentacula, and tapers slightly towards each extremity. The head of the pupa is always pointed, never bifid or truncated. The Pieridæ form an extensive group of insects scattered over the whole world. The prevailing colours in the insects of this family are white and yellow. Our common Cabbage-butterfly (*Pieris Brassicæ*), and Brimstone-butterfly (*Gonepteryx Rhamni*), are characteristic examples of the family.

The species of the genus *Euterpe*, with their broad hairy head, are found in the New World, as are the species of the singular genus *Leptalis*, in which the hind wings are generally much broader than the fore wings, and nearly or quite as long. Some of the species have a striking resemblance to the family Heliconidæ, and not less resemble them in their habits. Of the small genus *Leucophasia*, with its delicate wings rounded at the end, we have one species, *L. Sinapis*, which generally frequents open places in woods, and flies rather slowly with an undulating unsteady motion. The larva feeds on the tufted vetch and bird's-foot trefoil (*Lotus corniculatus*). The larvæ of the numerous species of the genus *Pieris* are particularly attached to the various species of Cruciferæ, and some of the British species, in their larva state, are very destructive in our gardens, making inroads on our cabbages, turnips, Indian cress, and mignonette; while in the United States, one described by Dr. Harris under the name of *P. oleracea*, is equally injurious to cabbages, turnips, and other garden Cruciferæ.

Some of the Indian and Australian species are varied on the under sides with bright colours, such as red and yellow. The male of a very common Australian species (*Pieris nigrina*) is white above, while below it is black, and has yellow marking on the fore wings and red streaking on the lower.

The grub of the *Pieris Cratægi* is often so very numerous in France as to occasion great injury to the almond trees, which are cultivated extensively in the south. Linnæus calls it "the pest of gardens." In the neighbourhood of Paris the gardeners, and those who would preserve their fruit trees, make a regular practice of stripping the branches of as many of these caterpillars as they can see. In this country it is not a very common insect; but in the south of France, if the almond plantations should happen to be attacked two or three years in succession by it, the loss of their leaves occasions the destruction of these valuable trees, and every year the amount of produce is materially affected by the caterpillar of this butterfly.*

The species of the genus *Pieris* are very numerous. Nearly two hundred are known, whose range extends from the Arctic regions to the Tropics, and from the Tropics to the most southern lands where butterflies are met with.

The genus *Zegris*, one species of which, *Z. Eupheme*, is found in Spain and in the Crimea, is singular among butterflies, inasmuch as the larva spins a delicate silken net-like web on the stems of the Sinapis. It suspends itself by a very fine transverse thread, and by the tail. The larva grows very slowly; the insect itself flies with great rapidity.

The species of *Anthocharis* have the wings in the males tipped with orange, or with pinkish red; they are commonly called Orange-tips.

The species of the genus *Callidryas* are found both in the New World and in the Old; their colours are most frequently yellow or orange, while a few are of a chalky white above; the females differ very much from their partners. Mr. Doubleday tells us, that the perfect insects appear in a few days after the change from the larva to the pupa state. They are powerful and rapid in flight, and fond of settling on flowers and the muddy banks of rivers and pools. I have heard Mr. Bates narrate, how he has seen clouds of the males of one species fly over the Amazon, near Ega. This habit of congregating in countless myriads has been observed by several writers. Sir Robert Schomburgh, when

* Guerin Meneville: Essai sur les Insectes Nuisibles, Enc. Mod., vol. xviii., p. 278.

neighbourhood of Thirsty Sound on the 29th of May, 1770, when he mentions that his party found a space of three or four acres covered by millions of them on the wing, and they noticed that every twig and branch were loaded with almost equal numbers at rest. A species of this genus, with its characteristic brownish red hue and black markings, is represented on some Egyptian wall paintings in the British Museum. The same species is still abundant in Egypt and in the Mediterranean district.

The species of *Hestia* are butterflies of a large size, with semitransparent whitish wings of rather delicate texture, with the nervules and numerous spots on or between the nervures and nervules and on the outer margin, and sometimes the margin, black. Mr. Arthur Adams observed a species of this genus, *Hestia Leuconœ*, on the Madjico Sima islands; and says that it flies slowly over the tops of the bushes and is easily taken.

FAMILY—HELICONIDÆ.

The family (*Heliconidæ*) is a very extensive one, which may be said to be peculiarly American. They have elongated front wings generally much rounded externally, their hind wings are narrow, and they have the costal margin almost double the length of the abdominal, while the latter margin has no fold to form a channel for the reception of the abdomen. The abdomen is elongated, is always as long as the wings, and sometimes longer. The antennæ are long and gradually clavate, and the palpi are widely separated at the base and not convergent. Little seems to be known of their larvæ; the pupa is smooth and is suspended by the tail.

Lacordaire says that those species with white spots on a black or bluish ground (as *Hecate*, *Sappho*, and *Antiocha*), only live in the forests of Surinam. They fly in a free and easy manner, and do not rise high. The most common species are those with red or yellow spots on the upper wings and with no radiating marks on the lower, as *Melpomene*, *Sara*, *Thamar*, and others. They live in the neighbourhood of habitations and have a bold undulating flight, rarely proceed in a straight course, and yet are easily captured. Some which have yellow or red spots on the fore wings and red or fulvous rays on the second (as *Doris*, *Erato*, *Cynisca*, and others), are found only in the woods. They do not rise high above the ground, and they fly quickly with a sailing and sometimes with a bounding flight. The species in which yellow predominates, mixed with black, such as *Eva*, *Egina*, *Polymnia*, &c., for the most part frequent woods. Those with very narrow wings and elongated abdomen have an unequal jumping flight and often alight in great numbers on flowers, when they are easily captured. Others in which the wings are not so long, and the abdomen extends but little beyond the hind wings, have a rapid unequal flight. Lacordaire has often seen them rise suddenly into the air and then immediately descend, without ever sailing with expanded wings. He found them in consequence difficult to capture. The species with more or less transparent wings (*Ithomia*, &c.), such as *Nisæa*, *Flora*, *Œgle*, *Diaphana*, *Gazoria*, &c., remain constantly in the deepest forests among the bushes, where they fly slowly within two or three feet of the ground, alighting every minute on the ground. They are social in their habits, being generally found united in little societies more or less numerous.

On Plate 9 are figured two *Heliconiæ* from Mr. Hewitson's works, where so many of the group have been so carefully and beautifully illustrated. Plate 9 fig. 4 shows the *Heliconia Hermathena*, and fig. 5 *Heliconia Hecatesia*. That observer refers to the peculiar gland or appendage which these insects have at the end of the abdomen. It is concealed between the valves of the anus, but is capable of being protruded. In the *Lycorea Halia* this gland takes the form of a radiating tuft of hairs, which form, when exserted, two feathered globes at the end of the abdomen. In another species allied to *Heliconia Erythræa*, this gland is much developed. It is in the shape of small fleshy balls of an orange colour. Mr. Wallace adds that, when the insect is captured, these balls are always exserted, and they give out a peculiar penetrating aromatic odour which somewhat resembles the smell of chamomile.

One of the first butterflies to attract the notice of the naturalist in Jamaica is the *Heliconia Charitonia*. Its beauty and singularity of form, the great length and little breadth of the wings, the length and sleuderness of the body, and the brilliant contrasts of colour, lemon-yellow and velvety black, together with the very peculiar flapping of the wings in flight, as if their length rendered them somewhat unwieldy, excite a sensation of delighted surprise.

FAMILY—ACRÆIDÆ.

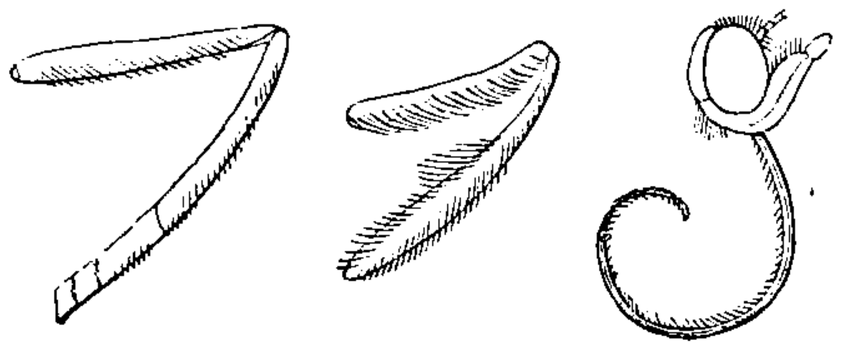
The family ACRÆIDÆ,* so named from the genus *Acræa*, is regarded as closely allied to the *Heliconidæ*, but may be at once distinguished from that family by the insects in it having short, abruptly clavate antennæ; and from the next family it may be known by its posterior wings, the inner margins of which do not form a channel to receive the abdomen. The wings in many of the species are semitransparent; the larvæ have much resemblance to those of Argynnis, being cylindrical and spiny; the spines are long and set with little whorls of hairs or more delicate spines. The pupæ in some of them are furnished with a few spines. The perfect insects are not by any means showy, though there is a liveliness about one or two of the African species which is very pleasing. These insects resemble the Heliconidæ in many particulars, and like them frequent the open parts of woods, and also the shady parts, where a ray of sunshine that has pierced through openings in the dense foliage of the trees shines on the scanty undergrowth of low shrubs or herbage. The flight of the species is described as being rather slow and feeble. The metropolis of this family or sub-family is Africa, particularly in the western parts, such as Sierra Leone. In Asia there are two species only as yet known.

* Doubleday: Gen. Diurn. Lep., p. 138.

FAMILY—NYMPHALIDÆ.

The butterflies of this family have almost without exception the fore legs short and not fitted for walking; the tibiæ and tarsi of the male are often clothed at the sides with a fringe of fine hairs, forming a flattened brush; the tarsus consists of a single elongated joint, blunt at the tip, and without claws (fig. 155); the eyes

Fig. 155.



and labial palpi are large, the latter extend considerably in front of the head; the thorax is large, and the wings are large and often greatly variegated in colour, and marked with ocellated spots; the larva is long and more or less spined, it is generally not attenuated behind, and is blunt at the end; the chrysalis is elongated, and is simply suspended by the tail, hanging by the extremity of the body, and not girt across the middle by a skein of silken thread.

Mr. Bates found out when in Brazil how to distinguish the sexes of the Nymphalidæ by the fore legs—the fore tarsi in the males have a few pairs of minute spines at the apical joints, which are not found in the other sex. This difference prevails in the Heliconidæ, Satyridæ, Erycinidæ, and probably in the Polyommati.

The Painted-lady butterfly (*Cynthia Cardui*) is universally distributed; it is found throughout Europe, Asia, Africa, and America, in Greenland, and a specimen has been taken as far north as lat. 59°, and west long. 319°; it has also been taken in Terra del Fuego.

Vanessa Urticæ, *Vanessa Polychloros*, *Vanessa Atalanta*, *Vanessa Iö*, *Vanessa Antiopa*, *Grapta C. album*, and the *Argynnis* and *Melitæa* genera, are all nymphalidous butterflies.

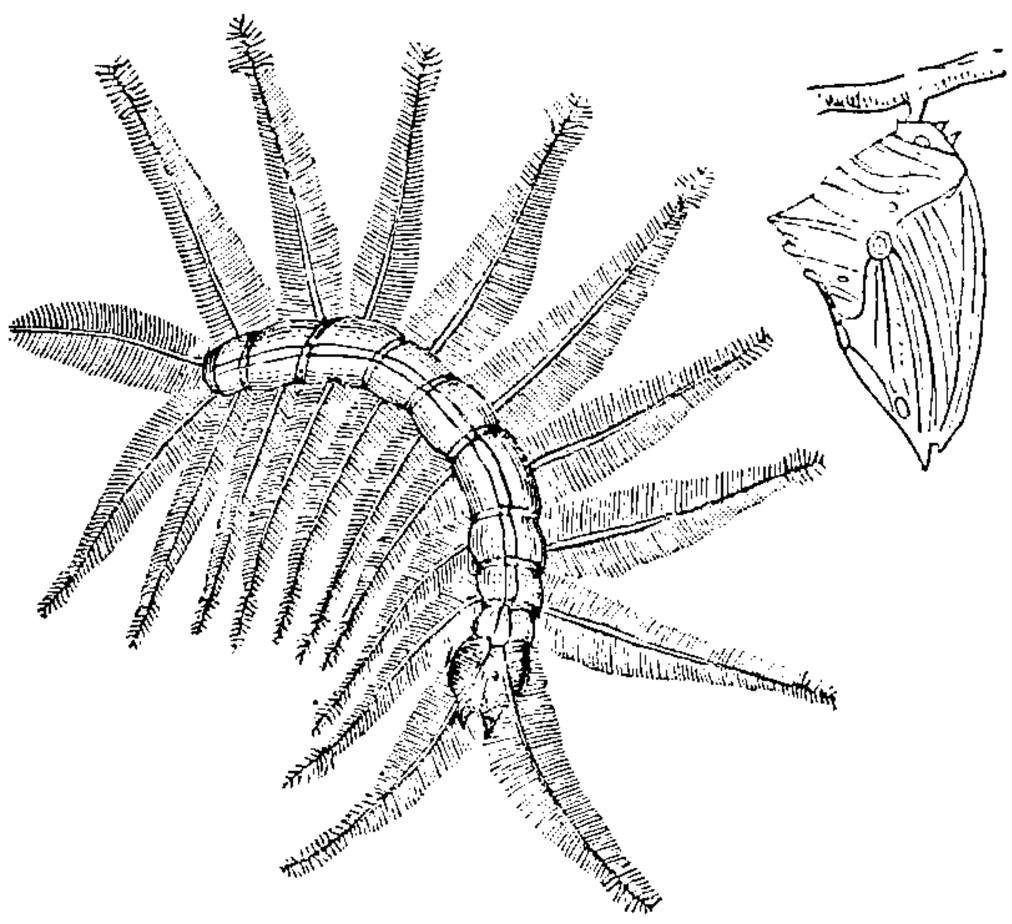
As illustrations of the curious larvæ of the *Nymphalidæ*, and no less curious angled chrysalids, there are figured two specimens from the work of Dr. Horsfield. Fig. 156 is the larva of *Acanthea primaria*; Fig. 157 the pupa of the same.

To the Nymphalidæ belong the genera *Limenitis*, and *Apatura*. The former genus with its allies, *Neptis* and *Athyma*, abounds in exotic species. One of our rarer British butterflies belongs to this genus. It is the *Limenitis Sibilla* or the White Admiral. The larva feeds on the honeysuckle.

On Plate 9, fig. 1, and 1 *a*, is figured Mr. Hewitson's exquisite Amazon Butterfly (*Catagramma excelsior*), one of a set of truly gorgeous South American Butterflies, the under sides of which are so curiously marked. Columbia is particularly rich in species. On Plate 9, fig. 6, is figured *Epicalia Penthia*, one of a genus the sexes of which differ greatly—so much so, that the males and females of one species have been described as two species of two genera.

To this family belong many gorgeously decorated Butterflies, the males of which are shot over with vivid purple, or with metallic green and blue.

Fig. 156. Fig. 157.



Larva of Acanthea primaria.

In this country we have one of these, though it is confined to the southern parts. The Butterfly is named the "Purple Emperor" (*Apatura Iris*).

The Caterpillar of the Purple Emperor feeds on sallows and on the poplar; it is a pretty object, especially to a collector, who much admires that singularly armed head, which has two horns on it, somewhat like a snail or slug. Its colour is pale green, with slanting yellow lines and a yellow stripe on each side. The chrysalis is suspended by the tail on the under side of a leaf. The male is a truly beautiful insect, having for its basis colour blackish-brown, which, as the insect turns to the light, seems to change into the most brilliant purple, the colour varying most surprisingly at every turn, while the white band and the broken white spots relieve the hues in a manner that is singularly charming.

An insect from South America, figured in our plate (*Apatura laura*—Plate 9, fig. 3), is one of a set washed with silver on the under side, and having the finest "shot" of green and blue running over the greater part of the upper wings.

The *Celænis Dido* is a handsome, though not very showy butterfly, named by its first describer after the Queen of Carthage, celebrated in the classic page of Virgil. Mr. H. W. Bates found it and other species of the genus very abundantly in June, 1852, on the river Amazon. The species figured (Plate 10, fig. 1) is the *Agrias Claudia*.

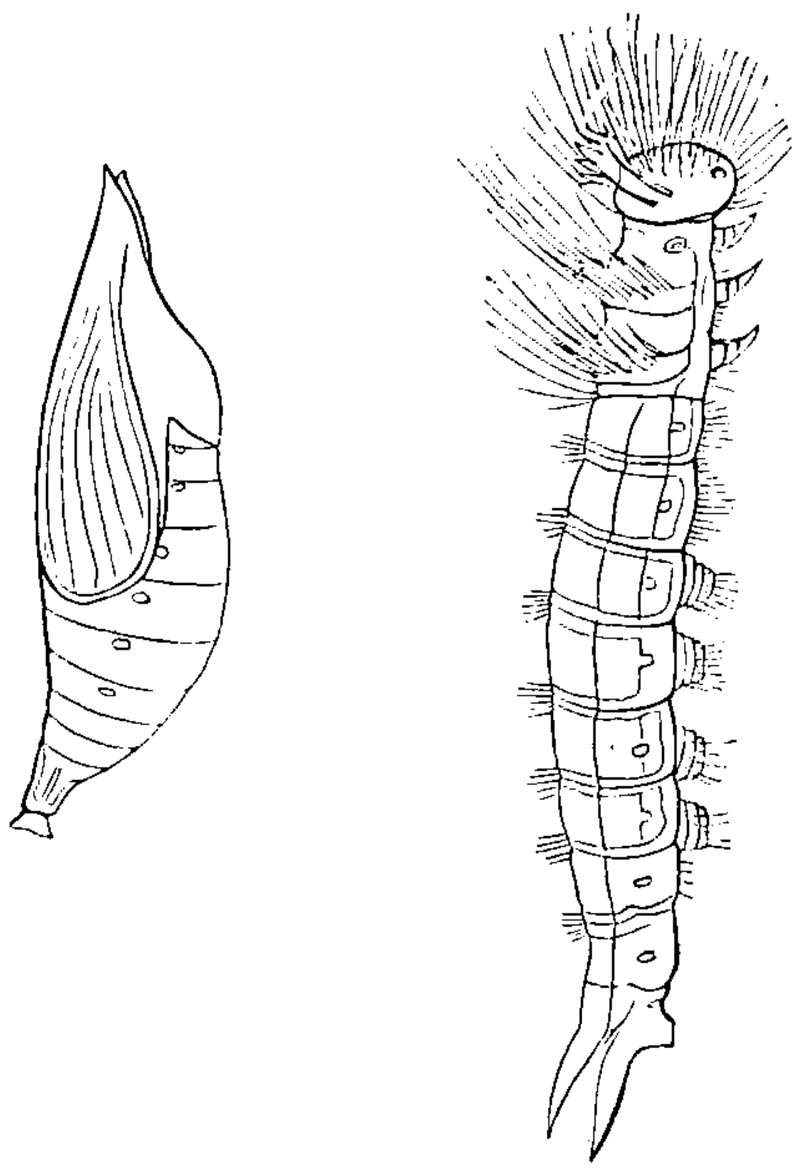
FAMILY—MORPHIDÆ.

In this family of Butterflies are many of the largest and most brilliant of the Diurnal Lepidoptera. Although some of the group are found in Asia and the Asiatic

islands, by far the larger number are peculiar to South America. M. Lacordaire describes some of the species of Morpho as flying majestically round the tops of trees. Although he spent twenty months in Cayenne, and frequently saw some of these, he was unable to capture them, while others differing from them in mode of flight he occasionally captured, as they jerked forward to the distance of eight or ten steps at a bound, and thus progressed rapidly through the forests. Many of the species have on the upper surface large masses of shining blue on a dark ground, and the under side of the wings is ornamented with many ocellated spots. The body is small and slender, the head of moderate size, and the eyes generally large and prominent; the labial palpi are generally erect, small and wide apart, generally clothed in front with depressed scaly hairs. The antennæ are slender, and end in a very slender club; the fore wings have the discoidal cell much elongated and always closed; the hind wings of the males are generally furnished with one or two tufts of hair near the base; the discoidal cell is in some open, in others closed, while the anal margin forms a deep gutter for the reception of the abdomen. The anterior legs are imperfect.

Some of the genera, such as *Clerome*, *Drusilla*, and *Thaumantis*, are peculiar to the Old World, being restricted to India and the Eastern islands. Some of them seem as it were to link this family to *Satyridæ*. One of these is figured *Drusilla Mylœcha*—Plate 10, fig. 2—a native of the Louisiade archipelago.

Fig. 158. Fig. 159.



Amathusia Phidippus.

Fig. 158 shows the pupa of *Amathusia Phidippus;* 159 represents the larva; one of the butterflies of the East Indian archipelago.

The *Morphos* are forest insects, rarely coming into the open grounds, and often flying for miles along roads and open pathways. Their flight is slow and undulating, but they are very difficult to take on the wing.

FAMILY—BRASSOLIDÆ.

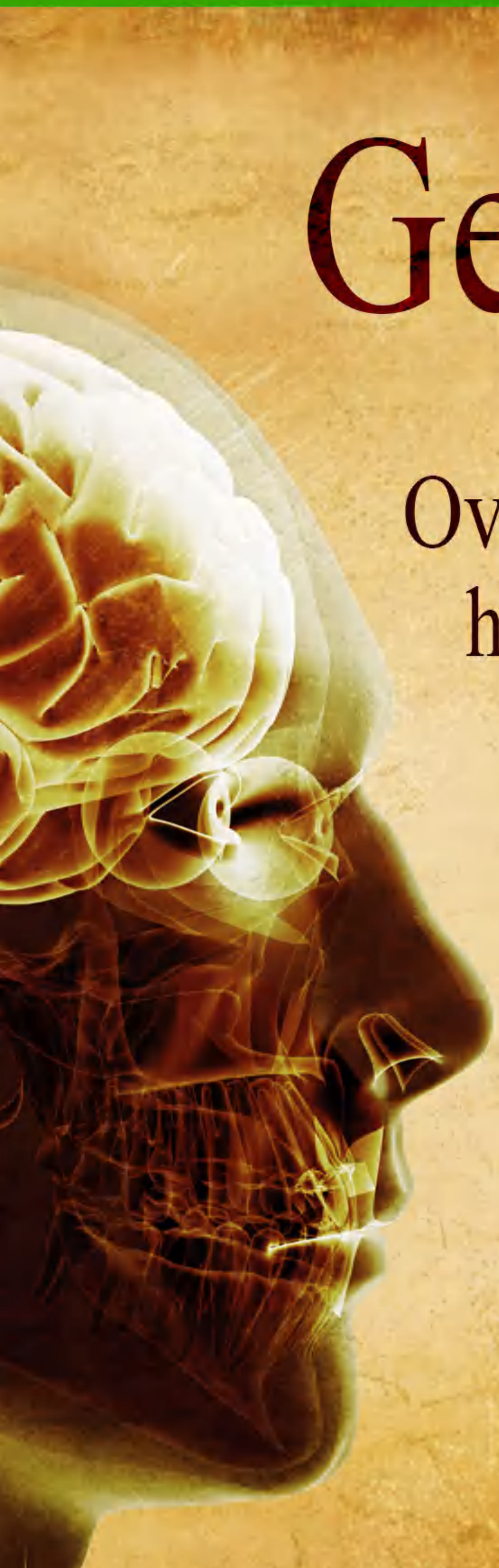
The family BRASSOLIDÆ is characterized by the very strong body, the small head, with very small palpi so closely applied to the face that they appear, when seen from above, simply to be two points between the eyes. The fore legs of the males are small and brush-like, and have, as in the Nymphalidæ, the tarsal joints obsolete. The species are all inhabitants of the warmest regions of the New World. The caterpillar is of a social disposition; it lives in companies of considerable numbers in a close web which it spins, and from this web it comes out only during the night to feed. This caterpillar changes into the chrysalis at the beginning of April, and the butterfly appears in about two weeks after. The chrysalis is pale, spotted with dark red, and marked with four silvery spots; the butterfly is of a sombre brownish-black colour, barred with yellowish brown, and is said to fly very swiftly, and it appears only early and late in the day.

FAMILY—SATYRIDÆ.

The insects of this family differ from the butterflies of the families *Morphidæ* and *Brassolidæ*, in having very long palpi, which are more or less erect and clothed in front with long porrected hairs; the hind wings have no prædiscoidal cell, and the insects are generally weak compared with the stout large species so common in the preceding groups. They have a vast range, being generally scattered over the world; some of them, such as the species of *Chionobas* are found in the arctic regions—dusky, dull, brownish butterflies, which with their *life* help, along with the flowers and grasses on which they feed, to enliven these dreary parts. There are more species of this family of butterflies in Europe than a third of the whole number of European diurnal Lepidoptera; they are generally of small or moderate size, and their prevailing colour is brown—hence the name of "Meadow Browns," given to them by collectors. The under surface of the wings is generally ornamented with eye-like spots. The larvæ are attenuated behind, the body ending in a fork or two small epines; they are covered with downy hairs. The head is more or less rounded, and is armed with two spines. These caterpillars almost exclusively feed on grasses, which accounts for their wide geographical distribution. They are not often seen, as they have the peculiar habit of feeding only at night. Many of the species, such as our *Janira* and others, in the chrysalis state suspend themselves by the tail, while others, such as *Circe*, *Semele*, and others, are found to retire into the ground to undergo their change into the pupa state. The eggs are more or less globular. We have eleven British species.

FAMILY—EURYTELIDÆ.

The species are chiefly natives of the hottest regions of the globe; such as Asia, tropical Africa, Brazil, and



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In their flight they are very rapid, the eye being scarcely able to follow their movements. They are fond of the hottest sunshine, and in rapidity of wing they rival the Hawk-moths. Our English collectors have given them the name of "Skippers," from their peculiar flitting movements. The caterpillars are of moderate length, cylindrical, fleshy, and not spined. They have a large head and a narrow neck, and generally live in rolled-up leaves; hence Dr. Boisduval has given the name of *Involuti* to the division which contains them. The chrysalis is entire, and is generally without angular prominences. It is attached by the tail, and is girt round the middle, being, however, sometimes inclosed in a slight silken cocoon among the rolled leaves.

The chief character of the family consists in the middle legs having a pair of spurs in the middle of the hind tibiæ, a character not met with in other butterflies.

Mr. Westwood gives the following as the characters of the family.—The head is often very broad, and has generally a tuft of hairs at the base of the antennæ, which are wide apart and often terminated by a thick club or a strong-curved hook. The eyes are large and very prominent. The labial palpi are short and broad, and closely compressed against the face; they are densely covered with scales, and the terminal joint is often very minute, scaleless, and conical. The spiral tongue is very long. The forewings have always four branches to the postcostal vein; all rising before the extremity of the discoidal cell. The hind wings have the anal portion of the outer margin often produced into a lobe or tail. The fore legs are perfect; the tibiæ are short, and have generally a horny flattened spur on the inside beyond the middle, which is generally concealed by long hairs. The peculiar spurs on the intermediate legs have been previously noticed. The hind legs have generally a pair of spurs below the middle and another pair at the tip. The tarsi are long, and have rows of short spines beneath; the claws are much bent, are broad at the base, and have a deep notch in the middle.

HETEROCERA.

IN this great section of the Lepidoptera are placed all those species in which the antennæ is never terminated in a club, as in the preceding group, the Butterflies. In the species composing this group, the antennæ are filiform, fusiform, or setaceous; the males in many species having them beautifully pectinated. There are not less than nineteen hundred British species known, and the number of exotic species is probably equal to that of any group in the entire order of insects. Interesting as it would undoubtedly be to dwell upon these insects in the same detailed manner in which those composing the preceding orders have been treated, we are compelled, by want of space and other circumstances, to give a very brief account of the Moths, which comprise the group *Heterocera*.

FAMILY—SPHINGIDÆ.

These insects are the most robust and powerful of the whole group. They are known in this country as the Hawk-moths. The tongue in many species is very long, being adapted for reaching the bottom of the longest-tubed flowers. They are called Sphingidæ from the circumstance of their larva assuming a position, when alarmed, resembling the figure of the emblematic Egyptian sphinx. Many of the species only take wing in the evening, about twilight; others fly by day, as does the Humming-bird Hawk-moth—so called from its flight and its mode of hovering on the wing, after the manner of the Humming-bird, whilst it quaffs the nectar of flowers.

The *Sphinx convolvuli* takes wing in the evening, not flying, but darting like a flash of lightning from flower to flower; its tongue, which is longer than its body, reaching to the bottom of the longest-tubed flower.

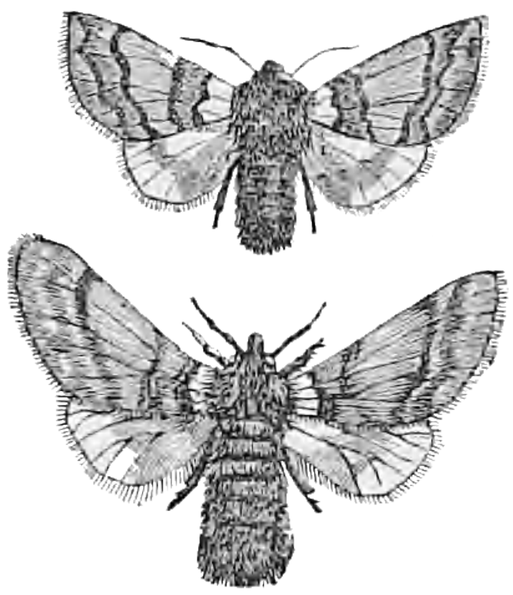
One of the best known and most universally distributed species of Sphingidæ is *Acherontia atropos* (the Death's-head moth), so called from the pale skull-shaped spot on its thorax, which has caused its appearance to be regarded with dread by the superstitious. This moth sometimes commits depredations on the stores of the Hive bee, a fact well known to apiarians.

All the species of this family are beautiful insects, being, as it were, painted in the richest and most harmonious colours. Some of the British species are of great rarity, as *S. Pinastri* and *Deilephila Euphorbiæ*.

FAMILY—ÆGERIDÆ.

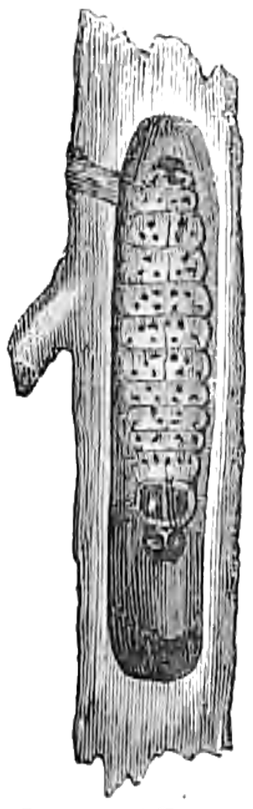
The family ÆGERIDÆ contains the moths known as Clear-wings.

Fig. 160.



Cnethocampa processionea.
a male; *b* female.

Fig. 161.



Larva of Zeuzera Æsculi.

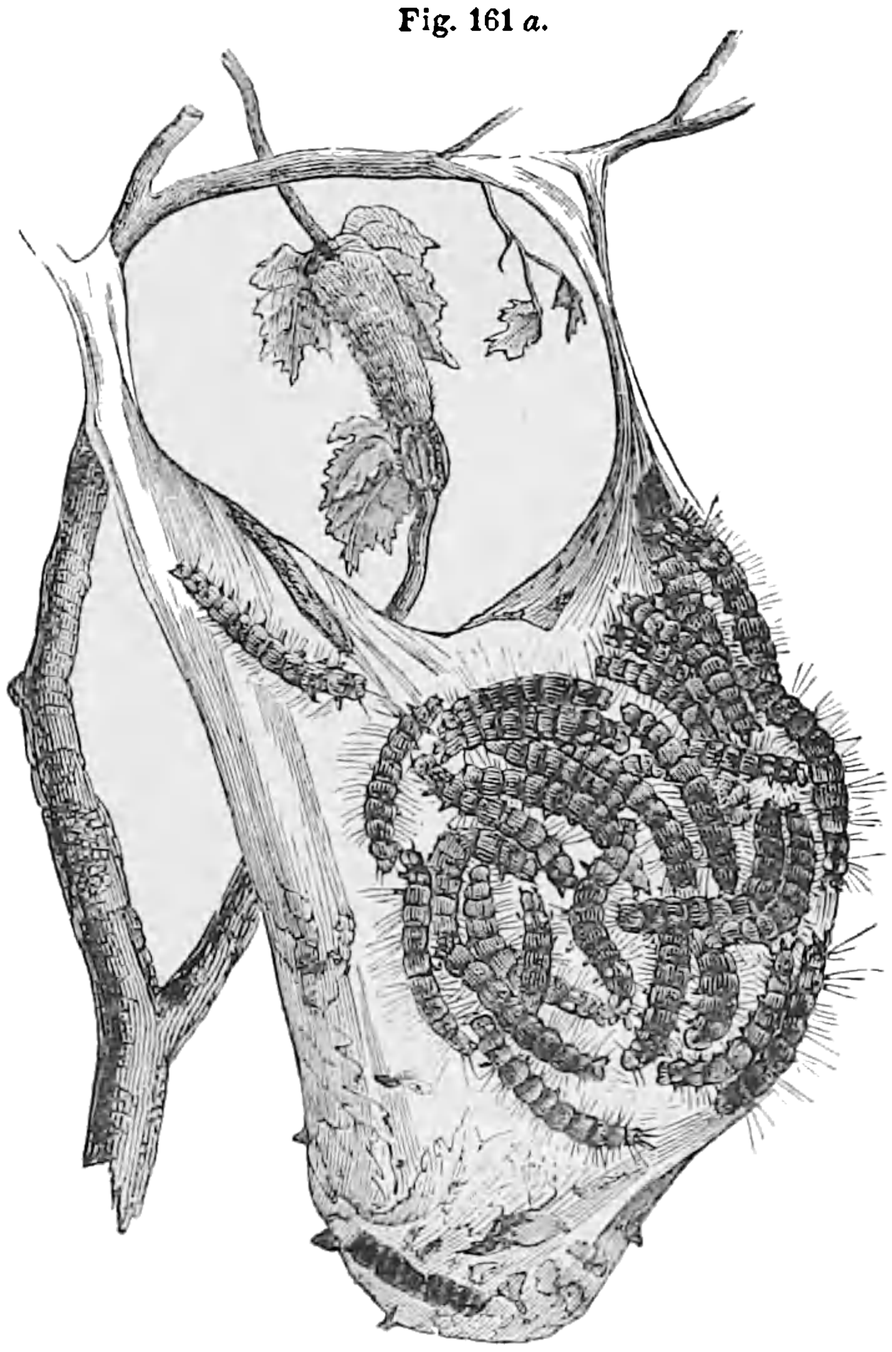
FAMILY—BOMBYCIDÆ.

The family BOMBYCIDÆ contains the silk-producing species; the best known, and that which produces the

most valuable kind, being the *Bombyx mori*, the common silk-worm being the larva of that species. Many other moths belonging to this family are silk-producers, particularly those belonging to the genus *Attacus*. To this genus belong some of the largest moths, popularly known as Atlas moths, and one of these is now being domesticated in Algeria and Brazil in the same way as the common silk-worm. This species is the *Attacus Cynthia*. It feeds on the castor-oil plant.

The "Procession moth" is worthy of notice, cramped as we are for space. It is a common species in Germany (*Cnethocampa processionea*). On its larva the fine beetle, *Colosoma sycophanta*, feeds. Fig. 160 shows the male and female. To this family also belongs the great Goat-moth, so destructive to willow and elm trees. *Zeuzera Æsculi* is also a destructive insect in the larva state to elm, horse-chestnut, pear, and apple trees. Fig. 161 shows the larva.

Fig. 161 *a*.



Social larvæ of (Eriogaster lanestris) the Processionary moth feeding on the lime tree.

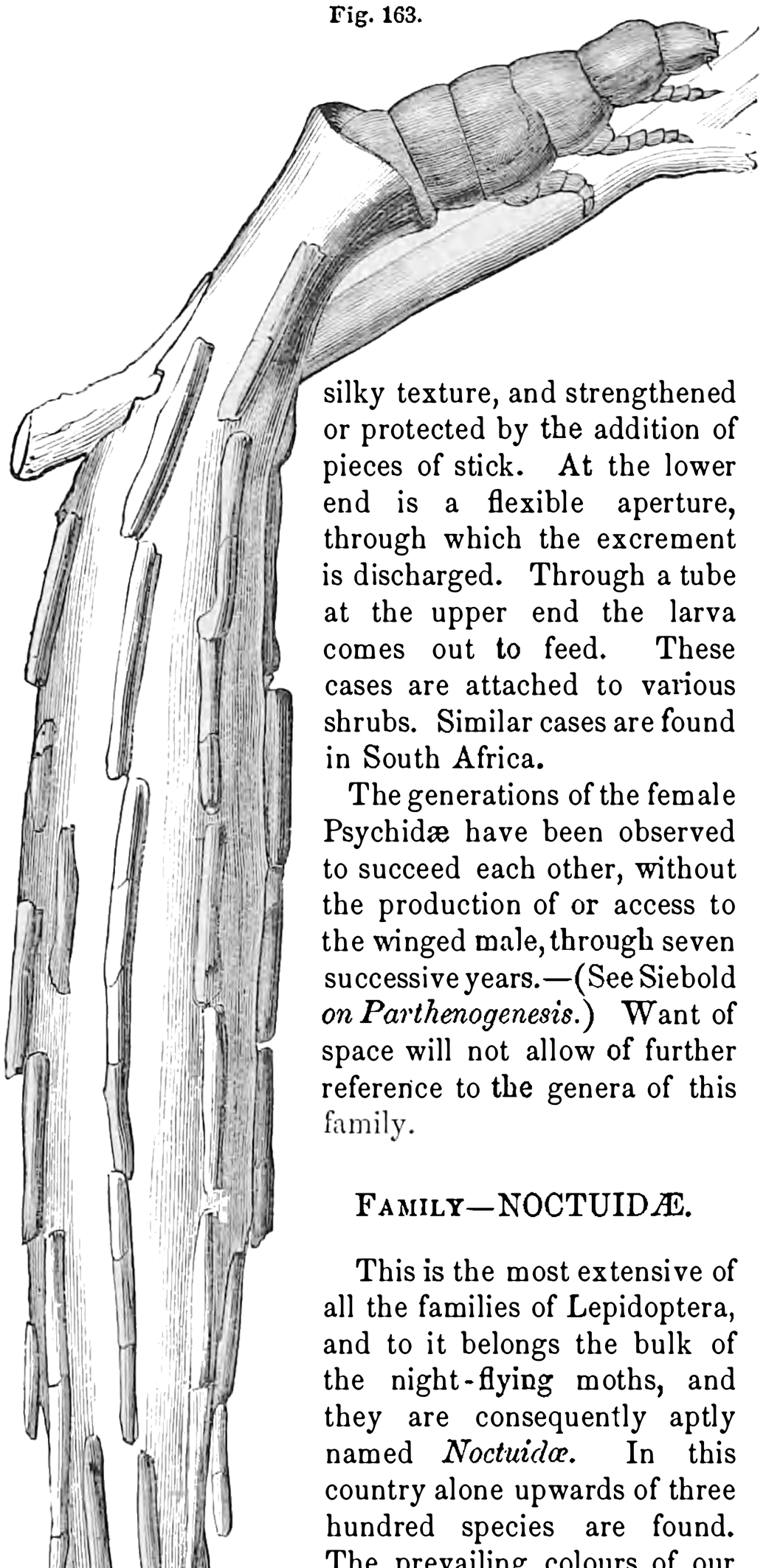
Fig. 161 *a*, represents the gregarious larvæ of *Eriogaster lanestris* (the small Eggar) inhabiting a general nest, which they occasionally enlarge, and from which they issue at night in search of food.

FAMILY—PSYCHIDÆ.

These are case-making moths. The females are wingless, the legs, antennæ, and organs of the mouth, being almost entirely obliterated. A few small species are found in this country. One, *Oiketicus nigricans*, occurs in the New Forest. We give a figure of the cases constructed by this insect in its larva state—Fig. 162, p. 264. They are found attached to the heath and gorse in May, when the moth appears.

Some of the Australian case-makers are of a large size. In fig. 163 is represented the case formed by the larva of *Oiketicus Saundersii*. The case is grey, of a

Fig. 163.



Larva of Oiketicus Saundersii and case.

silky texture, and strengthened or protected by the addition of pieces of stick. At the lower end is a flexible aperture, through which the excrement is discharged. Through a tube at the upper end the larva comes out to feed. These cases are attached to various shrubs. Similar cases are found in South Africa.

The generations of the female Psychidæ have been observed to succeed each other, without the production of or access to the winged male, through seven successive years.—(See Siebold *on Parthenogenesis*.) Want of space will not allow of further reference to the genera of this family.

FAMILY—NOCTUIDÆ.

This is the most extensive of all the families of Lepidoptera, and to it belongs the bulk of the night-flying moths, and they are consequently aptly named *Noctuidæ*. In this country alone upwards of three hundred species are found. The prevailing colours of our indigenous species are sombre, brown, black, grey, or these intermixed occasionally with dull reds. Some of the exotic species are much more highly coloured. In this family the body is robust; the antennæ are usually simple; the fore wings are narrow, under which the hind pair are folded in repose; the larvæ are usually naked, have sixteen legs, and undergo their transformation under ground. To this family belongs the common Yellow Underwing (*Triphæna pronuba*), so frequent in gardens, in strawberry beds,

&c. Some species are, however, very local, as *Agrotis lanigera* from the Isle of Wight, *N. Ashworthii* from

Fig. 162.

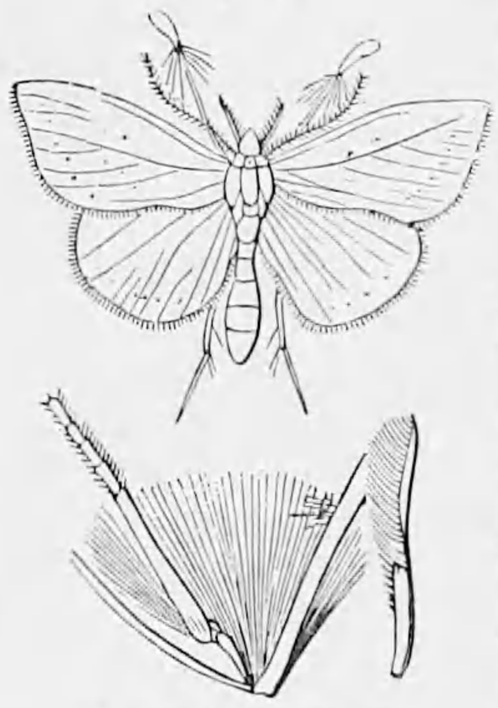
Cases of larva of Oiketicus nigricans.

North Wales, and others we have no space to enumerate.

FAMILY—PYRALIDÆ.

An extensive family, if we include the exotic species, but of very moderate extent in this country. Fig. 164 shows a remarkable species (*Sarrothripus cribralis*). It has been named "Four-foot moth" from its curiously hairy fore legs, a magnified figure of which is given beneath the moth.

Fig. 164.



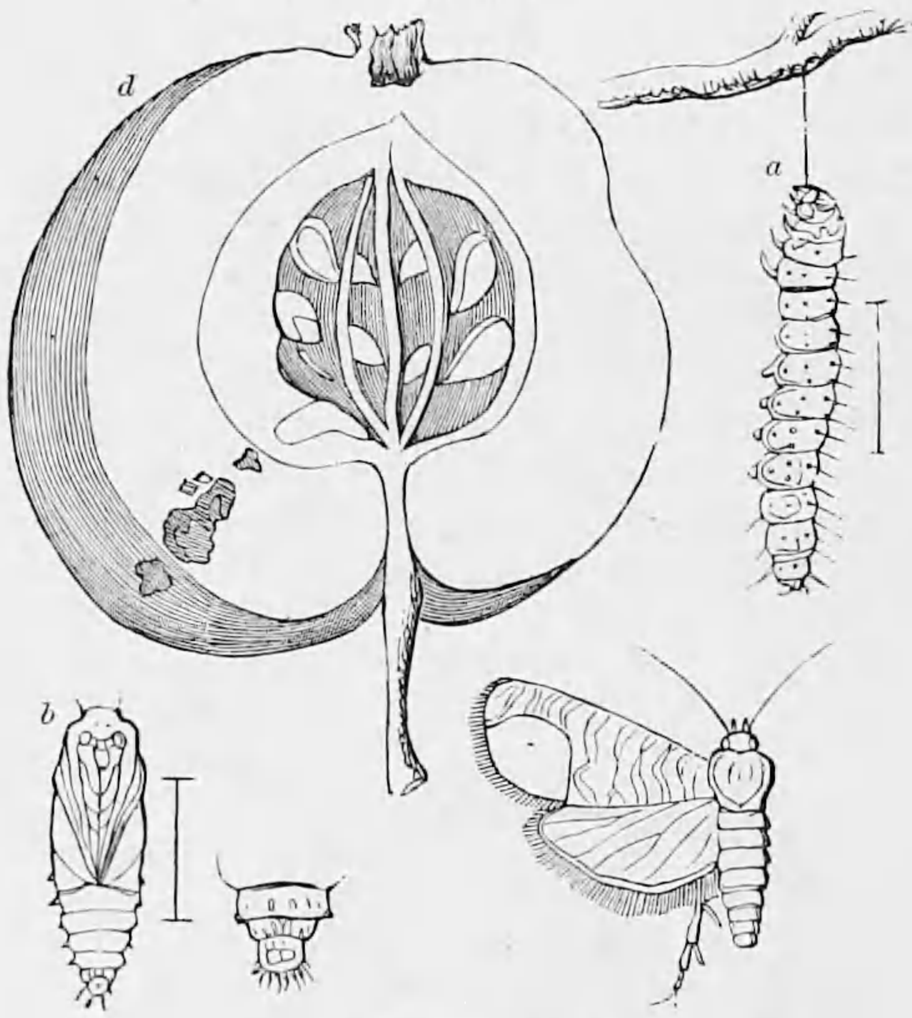
Sarrothripus cribralis.

A species of this family indigenous to Jamaica (*Diatræa sacchari*) is very injurious to the sugar cane. It is a pale-yellow dotted moth. Its larva destroys whole acres of cane in dry seasons, by boring into the stems of the canes.

FAMILY—TORTRICIDÆ.

So called from the habit the caterpillars have of twisting up leaves so as to conceal themselves. On Plate 10, fig. 10, a species is figured (*Earis chlorana*). There are nearly three hundred species in this country. They are usually small dull-coloured moths, and when at rest somewhat resemble a bell in shape. A species of this family (*Carpocapsa pomonella*), the Apple moth, is one of the most destructive enemies to the apple crop. The eggs are laid in the newly-formed fruit, within which the larva feeds, and all that are thus attacked fall prematurely to the ground. Fig. 165

Fig. 165.



Carpocapsa pomonella.

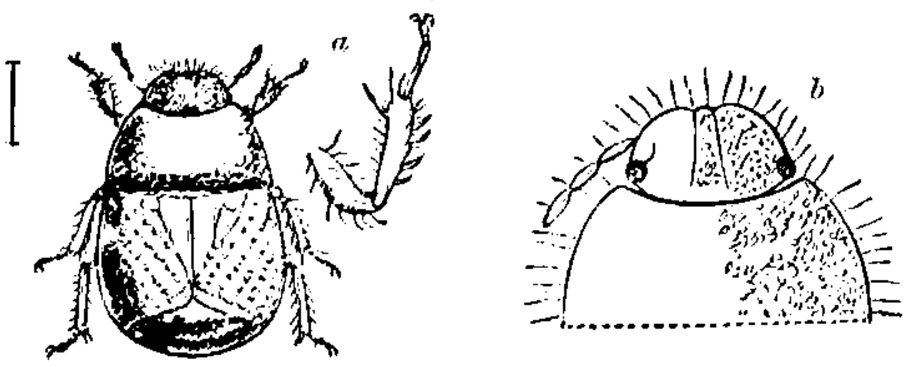
represents, *a*, the larva of *Carpocapsa pomonella*; *b*, the pupa; *c*, the perfect insect; *d*, the section of an apple, showing the track by which the larva escapes when full fed, previous to burying itself in the ground to undergo its subsequent changes. The plum, apricot, and other fruit trees, suffer from the attacks of species belonging to this family.

FAMILY—GEOMETRIDÆ.

This family is equally extensive with the *Noctuidæ*, but in this country probably not quite so numerous. The caterpillars are called loopers, or geometricians, whence the family name. They are rather slender-bodied, but their wings are ample. Their larvæ have only ten legs. Their mode of progression is very peculiar; having no legs in the middle of the body, they attach themselves firmly with their fore legs, and then bring up their hind legs close to them, thus curving or looping the body in the form of the Greek letter Ω. The caterpillars feed on the leaves of various plants, and, when disturbed, drop down swinging by a thread, up which, when their alarm is past, they remount. In some few species the females are quite, or nearly destitute of wings, and would never be taken for moths by non-entomological persons. Some species do great damage to fruit trees; others to forest timber, as *Bupalus piniarius* to pine trees.

leg magnified is the tore leg. The other figure, *b*, shows the head, one of the antennæ, and a part of the thorax. The first volume of Mr. Dallas's admirable catalogue

Fig. 166.



Chærocydnus foveolatus.

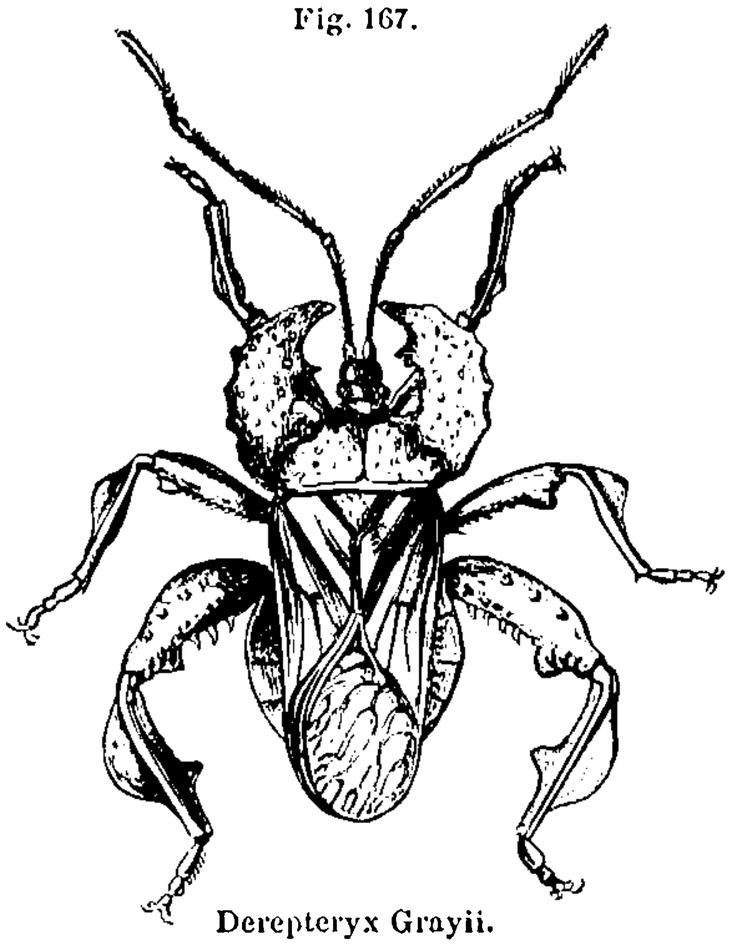
of the Hemiptera in the British Museum contains descriptions of these two families, with many outline figures of the genera.

FAMILIES—COREIDÆ AND LYGÆIDÆ.

Fig. 167 represents the *Derepteryx Grayii*, from the mountains of India.

One of the handsomest species of the family is the *Diactor foliacea*, a large beautiful fellow, with green elytra and thorax, the thorax lineated with yellow. Its hind legs have the tibiæ curiously dilated, and they are coloured with red and yellow. Should it fall into water its flat legs enable it to float. It is a common species in Brazil.

Fig. 167.



Derepteryx Grayii.

Plate 8, fig. 2, shows the pretty red and black *Lygæus punctum*, with the white dot on the end of its hemelytron. Fig. 5 of that plate shows the pretty slender *Berytus tipulavius*.

The learned Swedish naturalist Sparrman, a pupil of Linnæus, visited South Africa and discovered many new and curious subjects both in the animal and vegetable kingdoms. Among the former was a curious member of this family.* He relates that on one of his excursions at the Cape, as he was seeking shelter from the sultry sun under the branches of a large shrub, he observed this insect. It attracted his notice by falling from the branch: at first he took it for a little pale crumpled leaflet. Great was his surprise to find a curious live insect creeping on the ground, like a small piece of withered leaf with its edges turned up and gnawed by caterpillars, while it was closely stuck over with prickles. The insect has been frequently found since Sparrman's time, and is now, with others of its congeners, well known to them under the name of *Phyllomorpha* (Leaf-shape). It is of a tawny yellow hue, varied with different shades of brown and red, and is not quite half an inch in length. Two species of the genus have been met with in Southern Europe. On Plate 8, fig. 4, is figured the *Phyllomorpha paradoxa*, or *Syromastes paradoxus*, as it is named on the plate.

* Cimex paradoxus of Sparrman—Phyllomorpha paradoxa of modern authors.

FAMILIES—CIMICIDÆ AND TINGIDÆ.

The Bed-bug (*Cimex lectularius*) was formerly a rare insect in this country. Old Mouffet mentions, that in 1503 two ladies were thrown into a state of great alarm by the appearance of bug-bites upon them; till their physician, who was a naturalist, explained to them the insect cause of their being spotted, they were afraid that they had the symptoms of the plague! Their fears were turned into laughter when they saw the little flattened insects, whose nocturnal attacks had marked them. Kirby and Spence tell us that their original name in English was *Chinche* or Wall-louse. The name Bug was not applied to them till after John Ray wrote. It is a Celtic word signifying a ghost or goblin, and was given to them most probably because they were considered as "terrors by night."* They are difficult of eradication when they get into houses. On Plate 8, fig. 1, is figured the *Dictyonota* or *Tingis vinarum*. Some of the Tingidæ, if on a larger scale, would arrest the attention of any one by their exquisite beauty.

The *Capsi and Phytocoris* group are very numerous.

FAMILY—REDUVIIDÆ.

A large and important family.

The *Reduvius personatus* derives its name of *personatus, i.e.*, "the masked," from the insect in its larva and pupa states being covered with dirt, even on the legs and antennæ, so as to alter its appearance. This dirt consists of the dust, fragments of wool or cotton, and such matters as fly about rooms. It is predaceous, and is glad to make a meal of that much hated relation the bed-bug. It is not an uncommon British species.

The forms of Reduviidæ are most various. But to *Eulyes Petalocheirus*, &c., we can only refer. Bishop Heber was evidently much annoyed by Hemiptera in the East. He says:—

"One of the greatest plagues we have as yet met with in this journey is that of the winged bugs. In shape, size, and scent, with the additional faculty of flying, they resemble the odoriferous genus too well-known in England. They came out in hundreds and thousands

* In some of the old versions of the Bible Ps. xci. 5 is translated, "Thou shalt not need to fear any *bugs* by night."

from every bush and every heap of ruins, and so filled our cabins as to be scarcely endurable . . The mighty army settled on the wet paint of the ceiling, and remained there black and stinking until the ants devoured them. These last swarm in my presence; they have eaten up no inconsiderable portion of my provisions, and have taken, I trust to their benefit, a whole box of blue pills; but as they do their best to clear it of all other vermin, I cannot but look on them with some degree of favour."*

FAMILY—NEPIDÆ.

The insects of this family are pre-eminently carnivorons, if that title can be given to the larvæ of water insects, and to small fish and reptiles. The largest species of the group belongs to the genus *Belostoma*, from Brazil. The antennæ are very short, and have four joints; the terminal three being more or less branched, while the tarsi are two-jointed. It is restricted to the warmer parts of the world, is aquatic, and eminently rapacious. Dr. Leidy describes another genus, under the name of *Perthostoma*. The beak is short, strong, and pointed, and the bite is exceedingly venomous to the smaller animals.

The insects are found in lakes, ponds, ditches, or tranquil waters, where they reign undisputed monarchs over insects and small fry. Mollusca, the smaller crustacea, and even small frogs and fish, become an easy prey to them.

The insects of these genera quit the water when it is nearly dried up, or is depopulated through their voracious appetite.

The female of Perthostoma, according to Leidy, carries about one hundred and thirty eggs on her back until the larvæ are nearly in a condition to make their escape. When the ova have arrived at maturity, the insect casts the mass from her back, when they lie at the bottom of the water until the young burst from their confinement.

Plate 8, fig. 9, represents the *Naucoris cimicoides*, a British species. There are three British species. The genus *Ranatra* is long and filiform; *Nepa*, or the Water-scorpion, is broad and flat, and has two long anal setæ.

FAMILY—NOTONECTIDÆ (*Water-boatmen*).

These insects are true swimmers; their hind legs are greatly elongated, and edged with strong hairs, close together, and forming a blade, as it were, to the oar-like propelling leg.

Plate 8, fig. 6, exhibits the curious *Notonecta glauca*, or Water-boatman. The name Notonecta, or swimmer on the back, alludes to the habit of the insects which swim in this way. Their beak is sharp; they prick very severely with it. There are thirteen or fourteen species of this family, in four genera; *Corixa* (separated with *Sigara* by some authors and placed in a family apart under the name *Corixidæ*) *Plea*, and *Notonecta*.

A strange use is made in Mexico of the eggs of some of the aquatic Hemiptera. The natives of Mexico cultivate a species of sedge called "toulé," on which the aquatic insects deposit their eggs, the place being one of those great marshy lakes called the Lagune of Chalco. These sedges are collected into bundles and floated on the water, where the insects are attracted to them as places on which to deposit their eggs. The bundles lie for about a month in the lake, when they are removed from the water and dried. The myriads of eggs are beaten from them into a large cloth. These eggs are cleared, and sifted, and put into sacks, and sold to the people, who make of them a kind of cake or biscuit, which they call "hantlé." It is described by M. Craveri as being tolerably good, but somewhat fishy in flavour, and with an acid taint. The bundles of sedge are again put into the lake, and a fresh supply of eggs obtained. The insects which deposit these eggs are chiefly two species of Corixa; one of them being new, he names it *Corixa femorata*; the other was described by Say, the American entomologist, in 1831, under the name of *Corixa mercenaria*.

FAMILY—GALGULIDÆ.

A very curious group of insects; rough on the upper side; and with a broad transverse head, and pedunculated eyes. There is no British representative of the family.

FAMILY—HYDROMETRIDÆ.

Who has not watched them speeding by fits and starts, like skaters on ice, across the surface of our quiet waters —"fearless walkers," as Hugh Miller observes, "that with true faith in the integrity of the implanted instinct never made shipwreck in the eddy or sank in the pool." On Plate 8, figs. 7 and 8, the *Gerris lacustris* and *Hydrometra stagnorum* are figured.

SUB-ORDER—HOMOPTERA.

THIS is a very extensive set of insects, in which the upper and lower wings are generally homogeneous. The antennæ are in most of them very short and bristly.

List of families and genera of British Homoptera:—

Sect. 1.—TRIMERA. Three-jointed tarsi.
Family 1.—*Cicadidæ*. *Cicada* 1.
Family 2.—*Fulgoridæ*. *Pseudophana* 1; *Issus* 1; *Cixius* 21; *Asiraca* 4; *Delphax* 19.
Family 3.—*Cercopidæ*. *Smilia* 1; *Centrotus* 1; *Ledra* 1; *Eupelix* 1; *Paropia* 2; *Ulopa* 3; *Cercopis* 1; *Aphrophora* 2; *Ptyela* 5; *Acucephalus* 11; *Aphrodes* 22; *Phrynomorphus* 1; *Evacanthus* 7; *Typhlocyba* 30; *Batracomorphus* 1; *Penthimia* 1; *Agallia* 4; *Idiocerus* 5; *Macropsis* 1; *Oncopsis* 1; *Jassus* 1.
Sect. 2.—DIMERA. Two-jointed tarsi.
Family 1.—*Psyllidæ*. *Psylla* 27; *Livilla* 1; *Livia* 1.
Family 2.—*Aphidæ*. *Aphis* 21; *Lachnus* 35; *Atheroides* 2; *Eriosoma* 11; *Adelges* 22; *Brysocrypta* 1; *Phylloxera* 1; *Thelaxes* 3—in all, ninety-six species. In Mr.

* Bishop Heber's Indian Journal, vol. i. p. 72. Murray, 1849.

Walker's list, two hundred and fifty-eight species are recorded.

Family 3.—*Aleyrodidæ*. *Aleyrodes* 2—Walker gives 6.

SECT. 3.—MONOMERA. One-jointed tarsi.

Family *Coccidæ*. *Dorthesia* 6; *Aspidiatus* 3; *Coccus*—Walker gives 22 species.

FAMILY—CICADIDÆ.

A very extensive family of insects, generally with broad head and clear wings, the males of which have a drum with which the remarkable noise is produced. A species of Cicada found in the United States, has acquired celebrity, and its name, *Cicada septemdecim*, from each brood requiring the interval of seventeen years for coming into its winged state. Dr. Fitch remarks, "The unusual length of time which it requires for completing its growth, and the perfect regularity with which every generation, numbering many millions of individuals, attains maturity so as to come forth at the end of seventeen years—the entire brood hatching within a few days' time—has caused this more than any other American insect to be noted throughout the world. The insect dwells entirely in timber land. They were noticed as long ago as 1715. The perfect insect deposits its eggs in many different kinds of trees, yet appearing to prefer those which have the twigs thick and robust. The eggs are white; the young when hatched have six legs, of which the front pair is by far the largest, and armed on the under side with strong spines. It drops from the tree and buries itself in the ground by means of its fore legs, which are well adapted for digging. The pupa comes out of the ground in the night; "the warmth and dryness of the air by day would doubtless cause its outer shell-like case to become stiff and crack open prematurely." It fixes itself securely by its feet, its thin covering cracks open in front on the back, and out crawls the large black, four-winged fly, with orange-coloured nerves and red eyes.

Cystisoma Saundersii, with its puffed-up body like a *Pneumora* among the Orthoptera, is a strange Australian form.

Tettigareta tomentosa, described by the writer, has a small head and a strange rounded thorax; it is Australian.

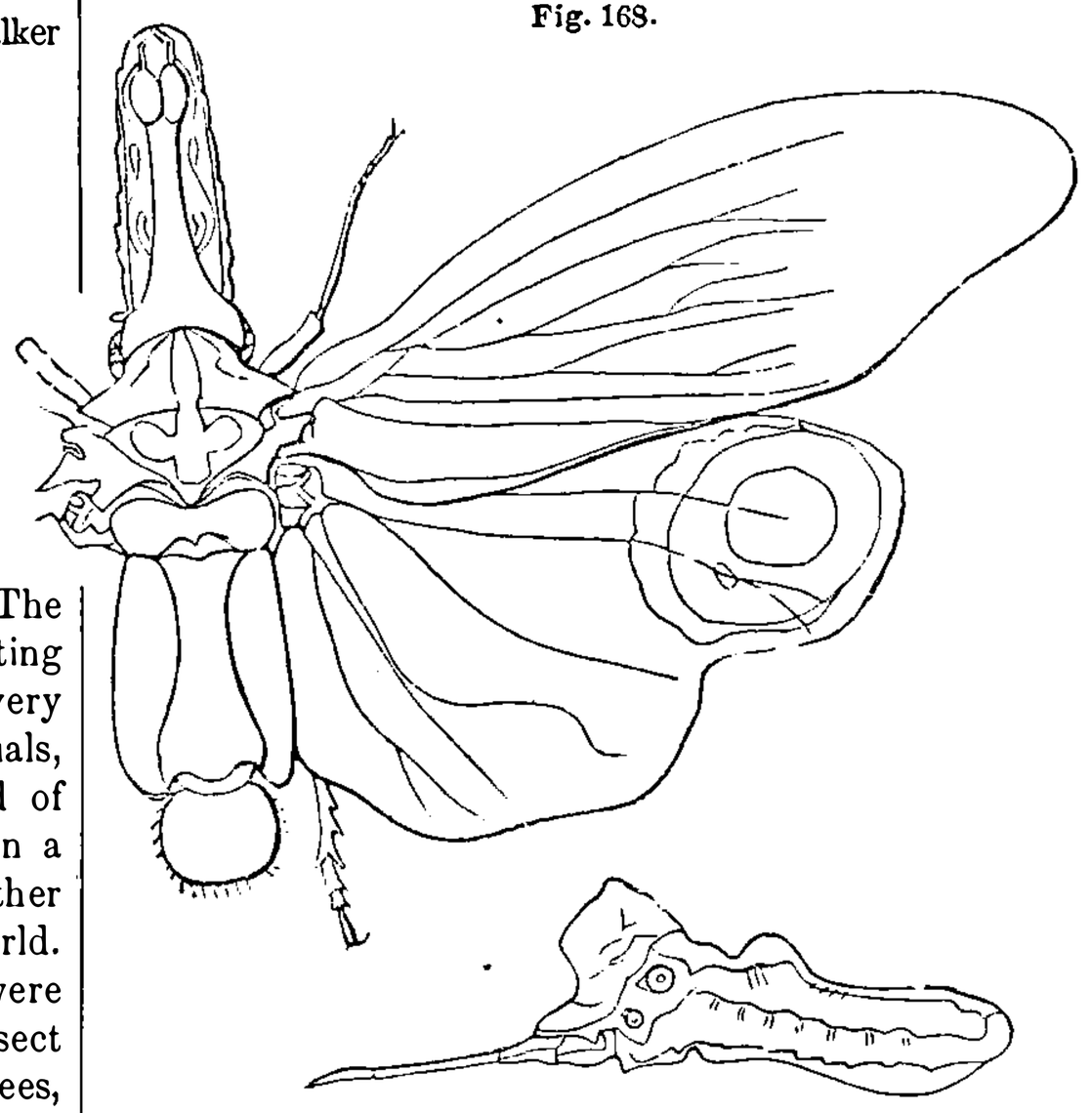
The *Cicadæ* and their noise, or "music," are often referred to by Virgil and Anacreon, and other Greek and Latin poets.

FAMILY—FULGORIDÆ (*Lantern-flies*).

Madame Merian was the first who stated that the great South American Lantern-fly (*Fulgora laternaria*) was luminous. Modern travellers have not been able to detect this luminosity; but it may nevertheless exist at times and in certain states of the atmosphere. I have asked Mr. Bowring of Hong Kong about the Chinese species, and he told me he had never seen any luminosity in the *Hotinus candelarius* (Plate 8, fig. 14, *Fulgora candelaria*). Fig. 168 is that of *Fulgora laternaria*.

The Fulgoræ are a curious group. Some are really most lovely, such as the Ceylonese *Hotinus maculatus*, dark, grizzled with flowery spots, dusted on its prettily

Fig. 168.



Fulgora laternaria.

veined upper wings; the lower wings are black, the base of a beautiful bluish-green.

Of the African species there is *Pyrops nobilis*, grey and ochraceous, with white wings; upper wings and head thickly dotted with black.

Phrictus serratus from South America, with his saw-like beak, is a strangely-coloured Lantern-fly.

Among the Fulgoridæ, but without the projecting forehead, may be mentioned the very beautiful genus *Aphæna*. They are chiefly from the East.

The *Lystræ* have broader heads (Plate 8, fig 12, *Lystra pulverulenta*). They are chiefly from South America.

The *Phenax auricoma* has the head and end of the abdomen covered with great patches of a yellowish-coloured waxy matter.

The species of Pæciloptera (*Flata* and *Pochazia*) are most curious. The wax of some of the Flatæ is collected, particularly in China and the East Indies, where it is manufactured into candles.

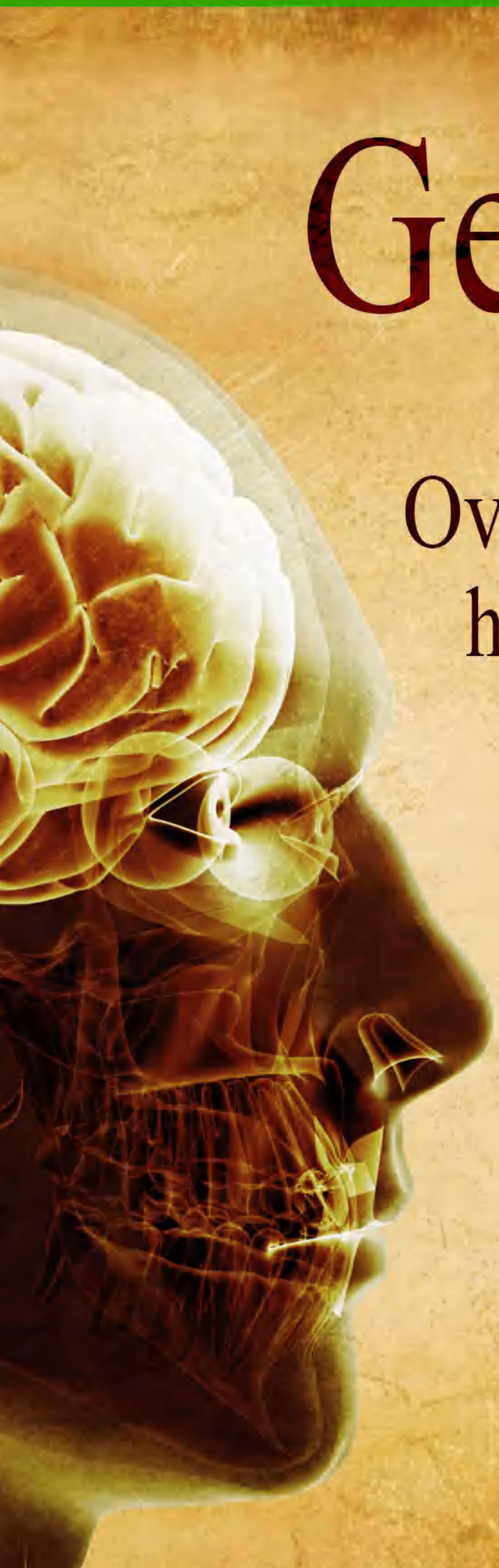
The *Delphax saccharivora* of Westwood is most destructive to the sugar cane in the West Indies.

Eurymela is a pretty, broad-headed, Australian genus; some of the species are deep brown, with white spots.

Ancyra is a curious genus described by the writer; the species *Ancyra appendiculata* (Plate 8, fig. 10), is so named from the curious little appendages to the wings. It is a native of the coast of the Gulf of Martaban.

Achilus is a genus of Australian Homoptera described by Kirby. The species (figured Plate 8, fig. 11) is of a reddish vermillion hue.

There are about thirty species of the great group in the British islands; they are included in the families *Pseudophanidæ* and *Delphacidæ*.



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over the kingdom; so that a supply could not be obtained for the navy.

Plate 8, figs. 16 and 17, shows the *Aphis rosæ;* the former figure represents the male, the latter the female of that species; the figures, of course, are very highly magnified.

ERIOSOMA.—This genus, so called by Leach from its seemingly woolly body, has no tubercles at the end of the body for the secretion of honey-dew. The antennæ are short and the fore wings have simple oblique disooidal nerves.

To this genus belongs the *Aphis lanata* or *A. lanigera* of authors, which is so destructive to the stems of apple trees. Mr. Knapp has given a most excellent account of this insect* as observed in one of the western English counties. He says—"Our apple trees here are greatly injured, and some annually destroyed, by the agency of what seems to be a very feeble insect. We call it, from habit or from unassigned cause, the 'American blight,' this noxious creature being known in some orchards by the more significant name of 'white blight.' In the spring of the year a slight hoariness is observed upon the branches of certain species of our orchard fruit. As the season advances this hoariness increases; it becomes cottony, and towards the middle or the end of summer the under sides of some of the branches are invested with a thick, downy substance, so long as at times to be sensibly agitated by the air. This substance on close examination is found to conceal a great number of small wingless creatures, busily engaged in sucking the juice of the tree. This they effect by means of a beak ending in a fine bristle. This is insinuated into the bark and the sappy part of the wood, and through it the creature extracts, as through a syringe, the sweet liquor that forms as it were the life-blood of the branch. This long bristle is not to be seen in every specimen. In those possessing it, it is of different lengths, and is usually kept closely concealed under the breast. In the younger specimens it may be seen protruding like a fine termination to the anus; but as the bodies lengthen, the bristle is soon concealed from view."

Mr. Knapp continues as follows:—"The alburnum, or sapwood, being thus wounded, rises up in excrescences and nodes all over the branch and deforms it; the limb, deprived of its nutriment, grows sickly; the leaves turn yellow, and the part perishes. Branch after branch is thus assailed, until they all become leafless, and the tree dies."

The Eriosoma, not having wings, is dispersed by means of this downy covering, which is wafted by the winds in small tufts, so that the creature is conveyed with it from tree to tree throughout the whole orchard. In the autumn this substance is generally long, and the insects being dispersed by the winds and rains which are then prevalent, try to secrete themselves in any crannies they can find. There are no data to tell us when first this noxious insect visited us. America, Normandy, and the Netherlands have all been supposed to be the sources whence it was derived. Our climate, at all events, seems to be very favourable to its increase.

* Journal of a Naturalist, p. 337.

In 1745 Bonnet published his wonderful observations on the reproduction of the Plant-lice,* and proved that the mother produced her young when no male insect was present. "He isolated the young Aphis as soon as it was hatched. On the eleventh day the Aphis produced a young one alive; another succeeded, and another. Every four-and-twenty hours the brood was increased by three, four, and even ten arrivals. At the end of twenty-one days ninety-five young ones were produced from this single Aphis. Carrying further his observations, Bonnet found that the virgin offspring of this virgin parent also became parents! We know that this reproduction often goes on till the eleventh generation; then this process ceases, the last generation is of perfect insects, with separate sexes, and these produce ova which next year become the productive virgins we have just been reading of." The rate of increase may be conceived by the following calculation. The Aphis produces each year ten larviparous broods, and one which is oviparous; and each generation averages one hundred individuals.

Generation.	Produce.
1st, . . .	1, aphis.
2nd, . . .	100, a hundred.
3rd, . . .	10,000, ten thousand.
4th. . . .	1,000,000, one million.
5th, . . .	100,000,000, one hundred millions.
6th, . . .	10,000,000,000, ten billions.
7th, . . .	1,000,000,000,000, one trillion.
8th, . . .	100,000,000,000,000, hundred trillions.
9th, . . .	10,000,000,000,000,000, ten quatrillions.
10th, . . .	1,000,000,000,000,000,000, one quintillion.

Professor Huxley has made some very curious researches on the reproduction of the Aphides,† in which he ascertains that the virgin Viviparous aphis produces its broods of young from unfertilized ova, while the female oviparous aphis produces her young from ova fertilized by spermatozoa, and that both broods in their early stages are similar.

On the family ALEYRODIDÆ, which is so prolific, I have neither room nor time to enter.

FAMILY—COCCIDÆ.

This family of insects, which contains the well-known Cochineal, is a most anomalous one. The females are always wingless, and in their last state deposit their eggs and very speedily perish; their dried up bodies serving as a cover and protection to the eggs. The mates of these insects are small fellows, not at all resembling their females in any particular either of form or habit. They are active, and have only two wings developed, which they use by flying about in the bright sunshine; the place of the second pair of wings is supplied by two small projections somewhat like the poisers of flies. But to return to the females, Mr. Westwood,‡ speaking of the whole family, says, that without referring to their singular habits, "we find some of them on arriving at their last state so far departing from the typical characters of the winged insects, as to prove that Ptilota may exist, which in the imago state are not only wingless, but also footless and

* Insectotheologie, vol. i.
† Proceedings of the Linnæan Society, Nov., 1857.
‡ Arcana Entomologica, vol. i. p. 21.

antennæless, and in which even all appearance of annulose structure is lost, the creature, in fact, becoming an inert mass of animal matter; a slender seta arising from the breast, and thrust into the stem or leaf on which the animal is fixed, being the only external appendage to the body." The most famed member of the family is, however, the Cochineal (*Coccus cacti*, the male is shown in Plate 8, fig. 13), which received its specific name from the Mexican *Cactus cochinilifer*, or *Opuntia cochinilifera* of moderns, being its food plant.

The Cochineal, when first imported, was believed to be the seed of a plant. The insects are brushed off the plant with a squirrel's tail and killed by immersion in hot water, and afterwards dried in the sun or by the heat of a stove, as alluded to above. There are three harvests a year; the first is the best, as the impregnated females alone are taken; the young females are also collected in the second harvest; and the third harvest is inferior to the other two, as old and young females, and skins, are collected indiscriminately. Before the rainy season commences the Mexicans cut off branches of the Nopal, loaded with infant insects, which they preserve in their houses; otherwise the insects would perish in the inclement weather. The island of Teneriffe annually produces several thousand bags of cochineal. The editor of the last edition of Pereira* informs us that in January, 1857, there were four thousand eight hundred and ninety-one bags of Honduras cochineal in our warehouses, five hundred and sixty-seven Mexican, and one thousand four hundred and one of Teneriffe. To give some idea of the importance of cochineal as an article of commerce, the reader may be pleased to know that in the year 1852 the imports and exports of it were respectively twenty-two thousand and forty-two, and eight thousand nine hundred and sixty-four hundredweight. There were also imported in that year fifteen hundredweight of granilla, a finer kind, and two hundred and seventy-one hundredweight of the dust.

Great quantities of cochineal are annually imported into France from Algeria. There are great nurseries there of the peculiar cactus on which the insects feed; and in one year, 1839, M. Guerin-Meneville tells us that three hundred and four thousand nine hundred and ninety-one kilogrammes were imported into France. The Algerine production is not, however, so valuable as the Mexican, though the colouring matter is nearly as pure and strong. The Spaniards have introduced the cochineal into the Canaries, and the Dutch into Java, with excellent results to their exchequers.

In Teneriffe it is on the *Opuntia tuna* that the Coccus feeds. The plant is abundant in Madeira, where, according to Mr. Johnson, it gives a peculiar feature to the rocky parts of the landscape. This writer informs us that the merchants of Funchal are beginning to turn their attention to the cultivation of the cochineal insect, in the hope of its ultimately becoming a remunerative substitute for the vine.

The *Pe-la*, or insect which produces the insect-wax of China, is a species of Coccus (*Coccus Sinensis*), which was believed to feed on a kind of privet, somewhat brighter in leaf and foliage than the stiff shrub known so well in every garden and hedgerow by that name. Mr. Fortune, however—a good authority—says that it feeds on a species of ash. It is chiefly found in the province of Sze-tchuen, where the crude material is deposited by the insects around the branches of the tree on which they feed, and resembles a white, soft, fibrous, velvety coating of from one to two-tenths of an inch in thickness.

The late George Newport says—"So complete have been the ravages of the Coccus of the orange trees, that one of the Azores, the Island of Fayal, lost its entire produce from this cause alone. The usual exportation of fruit from Fayal has been twelve thousand chests annually, but in 1843 not a single chest was exported. This injury has already extended to St. Michael's, and is still continuing; and the inhabitants of the whole of that group of volcanic islands, depending almost entirely on the produce of their orange groves, and despairing of retrieving their prospects, are fast turning their attention to the cultivation of other objects of commerce. This amount of injury to a whole population by a diminutive and apparently contemptible insect, has been the result of but three years. The effects of this insect on a single article of luxury may fairly be adduced to show that entomological inquiries are deserving of full attention. The orange trade between this country and the Azores gives employment to upwards of two hundred sail of vessels; and, as I am credibly informed, the orange trade alone returns to the revenue of this country an import-duty of more than £50,000 per year.

Coccus Sinensis.—Mr. Westwood has applied this name to the insect which produces the white insect-wax of China, an important article very much used by the Chinese in the manufacture of candles; as much as 400,000 lbs. are believed to be annually used.

The Bark-louse of the apple tree (*Aspidiotus conchiformis*) frequently does much damage to the orchard. It has the form of a minute scale, resembling a mussel or oyster shell in shape, and hence its specific name *Conchiformis*. This insect adheres close to the bark, and is found often in prodigious numbers.

Porphyrophora.—Before the discovery of America, cochineal was obtained in considerable quantities from Poland. This cochineal was the dried bodies of the female of another species of the family Coccidæ, which derives its specific name from the country whence it was exported (*Porphyrophora polonica*). The female is roundish, about the size of a cherry stone, and furnished with short legs; she is quite soft, and of a dark amaranth colour throughout. When dried, the insects shrivel up into a small size, and are covered with a bluish mould. The true scarlet colour is produced by infusion, with the addition of acids; while the purple is produced by a solution of potash.

Lecanium Coffeæ.—This creature does not seem to have attracted attention till about 1845, when it began to spread with such rapidity that, in 1847, the planters became alarmed. It is curious that it was about the same period that the potato, vine, and olive began to be affected by disease in Europe. This scaly bug seeks out the softest and most sheltered parts of the coffee tree, such as the young shoots, the undersides of the leaves, and the clusters of berries.

* The Elements of Materia Medica and Therapeutics, by Jonathan Pereira, M.D., vol. ii., part 2, p. 760: fourth ed., 1857.

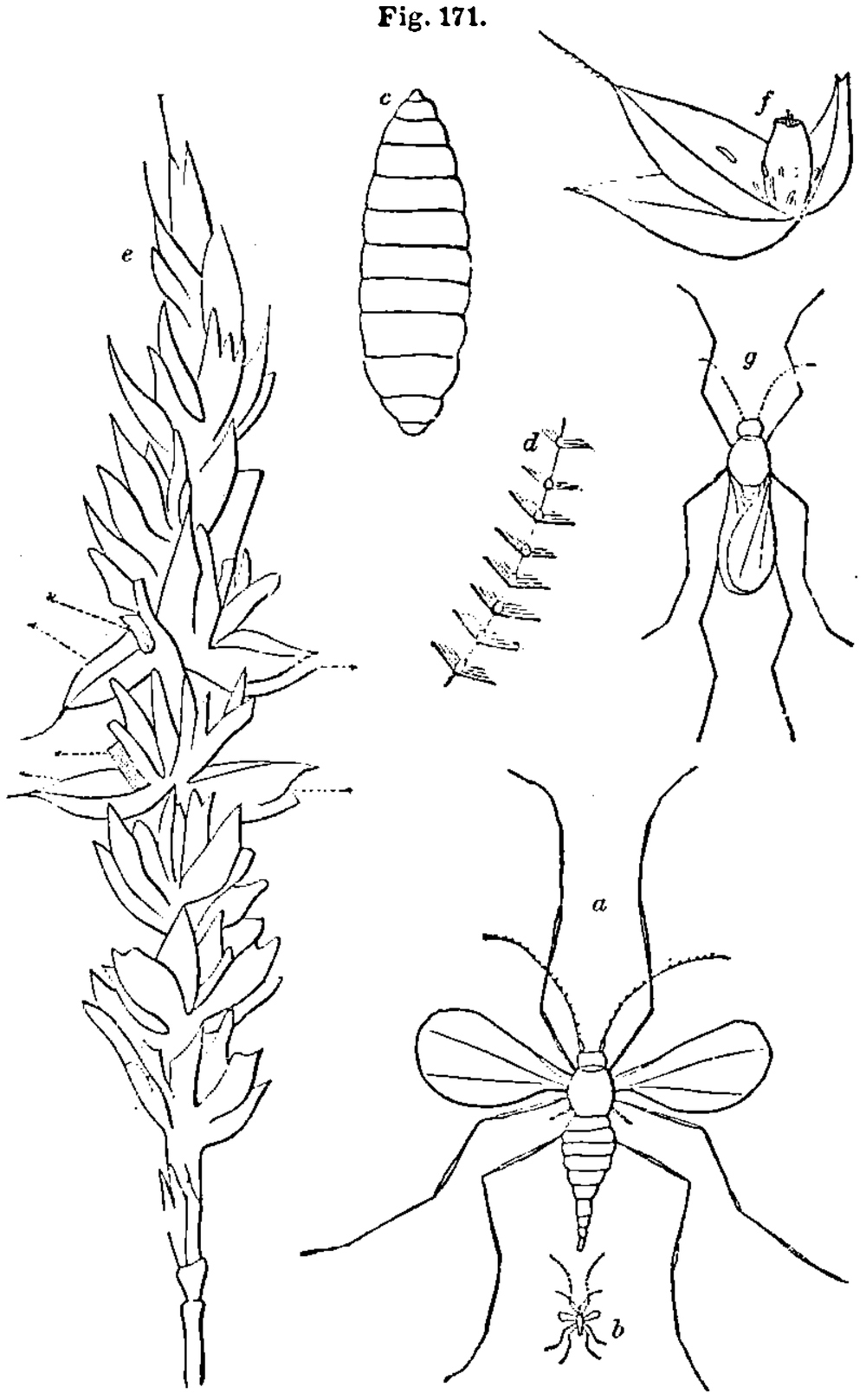
ORDER—DIPTERA.

AN order of two-winged insects, constituting one of the most extensive groups amongst the Annulosa. Although, strictly speaking, they are only two winged, yet they have, as it were, two abortive wings behind the true pair; these are commonly called *halteres* or balancers; they are frequently kept in rapid motion, whilst the true wings are apparently quiescent, and by this rapidity of motion cause a loud piping noise; this is particularly observable in the genus *Sericomyia*. Diptera are usually of moderate size, the largest known being a species of Acanthomera from Mexico—about one inch and three-quarters in length; the majority are, however, small insects.

Individual species are sometimes extremely abundant, so much so as in some instances to become a plague and a nuisance. Some of the species may be called domestic, the house-fly being an example. Flies have in all ages attracted observation from the numbers in which they sometimes appear, and in others from the terror they excite by their well-known power of causing the most intense annoyance both to man and animals. One of the plagues of Egypt was a "swarm of flies," probably mosquitoes, which came from the banks of the muddy Nile. Flies have no mandibles (jaws), but are provided with a proboscis and also several lancet-like organs. The common gnat (*Culex pipiens*) has the parts of the mouth produced into a slender rostrum, half as long as the insect; the males have beautiful plumose antennæ. The approach of the gnat is known by its shrill hum; but its alighting on the face or other uncovered part of the skin is so light as not to be easily perceptible; it instantly pierces the skin with its fine lancets; these, it pushes by degrees quite in to their base, and while the creature imbibes its fill, it apparently envenoms the wound, which subsequently causes the most painful irritation. Records of their appearance in immense hosts in particular localities, even in this country, are not wanting; thus we are told, that in 1736 they appeared at Salisbury in such hosts as to resemble columns of smoke; and in 1766, in the month of August, they accumulated in incredible numbers at Oxford, resembling a black cloud, almost totally intercepting the beams of the sun. Such appearances are not uncommon in Suffolk and Norfolk, as I have been informed by residents in those counties; on such occasions their torment is beyond description terrible.

Neither heat nor cold seems to affect these tormentors of the human race. In Lapland they swarm in incredible hosts during certain periods of the year; there is neither rest nor sleep for the inhabitants, indoors or out, unless the body is smeared with some unguent, such as grease, tar, or oil. In the eastern part of the world we well know that mosquitoes are a plague by day, and a "terror by night." Other species, belonging to the family *Tipulidæ*, are well known for the loss occasioned by their attacks on grain crops. The *Cecidomyia tritici* (fig. 171) deposits its eggs in the corolla of the young wheat plant, in which the larvæ are hatched, and by their ravages frequently cause a considerable loss, if not an entire destruction of the crop. In North America the ravages of the grain crops at times spread to an alarming extent. In Fitch's "Report of the noxious insects of the state of New York" are detailed accounts of their ravages; the larvæ of several genera are equally destructive. Species of the genus *Chlorops* have long been known seriously to injure crops. Linnæus mentions one, *Chlorops Frit*, which infests the heads of barley, causing an annual loss of not less than half a million of dollars annually in Sweden. The species of the genus *Chlorops* have, as the name indicates, green

Fig. 171.



a Cecidomyia tritici. *b* The same, natural size. *c* The cocoon of the fly. *d* Antenna of the male. *e* An ear of wheat attacked by it. *f* A grain of wheat attacked by it. *g* The American Chinch-Bug.

eyes, and may be seen frequently on the young heads of grain crops in the spring; but we must refer the reader to the work above alluded to, for a detailed account of the enormous loss occasioned to the farmer through the destructive agency of these minute depredators.

No destructive insect belonging to the family Diptera is better known than the species popularly called Daddy-long-legs (*Tipula oleracea*). This species, and some of its congeners, occasionally prove by their numbers exceedingly destructive in the larva state by feeding upon the roots of grass, and thereby doing great mischief;

appears fortunately to be confined to particular districts, and is usually found on hills, plains being free from it; it is not much larger than the common house-fly, but longer and of a blacker colour, with bars on its body. The attack of ten or a dozen is said to cause the death of a horse; to oxen its attack is equally fatal. The Tse-tse also at times attacks man; but no danger follows—in fact, no more than from the bite of a flea. Man and all wild animals appear to escape with impunity; but the losses experienced through its attack on domestic animals are quite appalling.

Dr. Livingston describes the Tse-tse as remarkably alert; it avoids dexterously all attempts to capture it with the hand at mid-day. In the cool of the morning and evening it is not so agile. He says that its peculiar buzz, when once heard, can never be forgotten by any traveller whose means of locomotion are domestic animals; "for it is well known that the bite of this poisonous insect is certain death to the ox, horse, and dog. In this journey, though we were not aware of any great number having at any time lighted on our cattle, we lost forty-three fine oxen by its bite. We watched the animals carefully, and believe that not a score of flies were ever upon them.

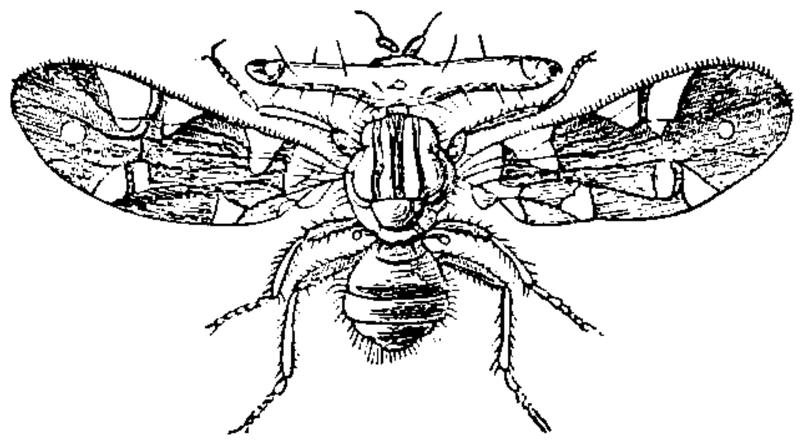
"The mule, ass, and goat enjoy the same immunity from the Tse-tse as man and the game. Many large tribes on the Zambesi can keep no domestic animals, except the goat, in consequence of the scourge existing in their country. Our children were frequently bitten, yet suffered no harm; and we saw around us numbers of zebras, buffaloes, pigs, pallahs, and other antelopes, feeding quietly in the very habitat of the fly. There is not so much difference in the natures of the horse and zebra, the buffalo and ox, the sheep and antelope, as to afford any satisfactory explanation of the phenomenon. Is not man as much a domestic animal as a dog? The disgust which the Tse-tse shows to animal excreta, is turned to account by some of the doctors. They mix droppings of animals, human milk, and some medicines together, and smear the animals that are about to pass through an infested district. This, though a preventive at the time, is not a permanent protection. Inoculation does not insure immunity, as animals which have been slightly bitten in one year may perish by a greater number of bites in the next. It is probable that with the increase of guns, the game, as happened in the south, and the Tse-tse deprived of food, may become extinct simultaneously with the larger animals. The ravages it commits are sometimes enormous. Sebituane once lost nearly the entire cattle of his tribe, amounting to many thousands, by unwittingly intruding upon the haunts of this murderous insect."

We must refer briefly to the great benefits derived by man through the agency of these insects. Diptera are the great removers or scavengers of all putrid animal and vegetable substances. No sooner does an animal or plant die and begin to decay, than it is resorted to by hosts of Diptera which deposit their eggs immediately upon it; and so quickly are these hatched and the larvæ full grown, that a successive generation of flies continue to subsist upon the same food, until it is entirely consumed, and thus the earth is cleared of all offensive, and what would probably prove infectious and injurious matter. Excrement of all kinds, is in a great degree, removed through their agency.

We have only space left briefly to allude to some of the more remarkable forms which occur in different genera of Diptera. In the genus *Asilus* some species from Brazil so closely resemble species of bees peculiar to the same country, that it requires an amount of entomological knowledge to distinguish the difference; other species of Diptera exactly resemble wasps, into whose nests they probably enter, being parasitic on the larva of the wasp. Species of the genus *Vollucella*, parasitic upon Humble bees, very closely resemble the bees themselves.

One genus, *Diopsis* (see Plate 11, fig. 7), may be mentioned as possessing a very remarkable peculiarity of structure; the eyes in the species of this genus are situated on pedicels half the length of the body of the fly. These pedicels arise from the sides of the head, at the usual situation of the eyes in ordinary species; the antennæ are situated near the eyes, one being on each foot-stalk or pedicel near to the eye which forms its

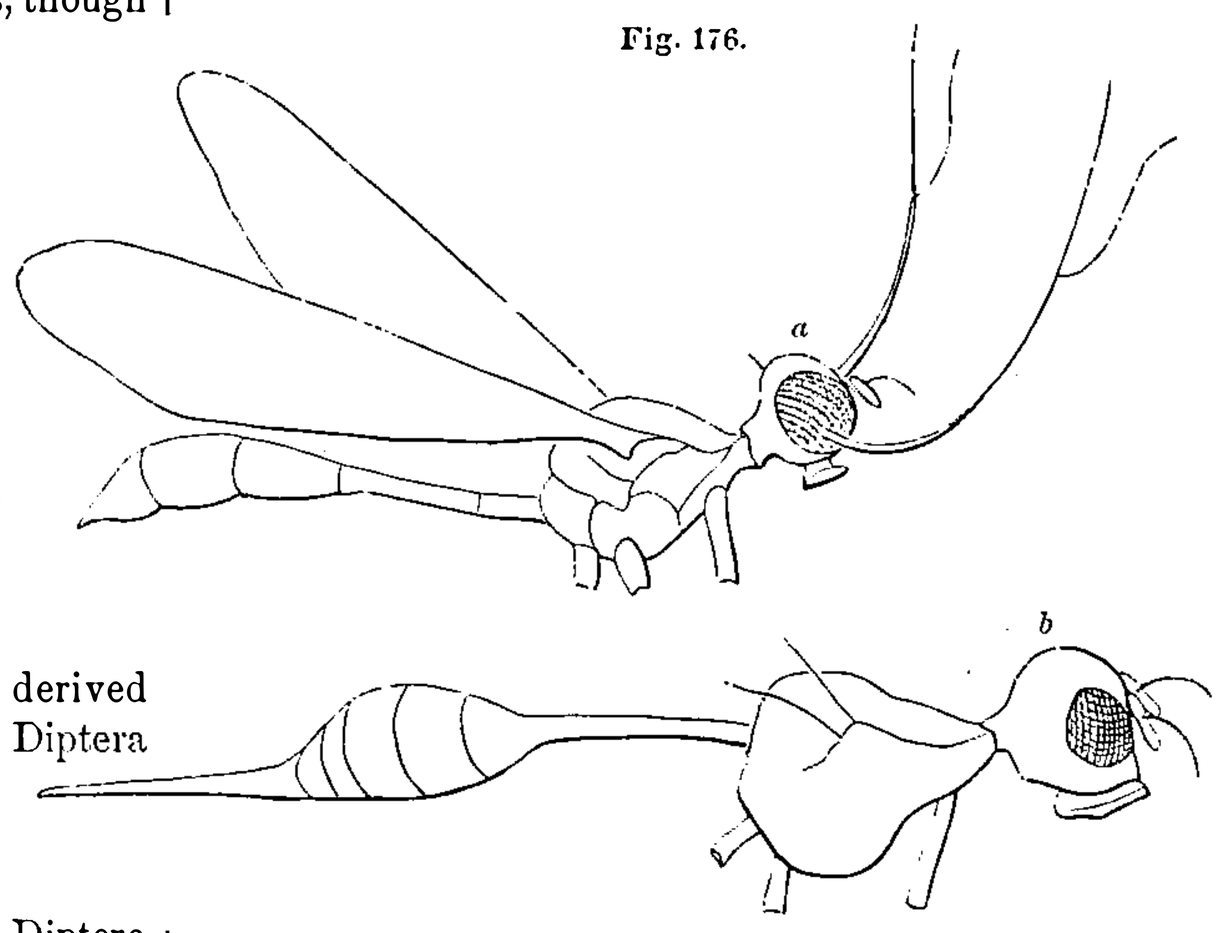
Fig. 175.



Achias maculipennis.

extremity. These species are found in Africa, India, and in the islands of the Eastern archipelago. Fig. 175 shows a species of an allied genus *Achias maculi-*

Fig. 176.



Phytalmia cervicornis, greatly magnified—*a*, male; *b*, female.

pennis, and fig. 176, *a*, *b*, two outlines of a remarkable species of the genus *Phytalmia* described by W. W.

Saunders, Esq., in the Transactions of the Entomological Society. The species figured is named *Phytalmia cervicornis*, in allusion to the remarkable horn-like processes with which the head is furnished; the male only has these ornaments, as will be seen on reference to the cuts.

Several of the genera of this group are parasites, whose province in the economy of nature appears to be to check the superabundance of species of other orders; the species of the genus *Tachinus* are parasitic upon various species of beetles. Carabi, Longicornes, &c., are attacked by them in the larva state; Lepidoptera, particularly the larger moths, such as the Death's head, are attacked by them; even the Hemiptera, the bugs, do not escape. The various species of the genus *Vollucella* live in the nests of bees and wasps, feeding upon the larvæ of those insects. *Vollucella bombylans* is figured in Plate 11, fig. 5; this species infests the nests of Humble bees. A few are known to live in the bodies of insects in their perfect condition; the species of the genus *Conops*, at least some of them, undergo their changes in the bodies of Humble bees, emerging from the plates of the abdomen. For further information upon these interesting insects we must refer the reader to the works of Fallen, Wiedemann, Meigen, Macquart, and Walker, who has described the British species in the "Insecta Britannica" in three volumes.

We must not pass over without notice another section of the order Diptera, a small group of parasitic insects forming the genus *Hippobosca;* one of the best known is the *H equina*, commonly known in some parts of the country as the Forest-fly. These insects have the head distinct, but partially immersed in the anterior portion of the thorax; the legs are short, stout, and bristly; the claws are dentate and curved; the rostrum is a complex structure furnished with sharp lancet-shaped organs adapted to piercing the skin of the animal upon which they are parasitic. These insects belong to a section called *Pupipara;* they have been regarded as forming a distinct order by some authors; they are the *Homaloptera* of Leach. The body of these insects is flat, short, and coriaceous; the wings are large, but in some species they are wanting. The eggs of the *Hippoboscidæ* are hatched in the body of the parent, the larva nourished and changed into a pupa in the same situation; in this state they are deposited by the parent fly; the change to the pupa state takes place within the skin of the larva. The *H. equina* attacks the horse, and in those parts of the country where they abound are exceedingly annoying, even in many cases dangerous; horses travelling for the first time in places which the fly frequents, and which are attacked by it, sometimes become unmanageable. The only way of removing the pest is by picking it off, so firmly do they fix themselves, clinging with their hook-like claws with unflinching tenacity; their bite, or rather the operation of piercing the skin and sucking the blood, evidently being attended with a considerable amount of pain. When these flies are placed on the ground after being caught, they run with considerable speed sideways like a crab, to which in reality they bear a considerable degree of resemblance; the crab only wants wings to make the similarity almost complete. The Forest-fly is abundant in Hampshire. The same species also attacks the ass, and not uncommonly even oxen. The writer once saw a horse attacked by at least one hundred flies, all having settled and fastened on his flanks; the poor creature was no doubt "to the manner born," as it stood as if quite accustomed to them, and only acknowledged their presence by a constant shivering attempt to drive them off.

Species of other genera attack different animals; *Lepoptera cervi* attacks the stag; *Melophagus ovinus* the sheep. Several species are found upon species of bats. The species belonging to the genera *Ornithomyia*, *Stepepteryx*, and *Oxypterum*, are parasitic upon various birds. The *Stenopteryx Hirundinis* is common in the nests of the sand-marten.

Another minute insect of this division must be noticed, it having been taken in this country; it is a species long well known on the continent, a parasite on the Hive bee (*Braula cæca*). It is a minute insect closely resembling the fly of the sand marten, but it has neither eyes or ocelli; it is figured in Ahrens' "Fauna," and previously by Réaumur in his fifth volume, Plate 38. This curious parasite was discovered a few months back in a hive of the Ligurian bee by Mr. Woodbury of Exeter. The specimen might have been imported along with the stock, but the species will probably be permanently introduced into this country.

GENUS NYCTERIBIA.—Only two British species are known, and the number of exotic ones are few. These insects have no wings; the legs are long and terminated with strong hooked claws fitted for clinging. They are found on the bodies of various species of bats.

Examples of several genera of Diptera are figured on Plate 11, in order to convey a better idea of the variety of form to be met with in this order. Fig. 1. *Ceria conopsoides;* 2. *Echinomyia fera;* 3. *Bibio pomonæ;* 4. *Henops marginatus;* 6. *Ceroplatus tipuloides;* 8. *Anthrax morio;* 10. *Phasia hemiptera.*

SUB-ORDER—APHANIPTERA.

THIS order contains the different species of fleas, forming the family *Pulicidæ*. These insects are too well known, yet few, except entomologists, would suppose that they have a close relationship to, if they do not in fact constitute, an apterous section of the Diptera. The organs of the mouth in a magnified representation of the parts, shows us the formidable apparatus wherewith they pierce the skin of their victim. The mandibles are represented by two elongate setæ, the edges of which are serrated; the tongue or sucker is of the same length, but more slender. These setæ when united, and inclosing the sucker between them, form the piercing lancet-like instrument with which the insect punctures the skin, which being effected and causing a momentary

pain, is succeeded by a tickling and not disagreeable sensation, occasioned by the insect sucking its sanguineous draught. The female lays a number of oval eggs of pure white colour, selecting frequently a hearth-rug, carpet, or chair-cushion; at other times she deposits them in dusty cracks in the floor. The larvæ are long slender thread-like worms which, when full grown, spin and inclose themselves in silken cocoons.

The species that attacks man is the *Pulex irritans*, a figure of which is given on Plate 11, figs. 15, 16. Although sufficiently numerous in this country, particularly in dirty houses and amongst people of dirty habits, little idea of the multitudinous hosts in which they swarm in hotter parts of the globe can be formed, until the traveller makes their acquaintance in favoured localities. We have been told that they skip about in the streets of Naples by thousands; on the shores of its lovely bay they assemble in myriads; and in all continental churches they abound, particularly under the dome of the magnificent church of St. Peter at Rome.

A particular and distinct species attacks the dog, but the same species is found on the cat, and it freely attacks man himself. This is the *Pulex canis*.

A distinct species is found on the cat, and no doubt were the subject pursued, many distinct species exist attached to different animals. A much more formidable insect than the flea is found in the West Indies, popularly known in those latitudes as the *Chigæ* (*Sarcopsylla penetrans*), Plate 11, figs. 11, 12. Mr. Waterton in his "Wanderings" says, "It looks exactly like a small flea, and a stranger would take it for one; it attacks different parts of the body, but chiefly the feet, betwixt the toe nails and the flesh. There it buries itself, and at first causes an itching not unpleasant. In a day or two you perceive a place about the size of a pea, somewhat discoloured; this is the nest of the Chigœ, containing a hundred eggs, and if allowed to hatch there the young ones will soon begin to form other nests, and in time cause a spreading ulcer. As soon as you perceive that you have got a chigœ in your flesh, with a sharp-pointed needle or knife you must take it out." Neglect of the latter precaution is followed by most serious results. It would appear that the attack of this insect on persons of inflammatory habit, has frequently been followed by fever and great suffering and pain.

CLASS—ARACHNIDA.

THIS class of articulated animals contains the spiders, scorpions, and mites; the spiders forming the order *Araneidea*. A concise summary of their organization and economy is all that our limited space will allow.

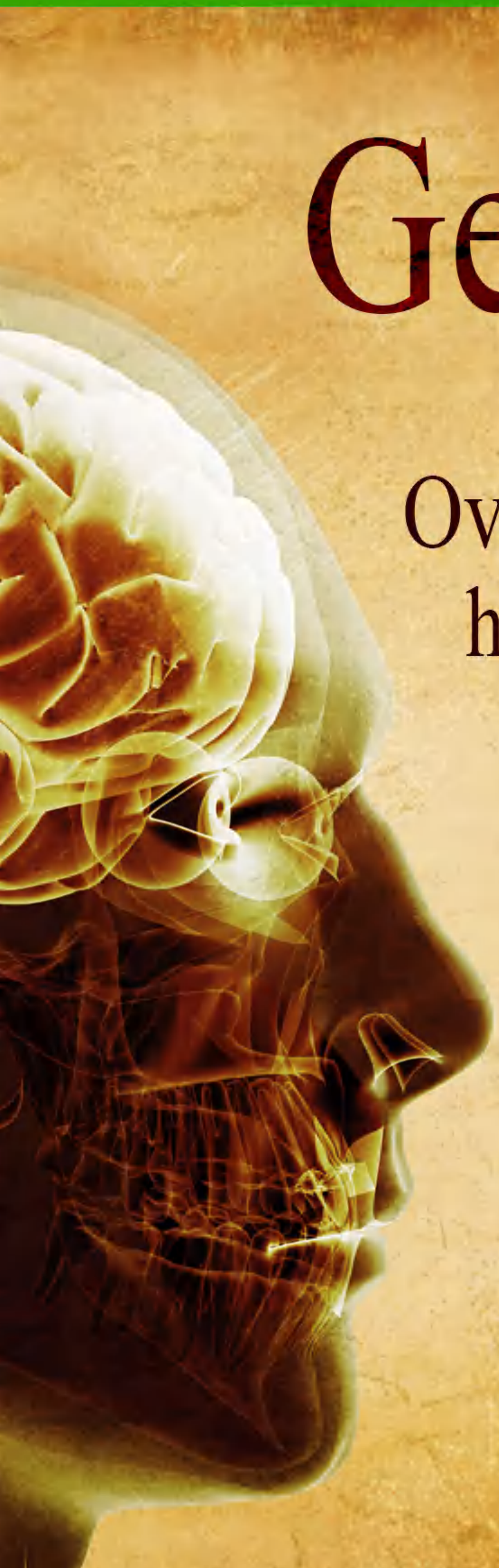
In spiders no distinct head, as in insects, will be observed; it is, as it were, merged into and apparently forms a part of the thorax, hence called the cephalo-thorax, the head and thorax being continuous; there are few exceptions to this rule. Spiders have no antennæ, and nearly all have eight legs; a few have six, and others ten. On the anterior, or cephalic portion of the thorax, are situated the eyes; these are eight, six, or two in number. Those organs which are used for seizing, and which in insects would be called mandibles, are in spiders called falces; these are situated in front, and are usually terminated by a sharp hook or fang. The legs are eight-jointed, having two or more claws at their apex. Their abdomen is soft, usually globular, but in some species oblong; it is in one piece, never having segments as in insects; at its apex beneath are six or eight fleshy mammulæ or spiracles; it is from these that the silk issues, when the animal is spinning. All spiders have eyes; they are smooth, and as observed above, differ in number; they also differ much in size and position, and from this circumstance important characters for their systematic arrangement are derived.

The falces, although modified in form in different species, are usually subconical, having at the extremity within, a longitudinal groove, the sides of which are dentate; this groove receives the fang when in repose. The claw or fang is hard, and acute at the point, near to which is a small opening which emits a colourless fluid; this, in some species, appears to be of a poisonous nature.

The falces are the organs in spiders which are used to seize and hold their prey. Spiders are extremely voracious, but are capable of enduring the want of food for a very long period; some species have been known to live from six to eight months without nutriment. In no animal apparently is the sense of touch so fine as in the spider; and on this sense much more than on sight, do many species depend for ascertaining the presence of insects, upon which they prey. The poet has finely described the sense of touch in spiders, which he says, "lies in each thread, and lives along the line." The accuracy of this description may be proved by any one who will notice a species of spider that spreads its geometric net on plants, from which many lines will be seen to converge to the mouth of its den; this will be in some hole in an old wall, &c. No sooner does an insect touch any part of the net, or of the silken cords that retain it in its position, than the spider through the delicacy of his sense of touch becomes instantly aware of its presence; the garden spider, *Epeira diadema*, may always be tempted out of its hiding-place by touching its web lightly with a twig or straw.—Fig. 177.

Spiders have been ascertained to undergo several moultings, subsequently to the time when they first escape from the egg, and before they arrive at maturity; some have been known to moult five, others as many as nine times. They also possess the power of reproducing limbs that have become mutilated, or which they have altogether lost; but this capability does not appear to have been observed in such as have arrived at maturity.

Any account of the economy of spiders, approaching even a satisfactory sketch of their history, would occupy a bulky volume; a few general observations is all that can here be attempted. Some species burrow, or excavate dens or holes in the ground; these are of a cylindrical shape, and are lined with a thick tissue of



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Species of the genus *Mygale* were formerly believed to spin webs of sufficient strength to entangle small birds, upon which they were said to prey; such is certainly not the case, as the species of Mygale do not spin webs. We were told, however, by a traveller in Brazil, that on one occasion he detected a large Mygale sucking the blood of a small unfledged bird that probably had fallen out of its nest; or, the creature might have carried it off. These insects reside in holes in the ground, and belong to the division of hunting spiders; they seize upon large species of locusts, cockroaches, and other insects, which they carry off to their dens. The species of *Mygale* in fig. 178 is from Brazil; the figure is about half the natural size. The only species of the family of the *Mygalidæ* found in Great Britain, is the *Atypus Sulzeri*, a large and formidable insect, which, when full-grown, is two inches in length; it is a stout reddish-browu creature, having rather short, thick legs; its falces are strong, prominent, curved organs, furnished with teeth on the under side. Altogether it is the most powerful of our hunting spiders; it is a local species, but not uncommon in many of the lanes in Kent, particularly in the neighbourhood of Dartford and Dover. This insect excavates a tunnel in the ground, inside of which it spins a tube of white silk; this material also covers a space round the entrance to its burrow. This species appears to prey by night, for it has not been noticed out of its nest by daylight.

Spiders are rapacious creatures, and live almost entirely upon insects; their mode of securing their prey differs in manner, as well as in the degree of ingenuity displayed in effecting their object. Some species depend upon the rapidity with which they run; others approach their victims with caution and circumspection, when cat-like, at a sudden spring they seize their prey; but the most ingenious of all modes, and that which has always attracted the notice and excited the admiration of mankind, is the spinning of beautiful silken webs, such as are spread by the well-known *Epeira diadema*, the garden-spider, and its allies. The surprising manner in which these silken nets are suspended in the required position, cannot but have been observed by every one; then again with what knowledge and foresight does the creature strengthen the cables, by which they are kept in position on the approach of windy weather; how neatly and completely are all necessary repairs effected, and what a beautiful provision in nature that such creatures should spin these webs, catch their prey by these means, and thus contribute to a necessary reduction of the numbers of many species of insects, performing an important part in the economy of nature!

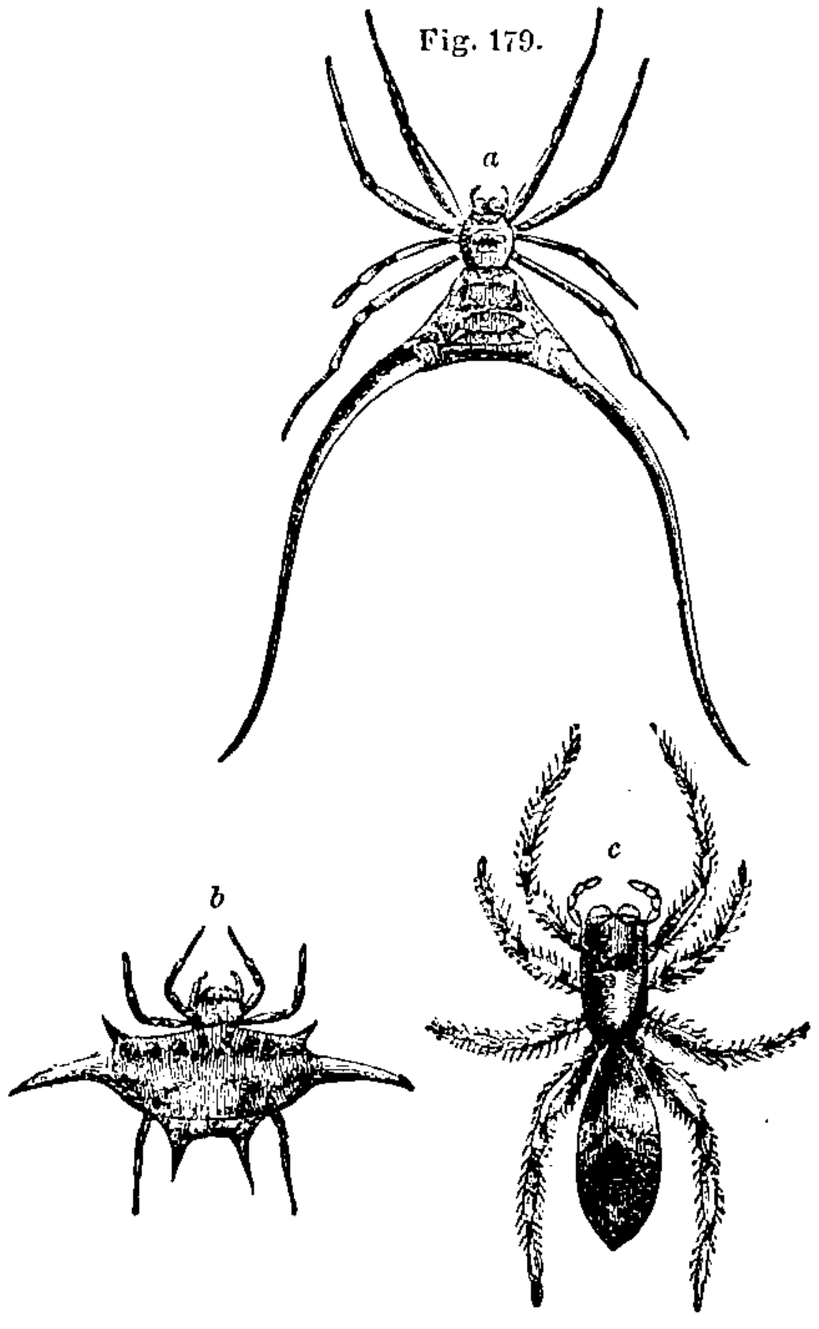
We have alluded to such species only as pass their lives in the earth, in holes in walls, &c., or which principally live on shrubs and trees; but others run with facility on water, occasionally dive into it, and even pass much of their time immersed in it. *Argyroneta aquatica*, in fact, may be said to be aquatic. It catches its prey, constructs its dwelling, and lives entirely under water. Other species pass much of their time in water, but it appears to be necessary that they should occasionally quit that element.

We must now point out another diversity in the habits of spiders, by noticing such as are aëronautic. Spiders have no wings, but by throwing out a number of gossamer-like filaments, numerous species are enabled through their buoyancy to ascend into, and sail through the air, to considerable distances. These aërial flights are supposed to be taken for the purposes of migration, and may be frequently witnessed in autumn, when the weather is remarkably serene. On such occasions these minute spiders ascend blades of grass, the tips of twigs, &c.; and, taking their position on the tops, they emit from their spinnarets a quantity of viscid fluid, which, drying instantly, floats about in fine fibres; and, catching the rarefied current of air which ascends on such occasions, the little animals are borne aloft floating about in the air; and doubtless, on these excursions, numerous small insects are entangled in the webs, and are preyed upon by the aërial voyagers.

The species of the genus *Phalangium* are the well-known Harvestmen that abound in the autumn, and at that time may be observed running on the ground, plants, &c., in great numbers. They are rapacious, their long legs enabling them to run with great rapidity.

The little Scorpion spiders, so numerous in hedges and thick bushes, belong to the genus *Chelifer*. These little creatures are by the unscientific called scorpions, to which they bear a close resemblance. They belong, however, to the true spiders. Their bodies are oval and depressed; their palpi longer than the body, forming, as it were, two arms, each terminated by a double claw; their legs are short, and furnished at their extremities with two claws. These creatures can either run in a straight direction, or, crab-like, sideways, at pleasure. There are four or five known British species, and numerous exotic ones from other countries.

Fig. 179.



a, Acrosoma arcuata; *b*, Gasteracantha; *c*, Salticus formicarius (male).

The species composing the genus *Gasteracantha* are

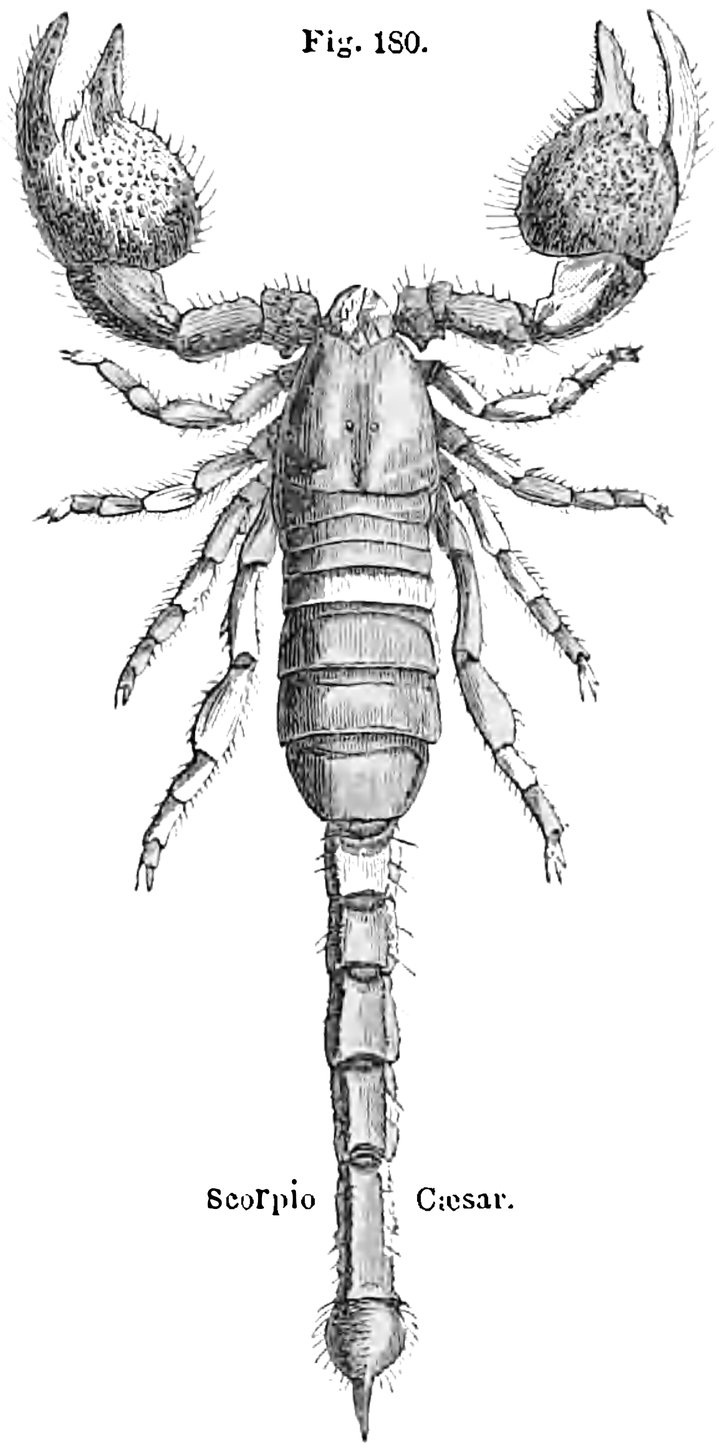
insects of quite a different texture from those we have previously glanced at. These, at least many of the species, have very much the appearance of minute crabs. Their bodies are transverse, have a hardened integument or shell, and are armed with numerous sharp spines. Others belonging to an allied genus have the body armed with two long spines, frequently curved, from an inch to an inch and a half in length. These are all exotic species. Many are most beautifully adorned, the cephalo-thorax being of a bright golden yellow, and the long spines of a bright steel-blue. Very brilliant species are found in Borneo, and in the islands of the Eastern Archipelago. This brilliancy of colouring, however, fades or disappears after death, but specimens occasionally retain much of their brilliancy for a considerable length of time.

SCORPION (*Scorpio*) a genus belonging to the class *Arachnida*. The Scorpion is one of the most renowned of all obnoxious creatures, and the most dreaded of the insect tribes; they have furnished the poet with similes the most expressive that language can convey, and in Holy Writ the Scorpion is used as symbolical of all that is hateful and malignant. That the Scorpion has engaged the attention of people in the most remote ages is certain, and, in the ancient mythology of Egypt, we find it represented as the genius of evil. Fabulous accounts of these creatures exist in abundance; the most potent medicinal virtues have been ascribed to them, and also the most poisonous and malignant qualities; so much so, that even to be touched by one was deemed a fatal occurrence. Scorpions of monstrous size were fabled, others with wings, and of habits so ferocious that the winged monsters attacked every one who came in their way.

Exaggerated as the records of antiquity certainly are, yet Scorpions are venomous, stinging with much virulence. The sting is usually followed by painful tumours, but in this case, as in the stinging of wasps, the effect is much more painful with persons of inflammatory constitutions. Some species are as much as eight inches in length. Not one is found in this country, but the Scorpion is met with in the south of France and in Italy. Some of the species from Africa, particularly those from the Gold Coast, are the largest known. The female brings forth her young alive, usually from twenty to forty; these only differ from the parent in being smaller: as the creatures grow, they from time to time cast their skins, until they arrive at maturity. The species are numerous, and in many localities are exceedingly obnoxious. Scorpions having the abdomen articulated, enables them to sting in all directions. There are twelve of these articulations; the palpi are very large, resembling the claws of a crab, with these they seize their victims; the abdomen is terminated by a curved spine or sting, at the extremity of which beneath, are two small orifices, out of which a venomous fluid is discharged in the act of stinging.

Scorpions are found in holes, under stones, logs, &c., in fact, in almost any cool place, particularly in houses;

Fig. 180.



Scorpio Cæsar.

they run quickly, curling their tail over their backs; they prey upon all kinds of insects, rendering them defenceless by stinging them before they feed upon them. The sight of these animals is acute; they have usually six or, in some species, eight eyes.

CLASS—MYRIAPODA.

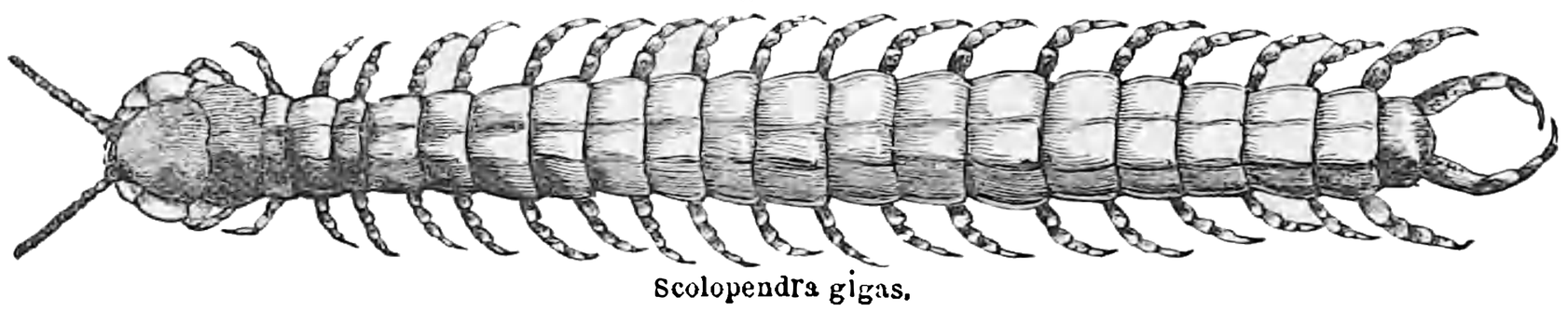
THIS class is composed of two orders, and in it are assembled all those animals commonly known under the names of *Centipedes*, *Millipedes*, and *Scolopendræ;* they cannot be called true insects, since they have the body divided into a great number of segments, each of which is furnished with a pair of legs; they are also destitute of wings.

The order CHILOPODA is characterized by having two short antennæ, thick at the base, and tapering to a point at the apex; the mandibles are furnished with a palpiform process, and have numerous denticulations at the apex; their feet are numerous, and each is terminated by a single claw; the representatives of the palpi are two jointed appendages, resembling legs, being terminated each by a claw; the body is elongate and flattened, of a corneous consistency, and divided into numerous segments. The Myriapoda are usually much neglected, more so than any other division of the Articulata. They are to people in general repulsive creatures, and to casual observation offer few apparent differences in the species; notwithstanding this, they have well-defined characters, and to the

student afford materials of the highest interest. The Chilopoda are predaceous in their habits, and seize their prey with the foot-jaws, which, in fact, represent the mandibles in the majority of the Articulata.

In the family *Scolopendra* are found the giants of the order, *S. gigas* measuring from ten to thirteen inches in length; it is of a reddish chestnut colour, and is truly a most repulsive and formidable-looking creature. There are about forty species known of this genus alone; they inhabit India and the adjacent islands, Africa, and America. It is in the hottest parts of the world they attain their largest size. *S. gigas* is found in South America.

Fig. 181.



Scolopendra gigas.

Cormocephalus lobidens has twenty-one segments, consequently forty-two legs. The *Gonibregmatus Cumingi* of Newport is 4¾ inches long, and has 161 pair of legs. In the genus *Geophilus*, one species, *G. xanthinus*, is six inches long, of a narrow tape-like form, and of a reddish-yellow colour; it is furnished with 162 pair of legs. In *G. Savignianus* we have a species possessing the astonishing number of 210 pair of legs; this species is about three inches long. The species, at least some of them belonging to the genera *Geophilus* and *Scolopendra*, are at times brilliantly phosphoric.

ORDER—CHILOGNATHA.

THE order CHILOGNATHA forms the second division of the class *Myriapoda;* in these the body is crustaceous, and in many short and cylindrical; the antennæ are more or less thickened at the tips; the legs are short and terminated by a claw; the mandibles are short, having the form of true mandibles, and adapted for eating or comminuting vegetable matter, on which they subsist. Some of the species very closely approach the *Annelida.* In some species the first, and somtimes the second segment also, are the largest, and represent as it were a córselet or shield. Some of the anterior and also the apical segments are not furnished with feet. Many of the species have the power of rolling themselves up into a ball. They have from thirty-two to thirty-four legs in the Onisciform genus *Glomeris*, the species of which resemble the common wood-louse.

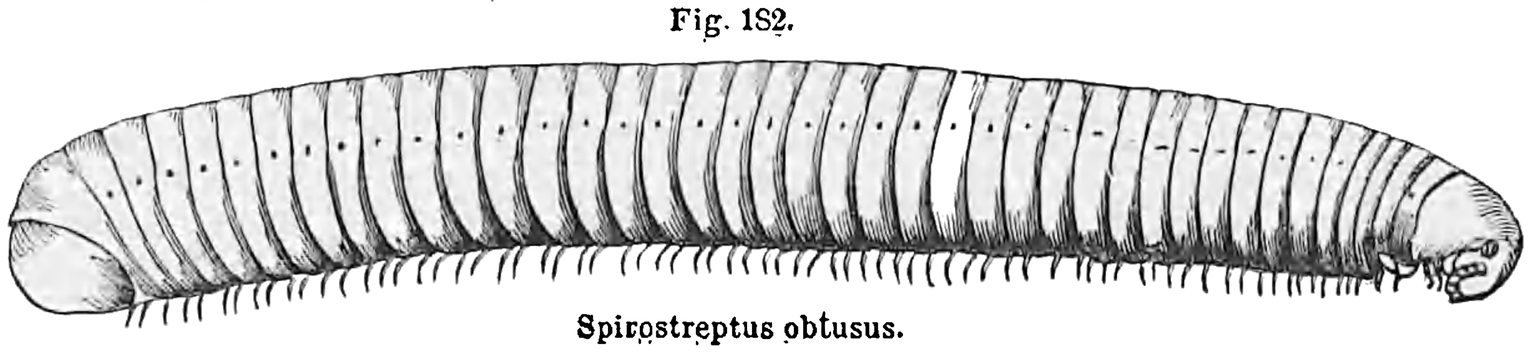
In the genus *Zephronia* the antennæ are six-jointed, clavate, and truncated at the apex; the species are exotic, and are exactly like gigantic *Onisci* (Wood-lice); their prevailing colours are brown, chestnut, and clay colour; one species, *Zephronia versicolor*, is black, with beautiful irregular-shaped yellow mottlings. The largest known species measures nearly 2½ inches in length.

The genus *Polydesmus* contains a series of insects of an elongated form, the body being composed of a series of eighteen distinct segments, exclusive of the head. The segments are transverse, with the anterior lateral angles usually rounded; the posterior being generally acute, sometimes hooked backwards. The largest known species is from Borneo, is 3½ inches long, and has the lateral margins of the segments denticulate.

The genus *Spirostreptus* contains some of the giants of the order; it consists of numerous species. Fifteen are described in Newport's monograph of the order. The species are principally from India, the Indian Archipelago, and Africa—one has been found in New Zealand, *Spirostreptus antipodarum.*

The genus *Julus* is allied to the *Centipedes*, but has the body cylindrical; the number of legs is very great, they have consequently been well named *Millipedes.* They can scarcely be said to run, but glide along much in the manner of a worm; occasionally, on being disturbed, twisting themselves up into a spiral form. Their bodies are hard and not easily crushed, except by violent pressure or by a blow. They have denticulated jaws, and their eyes are divided by hexagonal convexities. One species of *Julus* is very common under vegetable refuse, and in banks of light earth, &c.; it is of a shining black colour, about 1½ inches long—this is the *J. sabulosus.* It is oviparous; the young when first born have only three pair of legs, but as they increase in size they acquire additional numbers, not less than 100 pairs. The largest known species is the *Spirostreptus fasciatus*, which is eight inches in length; *Spirostreptus obtusus* (fig. 182) measures about 5½ inches. In the genus *Polydesmus* the eyes are obsolete.

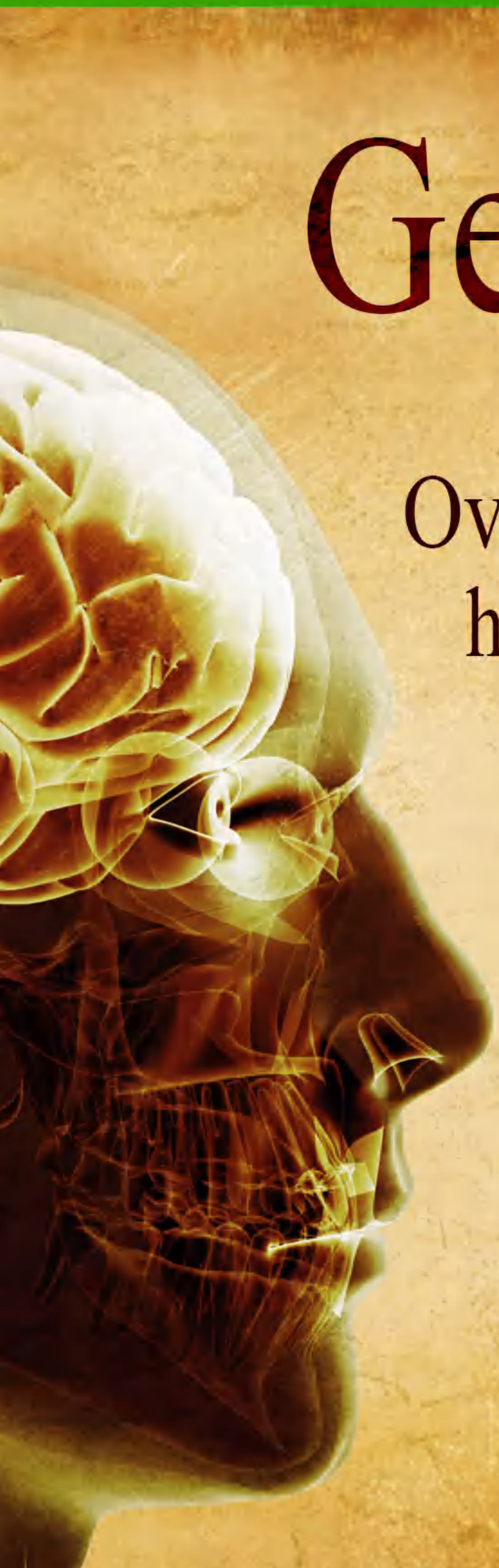
Fig. 182.



Spirostreptus obtusus.

Monographs of the species comprising the orders *Chilopoda* and *Chilognatha* have been published in Leach's "Zoological Miscellany," and more recently by Mr. G. Newport, in the *Annals and Magazine of Natural History*, 1844.

END OF INSECTS.



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these ganglions the nerves are distributed to the different organs and members of the body, and to the muscles which move them.

The sexes are distinct. The males have not as yet been seen in all; but there is good reason to believe that, with the exception of the cirripedes or barnacles, the two sexes exist separately in all cases, though in some the males differ very much in appearance from the females. They always produce their young by means of eggs, which, in most or all instances, are fecundated within the body of the female before she lays. In some genera the young are fully formed in the internal ovary of the mother, and are extruded alive. In many, the young at birth are like the parent, but in others they are very unlike, and undergo several changes, amounting almost to a kind of real transformation, before they assume the perfect form. The Crustacea differ from each other very much in form and appearance; they differ also very much in their habits. Most of them live constantly in the water, but there are some which during the greater part of their life inhabit the land, and are called *Land-crabs*. The larger number are carnivorous, and many even devour their own species.

For convenience sake, we divide the class Crustacea into two great sub-classes, the MALACOSTRACA and the ENTOMOSTRACA.

SUB-CLASS I.—MALACOSTRACA.

THIS name was originally applied by Aristotle to the whole class in general, but by Latreille and others it is used to designate only a particular division of it. It contains the greater part of the large Crustaceans, and more especially those which are useful to man.

It has been divided into two great sections, the Stalk-eyed Crustaceans or PODOPHTHALMA (those which have their eyes placed at the tip of a footstalk), and the Sessile-eyed or EDRIOPHTHALMA (those in which the eyes are not placed on footstalks)

SECTION I.—STALK-EYED CRUSTACEA (PODOPHTHALMA.)

THE Stalk-eyed Crustacea are chiefly distinguished by the possession of organs exclusively formed for the purpose of respiration (branchiæ, or gills), and the existence of eyes placed at the extremity of a movable peduncle or footstalk—hence their name. A large portion of the front of the body is covered by a buckler-shaped shell or carapace, which extends more or less beyond the thorax, and this kind of covering generally tends to distinguish the animals of this division of Crustacea at first sight.

They are divided into two orders, DECAPODA, or Ten-footed Crustacea; and STOMAPODA, or SEA-MANTES.

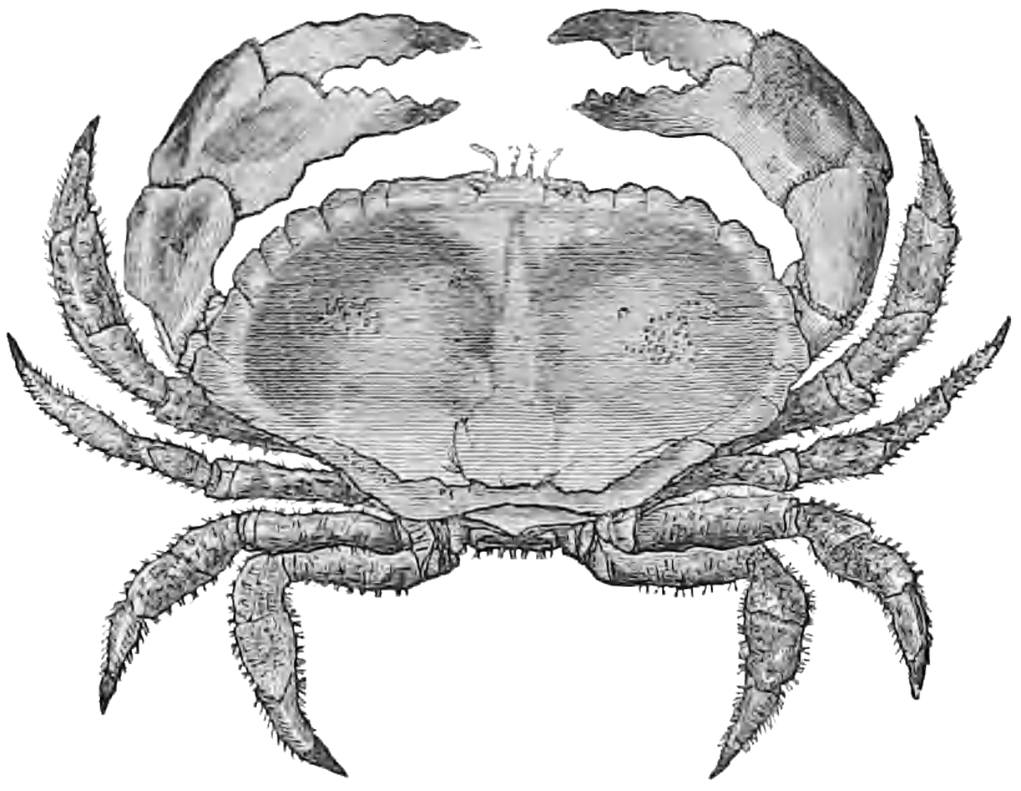
ORDER I.—DECAPODA (*Ten-footed Crustaceans*).

This order contains the greatest number of species of all the orders of the Crustacea. The animals which belong to it are those which have the most complicated organization, and the most perfectly developed faculties. The branchiæ, or gills by which they respire, are fixed on the internal surface of the thorax, and are lodged in a cavity formed by the prolongation of the carapace beyond the sides. The head and thorax are compactly united or soldered together, and are covered by a large shield-shaped carapace, which stretches beyond the front of the body, descends on each side to the base of the feet, and extends backwards as far as to the origin of the abdomen. The feet, properly so called, are five pairs; the first of which are transformed into arms, and are terminated by a pair of large claws or pincers, forming organs of prehension; the four other pairs being the true organs of motion. These animals are slow of growth, live long, and some of them become very large.

They are divided into three large groups, which are distinguished from each other by the comparative length of the abdomen, or, as it is generally called, the tail—the Short-tailed, or *Brachyura;* the Long-tailed, or *Macroura;* and the anomalous-tailed, or *Anomoura.*

BRACHYURA.—The Short-tailed Crustaceans, or Crabs, have their short abdomen generally bent under the

Fig. 183.



The Common Crab.

body and lodged in a cavity there, so that it is of little or no use to them in swimming. The species are very

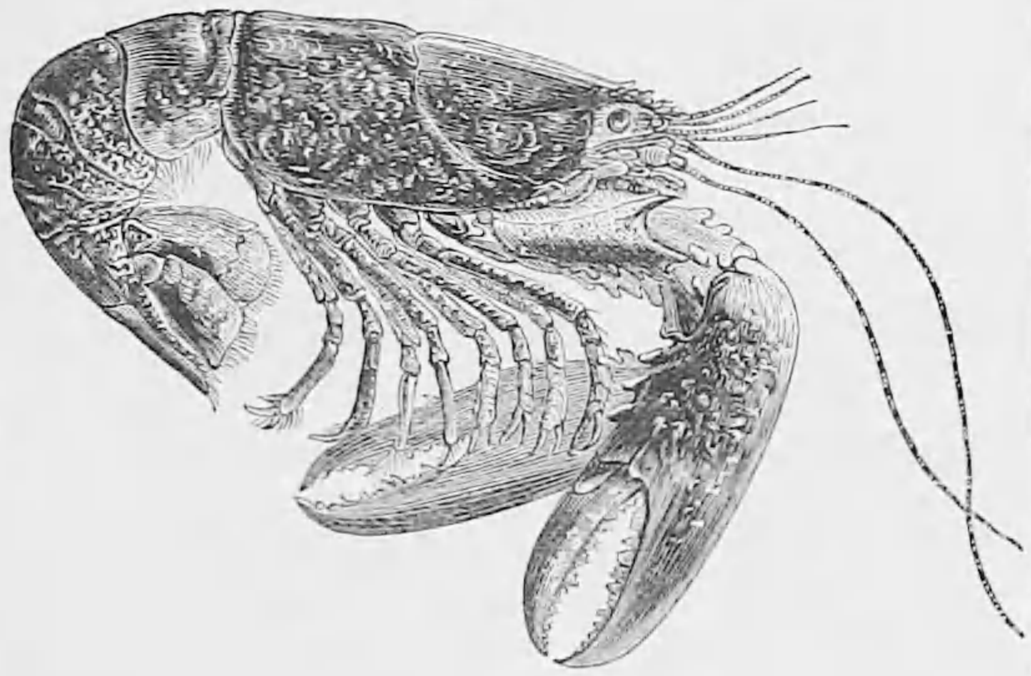
numerous, and some of them are exceedingly common on our own shores.

THE COMMON OR EDIBLE CRAB (*Cancer pagurus*) represented in fig. 183, is perhaps the best known of these. The carapace is large, rounded in front, narrowed posteriorly, and the dorsal surface is granulated. Its colour is reddish-brown, but the hands or claws are smooth and black. Of all the Short-tailed Crustacea, the crab is the most esteemed as an article of food, and its fishery constitutes an important trade on many parts of our coast. It inhabits the whole of the shores of Great Britain, especially those parts which are rocky, and the numbers annually taken are immense. They are caught in wicker traps called "crab-pots," made of the twigs of the golden willow, and formed on the principle of a common wire mouse-trap, baited with pieces of fish.

MACROURA.—The Long-tailed Crustaceans are easily recognized by the length of their abdomen, and by its being terminated by two large plates shaped like a fan and forming a fin, by means of which they swim with considerable velocity. The carapace is almost always longer than broad; the antennæ are very long; the thoracic feet are generally long and slender, and the first pair in most cases transformed into hands or prehensile organs. The species are rather numerous, and several of them are of great value as forming important articles of food.

THE COMMON LOBSTER (*Homarus vulgaris*) represented in fig. 184, is almost too well known to need

Fig. 184.



The Common Lobster.

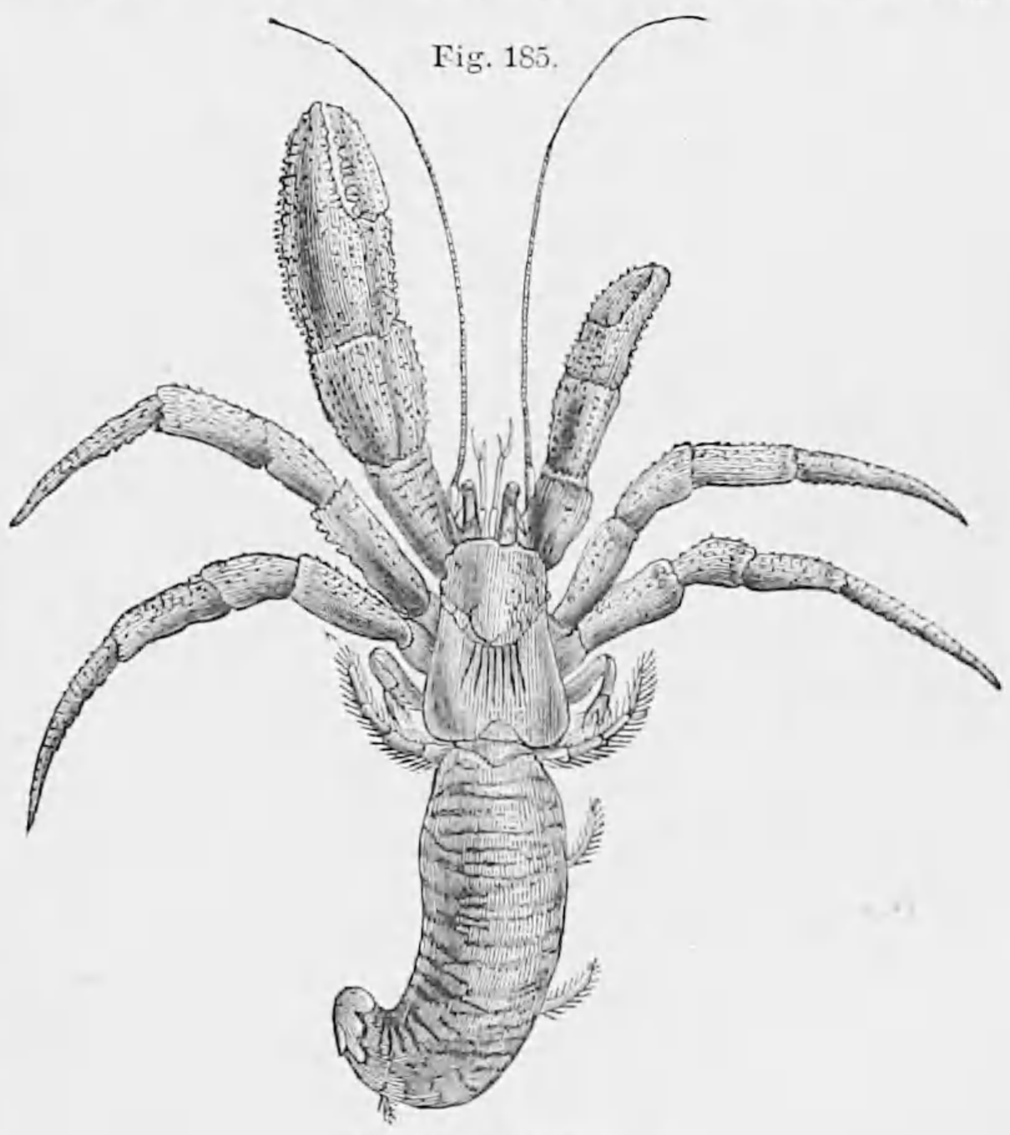
description. The general colour, when alive, is a dull, pale, reddish-yellow, spotted with bluish-black. When boiled it becomes red. In a commercial point of view, this species, from the esteem in which it is held as an article of food, is perhaps the most important of all the Crustacea. They are taken on various parts of our coast, and chiefly on rocky shores. From the coast of Scotland and the Orkney and Lewis islands, it is stated, one hundred and fifty thousand are annually sent to Billingsgate market. From Norway, six hundred thousand annually arrive in the same market; and it is no uncommon thing to see, in one day in that market, not less than from twenty to twenty-five thousand lobsters. The consumption, therefore, in Great Britain must be immense. According to all accounts they are very stationary in their habits, and differ very much in colour and appearance in the different places where they occur. A curious circumstance in their history is, the readiness with which they part with their large claws. When seized by one of them, the animal parts with it at once; and when suddenly alarmed by a loud noise, such as a peal of thunder or the report of a cannon, they *shoot* their claws immediately. The restoration of the lost member takes place slowly, and it is a considerable time before the new member attains the size of the old one.

The *Spiny lobster* (Palinurus vulgaris), the *Cray-fish* (Astacus fluviatilis), the *Shrimp* (Crangon vulgaris), and the *Prawn* (Palæmon serratus), &c., are all well known and valuable members of this section.

ANOMOURA.—The irregular-tailed Crustaceans have the abdomen in general slender, in some folded up under the body, in others extended; sometimes entirely membranous, at others more or less covered with the shell. It is not formed to assist in swimming. The penultimate segment has in some a pair of appendages more or less developed, in others these organs are wanting. The carapace of the upper part of the body is better developed than that of the abdomen, and in many cases resembles that of the *Brachyura*, though in others it is elongated. The antennæ are generally large, and are not capable of being bent back, nor are they lodged in cavities as they are in the Short-tails. The species belonging to this section are varied in form, and constitute several families.

THE HERMIT CRAB (*Pagurus Bernhardus*—fig. 185)—may be taken as an example of the *Anomoura*. This little crustacean is well known to every one who has paid a visit to our sea-shores. It is to be found in almost every whirled shell existing there. It is believed that they attack the true inhabitant of the shell, kill it, devour it, and then usurp the place of the

Fig. 185.



The Hermit Crab.

victim, clothing themselves with its spoils. They run about with great rapidity, and when seized draw themselves into the shell with a sudden snap, close the aperture with their stout claws, and resist strongly all attempts to pull them out. When young they may be found inhabiting small shells, such as the periwinkle, &c., but as they increase in size they take possession of the large whelk or buccinum.

ORDER II.—STOMAPODA (*Sea-Mantes*).

The *Stomapoda* are distinguished from the *Decapoda* by their not possessing internal branchiæ or gills. These organs when present are external, and generally spring from the basal joint of the abdominal false feet. Sometimes they are fixed at the base of the thoracic feet, and are suspended under the thorax. The carapace varies in form and size, sometimes covering the whole thorax, or at others only part. The abdomen varies much in appearance also. In general it resembles that part of the body in the *Macroura*, and terminates in a caudal fin, which fits them for swimming. The feet are seven or eight pairs, and in most of the species are placed near the mouth, or are folded upon it, hence the name. In some genera of this order the thoracic feet are slender, resemble each other in form, and are all adapted for swimming. In others, the first pair are large and prehensile, and the three succeeding pairs are also claw-shaped and formed for prehension.

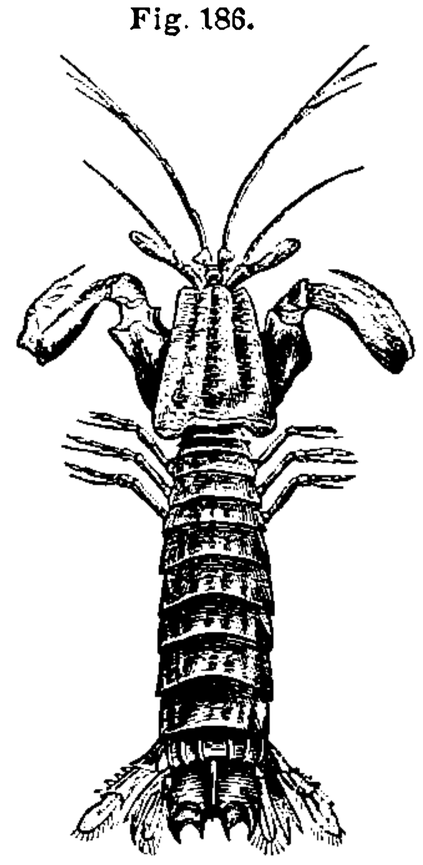
MYSIS.—Amongst those of the first group we may mention the genus *Mysis*, the species of which are known by the name of the Opossum shrimps. They derive this name from their carrying their eggs and young in a pouch beneath the thorax and between the thoracic legs. The species are small and have the body narrow and elongated, like the shrimps. They are found in vast numbers, especially in the northern seas, where they constitute a large portion of the food of the whale, and are luminous at night.

In this group we have also the curious crustaceans belonging to the genus *Phyllosoma*, the body of which is transparent and so completely flattened, that it is difficult to understand how the viscera have room to play.

In the second group we may mention the genus *Squilla*.

THE MANTIS CRAB (*Squilla Desmarestii*—fig. 186) is about seven inches in length. Its carapace only covers the anterior half of the thorax, the hinder being formed of rings like those of the abdomen. It is provided with enormous claws, terminating in a sharp hook; the last joint furnished with six sharp projecting spines, and the preceding joint with three, and so hollowed as to render this claw a most efficient instrument of prehension. They bear a considerable resemblance to the fore legs of the Orthopterous genus of insects, *Mantis;* hence the popular name applied to the species of this genus. This species is a native of the seas of Europe, but the greater number are inhabitants of tropical seas.

Fig. 186.



Sea Mantis, or Mantis Crab.

SECTION II.—SESSILE-EYED CRUSTACEA (EDRIOPHTHALMA).

THE Sessile-eyed Crustaceans are distinguished from the Stalk-eyed, or *Podophthalma*, by their branchiæ, or gills, not being organs specially formed for the purpose of respiration, but constituting a part of the organs of motion, their structure being peculiarly adapted to serve that end; and by their eyes not being placed on foot-stalks, but being sessile and immovable. They have no thoracic carapace; but the thorax and abdomen are composed of a series of rings or joints, separate from each other and movable. The head is distinct from the thorax.

They are divided into three orders—AMPHIPODA, LÆMODIPODA, and ISOPODA.

ORDER I.—THE AMPHIPODS (*Amphipoda*).

The Amphipods have their branchiæ or gills in the form of large membranous vesicles placed at the base of the feet, on their inner side. The thorax is generally divided into seven movable rings, and the thoracic, or true feet, are seven pairs. The abdomen is large and well developed, and the members, or false swimming feet attached to it, are elongated, narrow, and fringed with hairs. The three hinder pairs are bent backwards, and, along with the terminal portion of the abdomen, form a sort of fin, which serves the animal for swimming or leaping. The females carry their eggs under the thorax, between certain scales or vesicles, which form a kind of pouch. In this position they are hatched, and the young remain attached to the legs, or other parts of the body of the parents, until they gain sufficient strength to swim and take care of themselves. The order contains a considerable number of species, all of small size—some are parasitical, living attached to fishes, and in Medusæ or Acalephæ. Such are the species of the genus *Phronima*, one or two of which are European, and are found inhabiting the interior of a gelatinous, transparent, bell-like bag, open at both ends, and formed probably of the body of a Beroe. Others are free and very active. some living in the sand of the sea-shore, others in the sea or fresh-water.

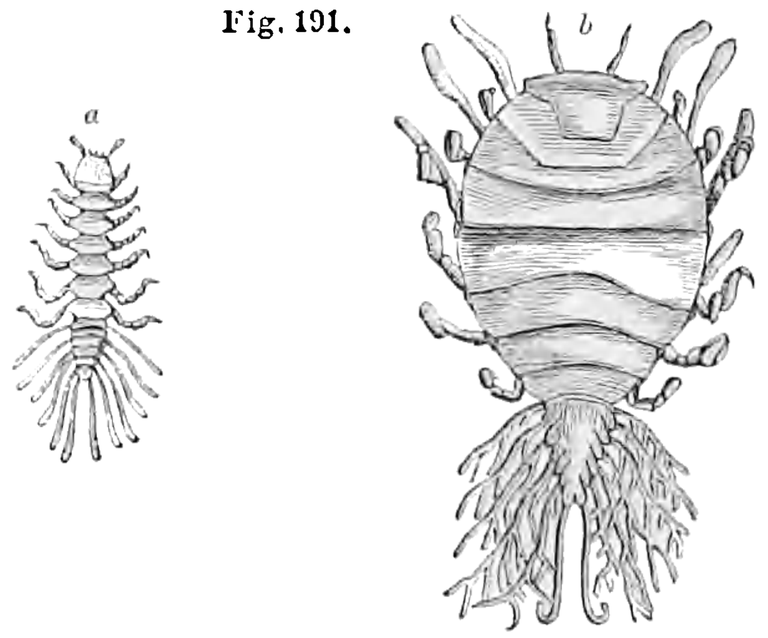
TALITRUS.—The species of this genus are well known by the name of Sandhoppers, or Sea-fleas.

THE SPHÆROMIANS (*Sphæroma*) live on rocks on the sea-coast, and have the faculty of rolling themselves up in the form of a ball, when touched or alarmed. They are all of small size, and several species are found in Great Britain. See fig. 190—*Sphæroma serratum.*

The third group are termed the Sedentary Isopods. In this group the sixth pair of false abdominal feet are altogether wanting, and their mouth is formed more for suction than for mastication; as the jaws, which all the other Malacostraca possess, in these are not in existence. They are completely parasitical.

THE BOPYRI, or *Tail-less Crab-lice*, live fixed under the vault of the branchial cavity of prawns, shrimps, &c., where they may be detected forming a small tumour. The males are five or six times smaller than the females, and are found attached to their abdomen. The figure (fig. 191) is that of another parasitical species, *Ione thoracicus*, which infests the shrimp.

Fig. 191.



Mud Shrimp louse—Ione thoracicus—*a* Male; *b* Female.

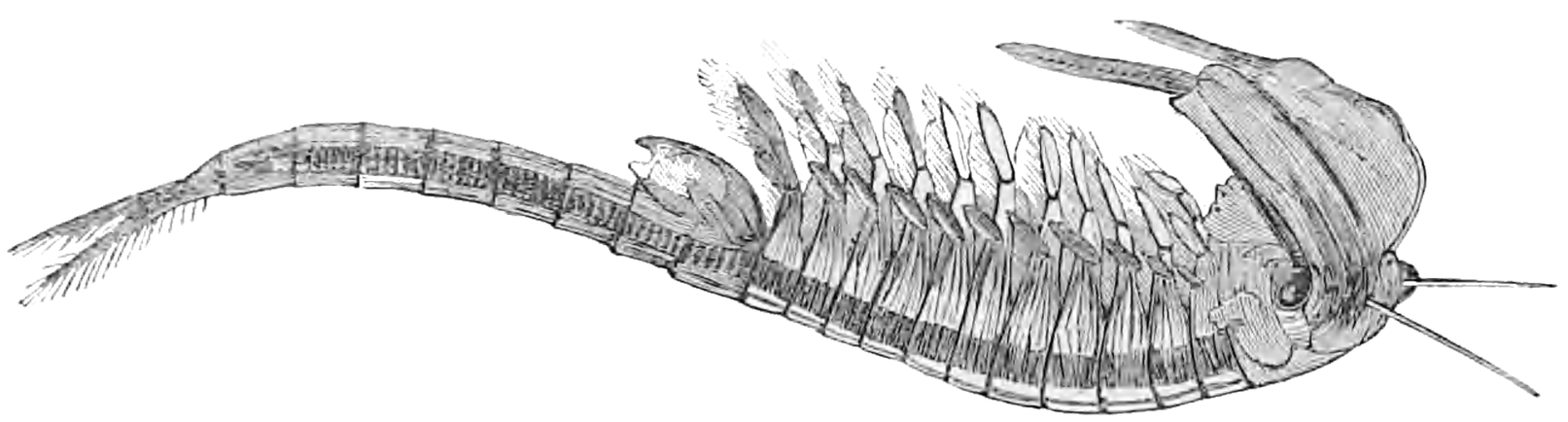
SUB-CLASS II.—ENTOMOSTRACA.

THE *Entomostraca* are for the most part extremely small crustaceans, but are very numerous. Their external envelope or carapace, which is of a horny or coriaceous texture, is formed of one or two pieces which either completely or in great part cover the body of the animal. In some it approaches in appearance so nearly to the form of a bivalve shell, that a person who did not examine with a microscope the animal contained within, would not hesitate at first to call it so. These creatures are carnivorous, and are very useful in clearing stagnant waters of putrid animal matter. Their gills are attached either to the feet or organs of mastication. They are preyed upon by larger animals, and form the food of some of our most esteemed fishes. Some of them are parasitic, living fixed upon the bodies of fishes and other animals that live in the water. Many undergo a series of changes, amounting to a species of metamorphosis, in their progress from youth to maturity. They are numerous in fresh water, and many are marine, those inhabiting the ocean assisting materially in producing the luminousness of "the world of waters." By naturalists they have generally been divided into three sections—BRANCHIOPODA, LOPHYROPODA, and PŒCILOPODA.

SECTION I.—BRANCHIOPODA (BRANCHIOPODS).

THE animals belonging to this section of *Entomostraca* have the mouth furnished with jaws fitted for masticating their food. Their branchiæ or gills are many and attached to the feet, which vary in number, sometimes being many and at others few. They are in general not adapted for locomotion. The antennæ are two, or four-jointed and ciliated, in some serving as organs of motion. They swim freely, and may be observed to have their branchial feet in constant motion in the water, their action being seldom interrupted, thus ventilating the stagnant water in which they for the most part live, and preventing it becoming soon putrid.

Fig. 192.



Chirocephalus diaphanus.

They are all arranged in two orders, PHYLLOPODA and CLADOCERA.

ORDER I.—PHYLLOPODS (*Phyllopoda*).

In the animals belonging to this order the feet are foliaceous in structure, branchiferous or gill-bearing,

and thus adapted more for respiration than locomotion. The body is usually divided into numerous segments. This order contains the largest individuals of all the Entomostraca, and many of them the most remarkable for beauty. As an illustration of the order, we have annexed a figure of *Chirocephalus diaphanus*.—See fig: 192.

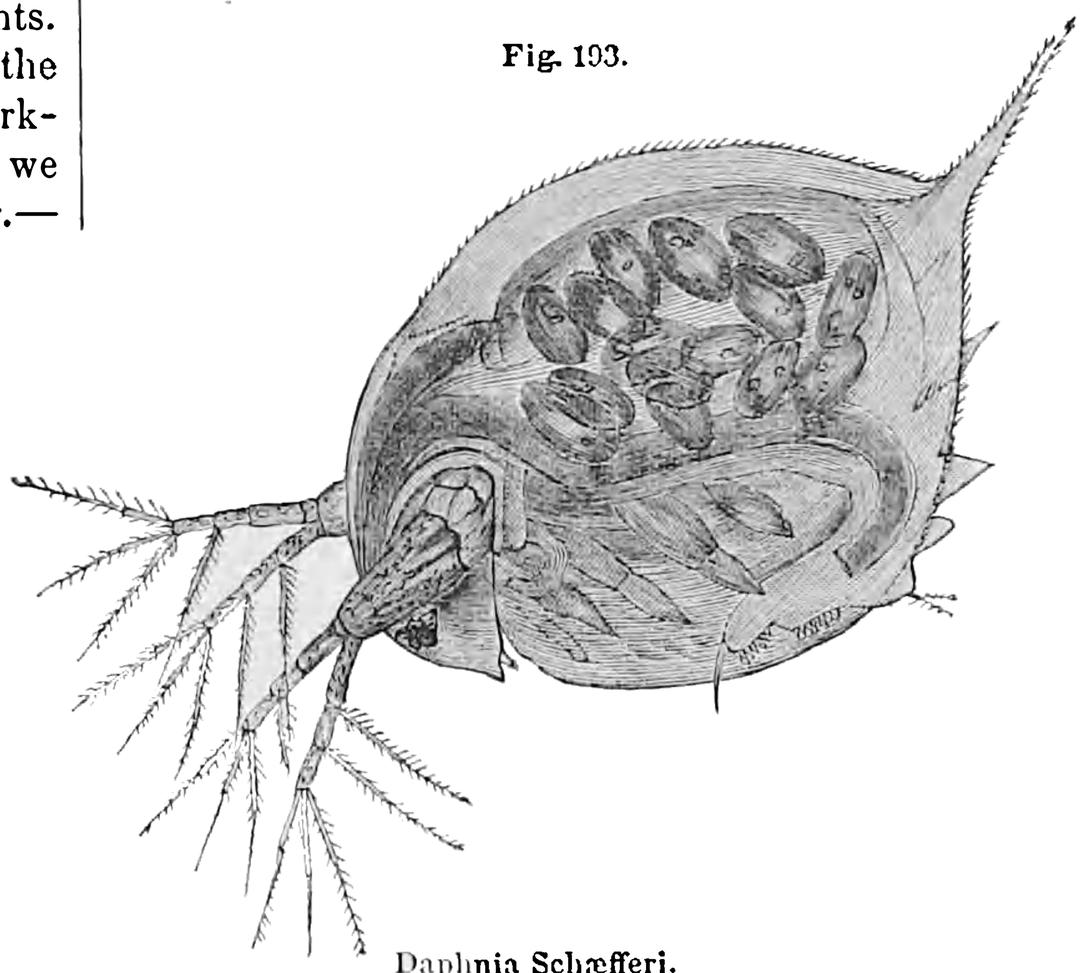
ORDER II.—CLADOCERA.

The species of this order are generally very small and have the body, with the exception of the head, contained within a delicate transparent carapace, formed in the shape of two valves joined together on the back. They possess from four to six foliaceous branchial feet, have only one eye, and two pairs of antennæ, the lower of which are the organs of motion.

The species here represented (fig. 193) is *Daphnia Schæfferi*.

There are seven known British species; that figured is by far the largest of the family, being about the fifth of an inch in length, and two lines broad. Their motion through the water is peculiar, being a tumbling, heavy sort of movement, and when seen in their native ponds they seem to keep near the bottom.

Fig. 193.

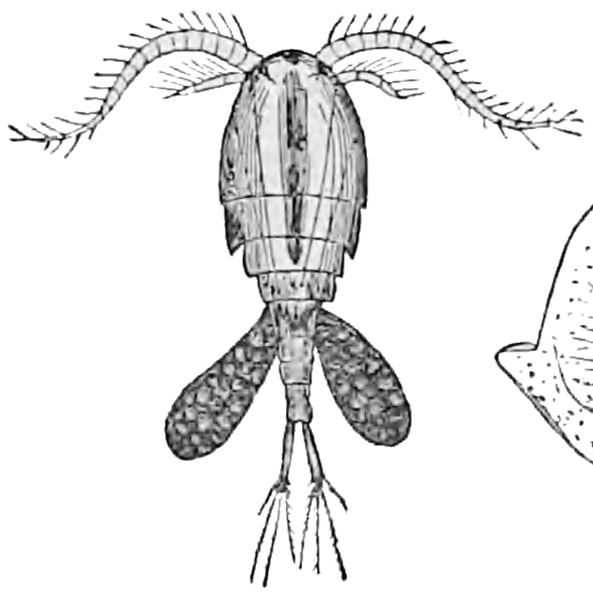


Daphnia Schæfferi.

SECTION II.—LOPHYROPODA.

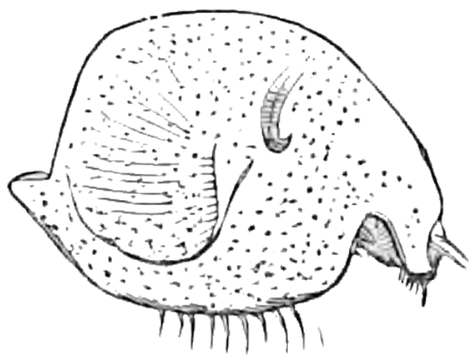
THE *Lophyropods* are characterized by their feet being essentially organs of locomotion, and not branchials.

Fig. 194.



Cypridina M'Andrei.

Fig. 195.



Cyclops quadricornis.

These are few in number, and are composed of several articulations of a more or less cylindrical form, which are furnished with a series of stiff hairs or *setæ*. Their branchiæ or gills are attached to the organs of the mouth and are few in number. The body is either completely inclosed within a carapace exactly resembling a bivalve shell, or partially covered by an envelope shaped like a shield or buckler. The two forms constitute two orders, OSTRACODA and COPEPODA.

The first order, or *Ostracods*, we illustrate by a figure of *Cypridina M'Andrei* (fig. 194); the second (the *Copepods*) by *Cyclops quadricornis* (fig. 195).

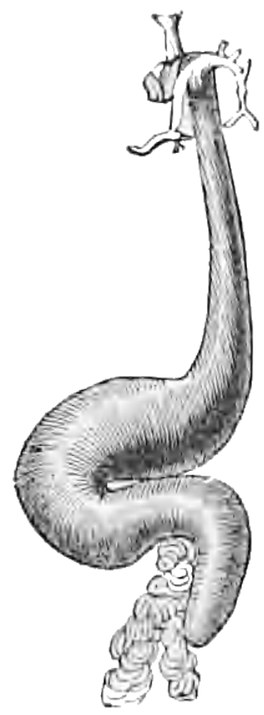
Very little is known of the habits and manners of these interesting and curious little creatures; the two species which have been found in Great Britain belonging to this genus were dredged by Mr. M'Andrew from a considerable depth. Cypridina M'Andrei was dredged in seventy fathoms, between the islands of Lewis and Skye. Other species, C. Bronda, was found in from eighty to ninety fathoms sand, twenty miles east of the Noss, in the Shetland Islands.

SECTION III.—PŒCILOPODA (PARASITIC CRUSTACEA).

THE animals belonging to this section have the organs of the mouth adapted for suction, and not mastication. They live a parasitic life upon aquatic animals, such as fishes, &c.; and their mouth therefore is constructed so as to accommodate them to their habitations and manner of life. Their body is for the greater part inclosed within a buckler-shaped shell or carapace of a horny substance; and their feet, which are in the greater number, four pairs, are partly adapted for enabling them to walk with, and partly serve for the purpose of respiration, having branchiæ or gills attached to them. When young they are free and unattached, and do not resemble in the least their parents. As they advance in life they undergo a series of changes, and become attached to various other animals. Many of them at last become so transformed that they lose their eyes and feet, and

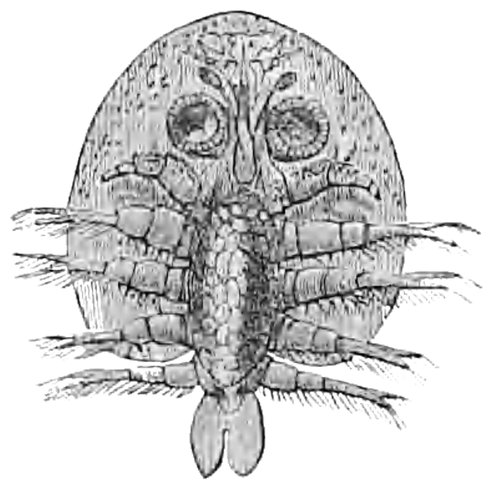
can no longer move from the position they have chosen. Others retain to a considerable extent their powers of locomotion, and some are able to change their position from one animal to another at will. The species be-

Fig. 196.



Argulus foliaceus.

Fig. 197.



Lernæa branchialis.

longing to this section are divided into two orders, SIPHONOSTOMATA and LERNÆIDÆ.

The first order, the *Siphonostomes* are represented by *Argulus foliaceus* (fig. 196); the second, the *Lernæans*, by *Lernæa branchialis* (fig. 197).

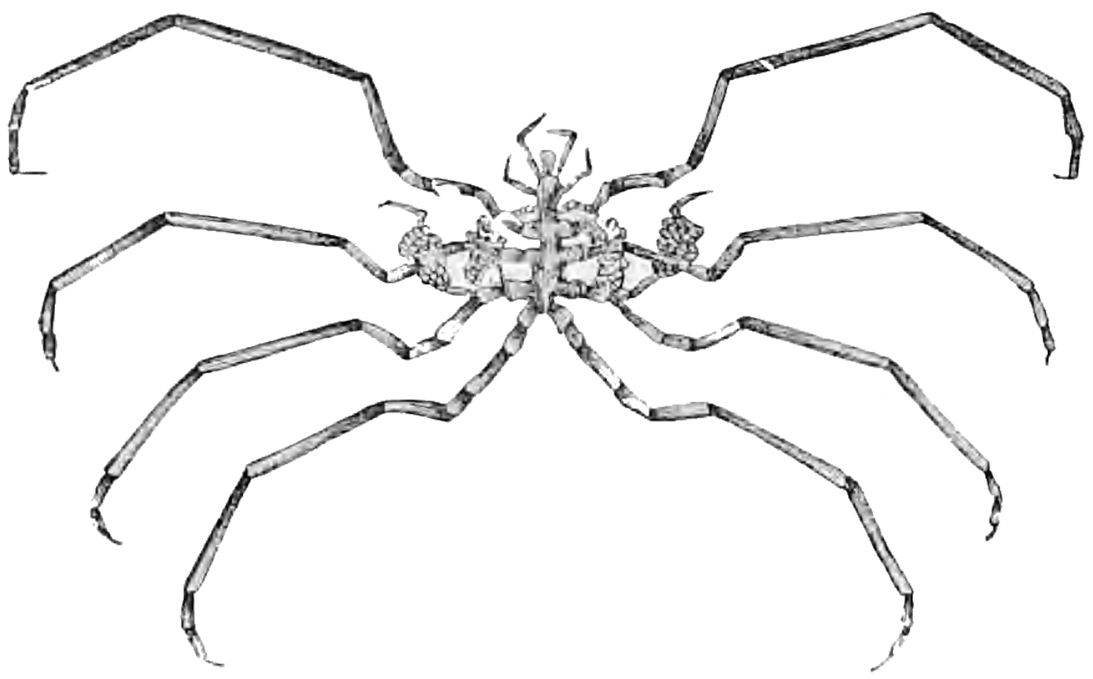
In the arrangement of the Crustacea, by M. Milne Edwards, who has done much for this class of animals, there follows immediately after the *Lernæidæ* the curious-looking creatures called the *Sea Spiders*.

SEA SPIDERS (*Pycnogonidæ*).

The Sea Spiders were originally classed by authors amongst the spiders, and it is only lately that they have been finally pronounced to be Crustaceans. Though they have no branchiæ or gills, they do not possess the *trachea* or pulmonary sacs for aerial respiration, which the spiders are furnished with. They appear, indeed, to breathe through the skin, the aeration of the blood being effected by the mere contact of the water, in which they live, with the external surface of the body. They have a crustaceous slender body of five joints, not much thicker than the limbs, which are four pairs in number, and generally very long. The females have a supplementary pair, much smaller than the others, bent under them and destined to support the eggs.

The Sea Spiders, as their name imports, are all marine, and they are of small size. They conceal themselves amongst the sea-weeds and corallines between tide-marks, and under stones within the lowest tide-line, and occasionally they are dredged from deep water. Their motions are remarkably slow, and they probably live on dead animal matter or small marine insects. The females are apparently fewer in number than the males, or at least are much more seldom met with, and may be readily distinguished by the supplemental pair of legs mentioned above as destined to hold and carry the eggs. These are collected into globular masses enveloped with a thin skin or membrane, each mass firmly adherent to the oviferous leg, and consisting of a congeries of numerous round ova. The young are softer and longer-bodied proportionally than the adult, and appear to undergo considerable changes in their progress to maturity. Our illustration of this order of Crustaceans is the *Nymphon gracile* (fig. 198), which

Fig. 198.

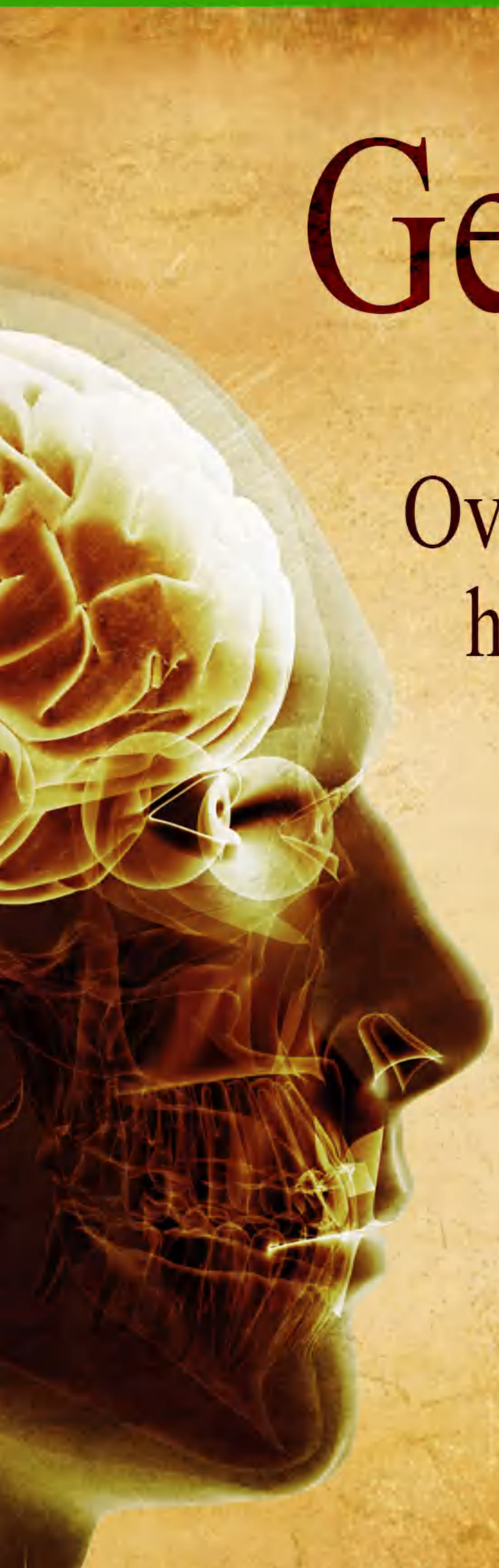


Nymphon gracile.

is distinguished by its very long slender legs, these members being about four times the length of the body.

SUB-CLASS III.—XIPHOSURA (SWORD-TAILS).

THE Sword-tails, or King-crabs, are distinguished from all the other Crustacea by the peculiar formation of the month. Instead of having mandibles and jaws, as the others have, the masticatory organs are the six pairs of thoracic feet, which are so situated as to surround the month. The basal portion of these members is armed with strong spines, which serve the purpose of teeth, and thus replace the ordinary organs for masticating the food. The branchiæ are in the form of numerous plates, or membranous folds placed transversely, lying one upon the other like the leaves of a book, and attached to the basal portion of the abdominal legs. The body is composed of three parts; the head and thorax united in one (*cephalo-thorax*), the abdomen, and tail. The *cephalo-thorax* is covered by a large horny buckler of a semicircular form, and on it we see four eyes; two very small and simple, and two larger, compound, and of an oval shape. The abdomen is covered also with a considerable-sized buckler, of a somewhat triangular shape, toothed at the sides, and sending off from its lower edge a long, sharp spine, nearly as long in general as the whole body, and con-



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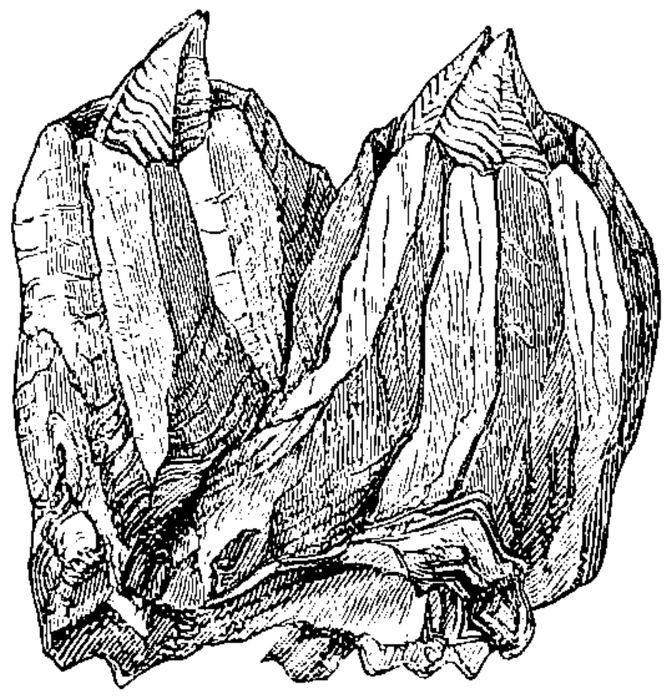
the whole world, the greater number however inhabiting the warmer, temperate, and tropical seas. The name of *barnacle shell* was originally given to the genus *Lepas*, which may be known by the head or *capitulum* being compressed and composed of five approximate valves. They derive this name from its being at one time believed that they gave origin to the barnacle goose!

FAMILY II.—BALANIDÆ (*Sessile Cirripeds*, or *Sea-acorns*).

The *Balanidæ* are characterized by their being fixed to submarine bodies without the intervention of a peduncle. The body of the animal is inclosed in a cylindrical or bell-shaped tube open at the top, formed of several valves united together, side by side, by a dentated suture, and covered by what is called an operculum, which consists generally of four valves nearly equal-sized and sunk into a flexible skin, allowing them a considerable degree of motion. The base by which they are fixed is a shelly plate. The species are numerous and most widely diffused, taking possession of rocks, ships, timber floating or at rest, shells of Crustacea and Mollusca, &c. Some of them are of considerable size, and one species of the genus Balanus (*B. psittaceus*) found on the coast of Chili, growing to the size of five or six inches, forms a very common and highly esteemed food for the natives, who call it *pico*. The flesh is said to equal in richness and delicacy that of the crab. Another species, *B. tintinnabulum* (fig. 200), is equally prized by

Fig 200.



Balanus Tintinnabulum.

the Chinese, the flesh of which is said to resemble the lobster. Some of the species, as in *Acasta*, are found attached to sponges, while others, as in *Pyrgoma*, are embedded in corals. The species of the genus *Coronula* and *Tubicinella*, attach themselves to the bodies of whales; and as they increase in size their shells are proportionally enlarged by the addition of new matter to the base of the valves, and they gradually raise themselves out of the substance of the skin in which they are immersed.

CLASS—ANNELIDA (ANNELIDES, OR RED WORMS).

THE class Annelida, as now constituted, is composed of a series of animals which form only a small part of the great heterogeneous class *Vermes*, or Worms, of Linnæus. They are distinguished, however, from all other worms by the fact that they possess red or coloured blood, and hence are often called by the name of Red Worms. This peculiarity was considered of such importance by Cuvier that he placed them in his last edition of the "Regne Animal" at the head of the sub-kingdom *Articulata*. Their general appearance nevertheless seems to point them out as the representatives of the larval rather than the perfect state of insects, and thus to indicate their proper position to be below both Insects and Crustacea.

Annelides, then, are worms with red or coloured blood, circulating in a double system of complex vessels, with a nervous system consisting of a double central cord, and respiring by organs which are either developed externally or are spread over the surface of the skin, or concealed internally. The body, which is more or less elongated, is always divided into numerous rings (*annuli*), from which circumstance the whole class derives its name. The first of these rings contains the mouth and the principal organs of sense. It is called the head, but in outward appearance scarcely differs from the rest, which all agree in having the same form and nearly the same size throughout. None of the Annelides are possessed of true feet or articulated limbs, but the greater number of them are provided with hairs or hooks, or bundles, of bristles which supply their place, while others have a suctorial disc which serves them for progression. Their antennæ (when they possess them) are seldom jointed, and the organs of their mouth consist of jaws, more or less powerful, or of a simple tube. The epidermis or external skin is very thin, and is not ciliated except where it covers the external branchiæ. The sense of touch is chiefly developed at the two first rings of the body, and exists either in form of a tentacular proboscis, contractile antennæ, or processes of variable number and shape called *cirrhi*. In a great many of the Annelides the eyes are wanting; in some they are represented by black dots merely, or eye-specks, which in the leeches and some others are numerous, and are considered to be light-perceiving organs. The digestive canal is usually straight, rarely having convolutions.

The skin in many of the species secretes a quantity of mucus which covers the body, and by means of which some of them glue together pieces of shell, grains of sand, &c., so as to form a tube to lodge themselves in.

The calcareous tubes in which others dwell, are secreted by a collar surrounding the first segment of the body. —(*Siebold.*)

Reproduction takes place partly by a transverse fissuration, and partly by a sexual apparatus. Those species which undergo the process of division never possess genital organs at the time it is taking place; but after this process ceases genital organs are developed, and reproduction takes place by eggs. "The extreme vulnerability and reproductive power of many Chætopodes give rise to their frequent multiplication by artificial and accidental division. The fragments thus produced are finally developed, and the mutilated animal ultimately regains its lost parts. Some have the power of voluntary division from the least handling of their body, and these separated parts are probably developed to new individuals."—(*Siebold.*)

Most of the species have separate sexes, but in the Leeches and Earth-worms the two are always united in the same individual. In by far the greater number of the Annelides (those which have the body provided with bristles as organs of locomotion), the young undergo a complete metamorphosis. The embryo, immediately it escapes from the egg, swims freely about like an infusorial animalcule, by means of the ciliated membrane which covers its whole body. This disappears, the embryo lengthens, eyes appear upon the anterior extremity, the body becomes divided into segments, and bristles, &c., make their appearance.

The Annelides vary considerably in their manner of life, and this, along with the structure of their breathing apparatus, has induced MM. Audouin and Milne Edwards to divide them into four orders:—

I. *Errantia*, those in which the respiratory organs are attached to the dorsal surface of the body along the whole or greater part of its length, hence called *Dorsibranchiata* by Cuvier and others. These species are found living a free and wandering life, crawling actively in mud or swimming in the water.

II. *Tubicola* or *Sedentaria*, those in which the respiratory organs are formed like plumes, attached to the head or anterior portion of the body, hence called by many authors *Capitobranchiata*. These species live a sedentary life, and are found, with few exceptions, having their abode in tubes.

III. *Terricola* or Earth-worms, those in which the respiratory organs are internal, being in the form of small vesicles opening externally by very minute pores. These are found making their dwelling-place in soft earth, piercing the ground in all directions.

IV. *Suctoria* or Suckers, those in which the respiratory organs are internal, like the preceding order, and disposed in the form of small membranous sacs, each of which communicates externally by a minute orifice on the ventral aspect of the body. They possess no bristles, but are provided with suctorial discs by which they progress. These are all natives of the water, and many are found living partially as parasites upon fishes.

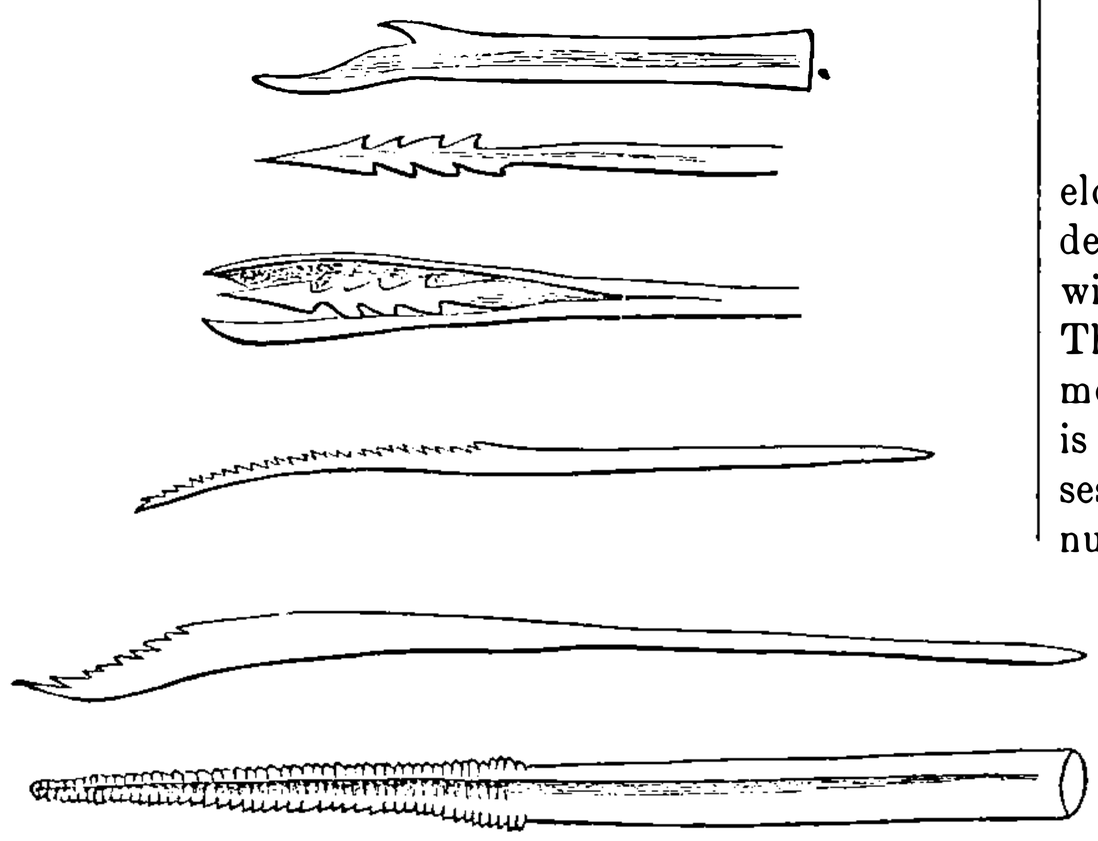
ORDER I.—ERRANTIA (=*Dorsibranchiata*).

All the species belonging to this order are aquatic, crawling with activity in the mud or swimming with facility in the water. The body in some of them is very long and slender—some species in the equatorial seas attaining the length of five feet—in others broad and rather short. Their head is distinct from the trunk, and is furnished with two pairs of rudimentary eyes, a certain number of conical or filiform appendages which are distinguished into antennæ, palpi, and tentaeles, and a mouth furnished with a proboscis which can be protruded at will, and often armed with strong horny jaws. The body is composed of numerous narrow segments or rings, varying in number from twenty to five hundred. In the majority of the species each segment or ring has on each side an organ which many naturalists call a foot. It is in the form of a fleshy tubercle; is composed of two divisions placed one above the other called *rami*, or branches; and provided with one or two brushes of bristles. These bristles are of two kinds, subulate and hooked, and the animal can protrude them considerably by means of muscles appropriated to that use. In addition to these bundles of bristles, there are attached to these feet a number of soft and blunt appendages, called *cirrhi*. They are usually two to each foot, but their number and position vary considerably. They are either in the form of long, subulate, fleshy tentacles, or merely compressed leaflets or papillary tubercles. In general they are partially contractile. The gills or branchiæ vary much in form, number, and position. In some the organ assumes the form of arbuscles or tufts, or fan-shaped crests; in a second series it is a simple or pectinated filament; and in a third it is a nipple-like lobe, or merely a membranons tubercle. In general they are placed along the back, but sometimes they are arranged along the sides or at the tail.

"Organized for locomotion," says Dr. Johnston, "this tribe of Annelides—the tyrants or the aristocracy of their race—wander abroad, and are in constant warfare with all around them. They crawl on the surface at a pace that varies in the species from extreme slowness to energetic activity. Many of them swim with ease, and others burrow in the wet sand of the shore. They are eminently carnivorous, with the exception perhaps of the *Ariciidæ*, which may be geodephagous or feeders on putrescent matter." Some of them appear to be truly pelagian, and are only met with in the high seas; but the great majority dwell between tide-marks on the shore, where they find refuge and concealment under stones, or among corallines and sea-weeds. A small number burrow in the sand, in which they form a sort of sheath by a glairy secretion from the skin, and a few are truly tubiculous; but these sheaths are not indispensable, and can be occasionally abandoned without inconvenience. The mouth, as has been stated, is well adapted for their rapacious manner of life; but in addition to these organs of offence, these animals are likewise provided with organs of defence against their enemies. The principal ones are the bristles with which the segments of their body are provided. "Some Annelidans when alarmed, such as the Aphrodites, instinctively contract the body into a sort of ball, bringing the head and tail into near contact, and in this manner seem anxious to elude the danger. Others, that have a long vermiform body, wriggle and

twist themselves with violence as if they would frighten away their foe by their contortions; but these are weak resources in comparison with the protection they derive from their panoply of spines and bristles, and it is curious to remark that as these diminish in size and piquancy, and become better adapted to locomotion than offence, the worms, as if conscious of their defenceless state, forsake the nomade life, and seek additional security by digging themselves furrows for retreat in the sand and mud."—(*Johnston.*) These bristles, which, as stated above, can be retracted within the body and protruded again at the will of the animal, are distinguished into spines (*aciculi*), and bristles properly so called (*festucæ*). The spines, or *aciculi*, are stiff and very resisting, and are distinguished from the bristles by being larger and being placed in the centre. The

Fig. 201.



Spines of Aphrodita.

bristles, or *festucæ*, are various and very remarkable in structure, and their uses are well worthy of attention. Did our space permit we could dilate at great length upon this subject, but limited as we necessarily are, we can only refer to the writings of Audouin and Milne Edwards, Oersted, Dr. Johnston, &c., for further information, and to the accompanying illustrations (fig. 201) of a few of their most interesting forms. These figures are highly magnified, the weapons themselves being extremely small though exquisitely formed. Their number in some of this tribe of Annelides is immense. Some species have been found to possess five hundred feet on each side. Each foot has two branches, and each branch has at least one spine and one bunch of bristles, some of them simple and some of them compound. These individuals then have two thousand spines at least; and if we reckon ten bristles to each brush, it has also twenty thousand of them! Not only are these spines and bristles of great importance to the animal, they are also beautiful objects to look at; for some even of these "laidly worms" shine with a splendour truly remarkable. The *Aphrodites* for example, or "Sea-mice" as they are often termed, have their bodies covered with bristles or hairs which possess a brilliant metallic lustre. "Gold, azure, purple, and green play upon their surface in a thousand different ways, and these colours, often iridescent, harmonize perfectly with the ever-changing reflections of the rings of their body. The wing of a butterfly has not received a more brilliant decoration than these worms concealed at the bottom of the sea, and often hidden in black and fetid mud."—(*M. Edwards.*) Cuvier was so struck with this beautiful play of brilliant colours that he says it does not yield in beauty either to the plumage of the humming birds or the most brilliant precious stones.

MM. Audouin and Milne Edwards, who have studied the Annelides very carefully, divide this order into eight families—I. *Aphroditidæ;* II. *Amphinomidæ;* III. *Eunicidæ;* IV. *Nereididæ;* V. *Ariciidæ;* VI. *Peripatidæ;* VII. *Chætopteridæ;* VIII. *Arenicolidæ.*

FAMILY I.—APHRODITIDÆ
(*The Sea-mice*).

The Sea-mice are of an oval, oblong, or linear-elongate and depressed form, the body composed of a definite number of segments, and the back covered with a series of scales, or elytra, disposed in two rows. The species belonging to this family are amongst the most highly organized of all the Annelides. The head is distinct from the other rings of the body, and possesses eyes placed on its vertex, generally four in number and arranged in two pairs; true antennæ, in general to the number of five, sometimes three, the odd one being placed in the centre; a cylindrical proboscis fringed with papillæ round the orifice and armed with four jaws united in pairs, the two above and the two below having their cutting edges placed opposite each other. The feet are usually very distinct, well developed, and composed of two branches, each furnished with a spine, with bristles, and with cirrhi. These feet, however, are not uniform in structure, for some are furnished with a superior cirrhus and usually with branchiæ, but have no elytra, whilst others have scales or elytra but want the cirrhi and branchiæ; and these different kinds of feet alternate for a definite space along the sides. The branchiæ, when present, are only rudimentary and generally concealed. But one of the most remarkable parts of the external structure of the Sea-mice is the existence of these elytra mentioned above. These are large membranous scales which form two rows placed longitudinally along the back of the animal, and are fixed to the base of the superior branch of the feet by means of a short pedicle. They are formed of two cutaneous or epidermoid layers, applied the one against the other, but capable of being separated so as to become vesicular, and, like the oviferous feet of the *Apus* amongst the Entomostraca, appearing at certain seasons of the year to be filled with eggs. A certain number of the feet are destitute of these scales, and, as stated above, these feet alternate with those that are provided with them—a peculiar structure which does not exist in any other family of Annelides, and forming the leading peculiarity of the present group, as well as one of its

organs are wanting. The feet form a projecting series of lobules along each side, and are all of essentially the same structure; in general they consist of two branches armed with bristles. These are mostly compound, and in each bundle there is a spine of the usual form. In the greater number of instances the feet are provided with two filiform, awl-shaped cirrhi, which in some are transformed into compressed laminæ or leaflets. The branchiæ are simple in structure, but their existence is sometimes doubtful. They are usually in the form of lobules or tonguelets placed on the feet, and distinguished from the true lobes of the feet by being destitute of bristles or any antennæ. The *Nerëis* (fig. 203) will illustrate this family.*

FAMILY V.—ARICIIDÆ.

This family contains several genera, and a considerable number of species. Their body is in general elongated and linear, like the Nerëides; but it is not truncate anteriorly as in these worms, and is smaller nearest the anterior extremity. It is usually cylindrical in form, and consists of numerous short segments. The head is very small, conical or rounded, in most of the species possessing no antennæ nor eyes. The proboscis is small, somewhat membranous, and is destitute of jaws. The feet are divided into two branches which are not very projecting, but armed with simple setaceous bristles. The branchiæ are either wanting altogether or are very simple in their structure, exhibiting the form of a setaceous or lanceolate filament reflected on the back, or elongated and spreading, and frequently clothed with large vibratile cilia. The species of this family are miners in wet sand or mud, and are found inhabiting slightly cemented sand-formed tubes.

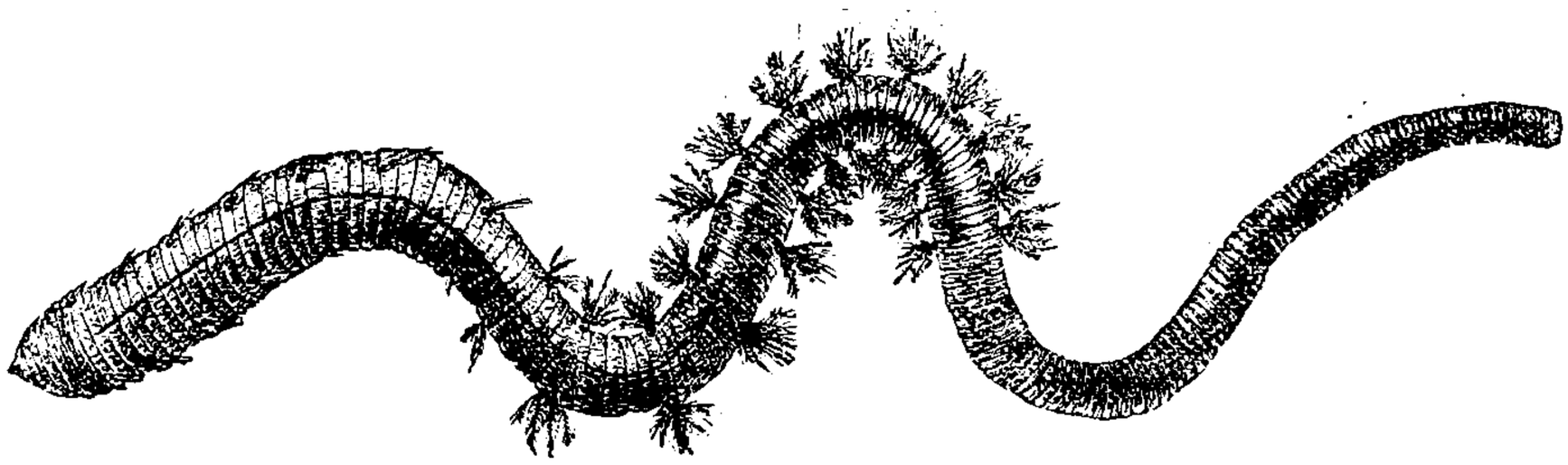
FAMILIES VI. AND VII.—PERIPATIDÆ AND CHÆTOPTERIDÆ.

The families *Peripatidæ* and *Chætopteridæ* consist each of only one genus, and only one species has as yet been described belonging to each of these genera. In both these families the feet are prominent and furnished only with bristles properly so called, and there is a total absence of distinct cirrhi.

FAMILY IX.—ARENICOLIDÆ.

This, the last family of the order ERRANTIA, appears to establish the passage of the animals belonging to it into those of the order TUBICOLA; M. Savigny, indeed, places them along with the *Serpulæ*. The *Arenicolæ* are of a cylindrical form, and the body consists of only a small number of rings, but these are divided by a multitude of transverse pleats. The head is merely rudimentary, and the mouth is terminal and furnished with a small retractile proboscis, but is destitute of jaws. There are neither cirrhi, antennæ, nor eyes. The feet are uniform in structure and composed of two branches, the dorsal branch being armed with simple bristles, and the ventral with a series of imbedded, hooked bristles. On a certain number of segments in the middle portion of the body we find the branchiæ in form of well developed arbuscles. The figure we here give (*Arenicola piscatorum*) will give a good idea of the family.—See fig. 204.

Fig. 204.



Arenicola piscatorum, or Lug-worm.

ORDER II.—TUBICOLA OR SEDENTARIA (=*Capitibranchiata*).

The Annelides of this order are so called from the great majority of them living in tubes, which, from the organization of their bodies, they are incapable of leaving. They are hence also named *sedentary* animals, as the tubes they inhabit are frequently permanently fixed. The body of the animals is worm-shaped, cylindrical, generally swollen or thickened on the anterior portion, while the posterior is smaller, of less diameter, and sometimes distinctly defined as a bristleless appendage. It is composed of numerous short segments; the head is ill defined, not distinguishable from the anterior segment which contains the mouth; and there

* There are several genera belonging to this family, as *Nerëis*, *Syllis*, *Phyllodoce Nephthys*, *Glycera*, &c., &c., but there is one which has a remarkable form, and which has been described as a new genus by the late Dr. Johnston of Berwick, and hitherto undescribed, which we should like here particularly to mention. He has named it *Gattiola*, in compliment to his friend Mrs. Gatty, authoress of the well-known "Parables from Nature." It has a body consisting of about fifteen segments, deeply indented at the sutures and narrowed in front. The small, flattened head has three long, filiform, unjointed antennæ, four eyes, and two pairs of tentacular cirrhi, similar to the antennæ. The feet are composed of only one branch, and the bristles are compound and falcate. Only one species has as yet been described; it is a native of England, and has been called by Dr. Johnston *Gattiola spectabilis*.

are neither antennæ, eyes, proboscis, nor jaws visible on the crown, or on a lobe above the mouth, or on each side near the mouth. On the anterior segment of the body we see in most of the species a series of filiform extensile tentacles, and on the first two or three segments the branchiæ are placed. These organs are few in number, are large, much branched, plumose, or pectinated; and are arranged along the sides, rarely on the middle of the back of these anterior segments: sometimes they are wanting altogether. The feet are distinct, but not projecting or fitted for enabling the animal to walk, as in the preceding order. They are not uniform in structure, but present a different appearance in different parts of the body. They are biramous, enlarged transversely, and armed with the ordinary setaceous bristles, as well as with hooked bristles or *uncini*, which serve the animal for moving up and down in its tube. The mouth is terminal and placed transversely. Some of these Annelides form a homogeneous calcareous tube, which is generally attached to a stone, rock, or shell, &c. Others construct tubes by agglutinating grains of sand, fragments of shells, and particles of mud, which they join by means of membrane. A third set, again, inhabit tubes which are entirely membranous or horny.

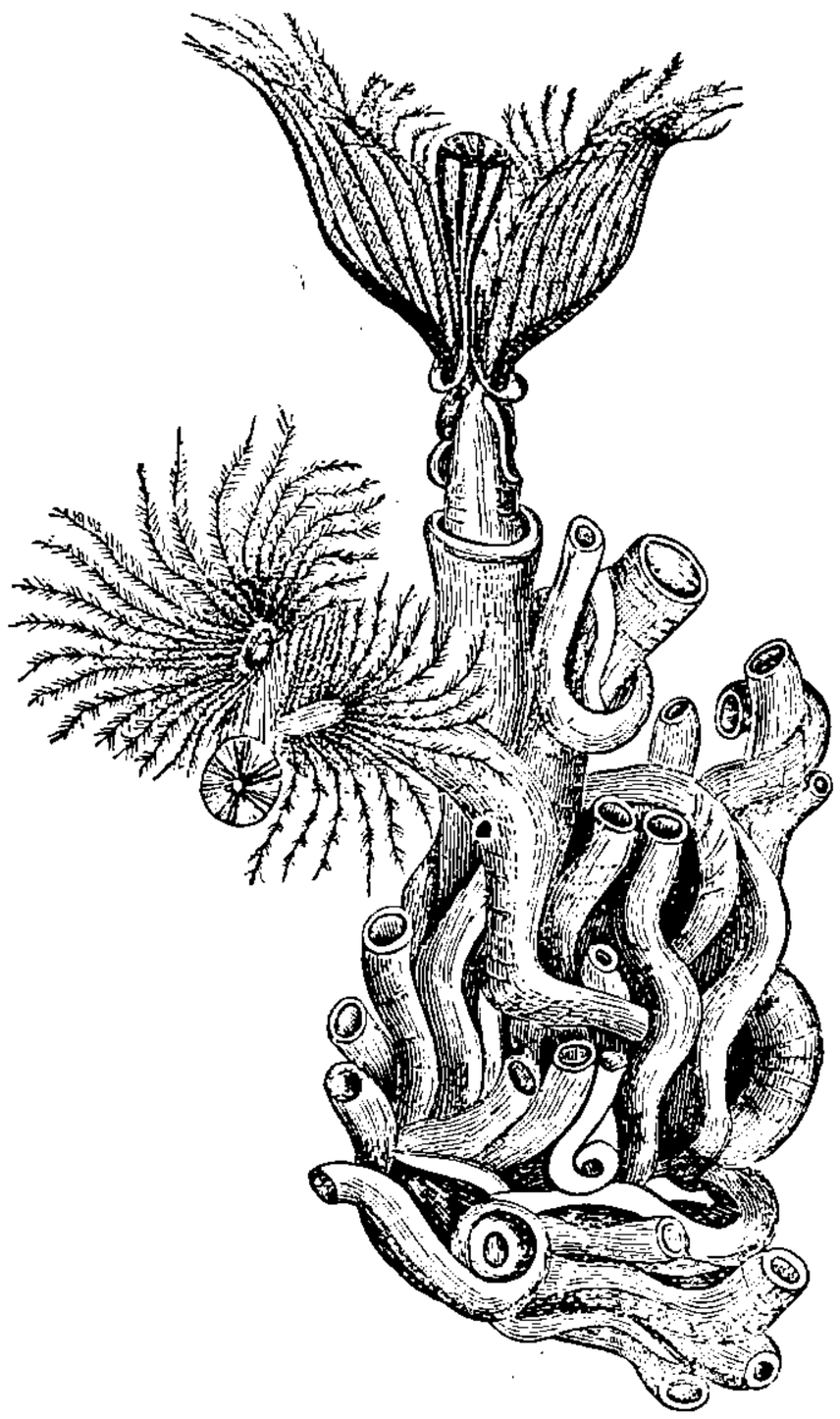
FAMILY I.—SERPULIDÆ.

The animals belonging to this family have an elongated, worm-shaped body, divided into short segments and distinguishable into thoracic and abdominal portions. The head is amalgamated with the following segments, and not noticeable in the adult. The first segment is encircled with a collar, which is said to be the part of the body that secretes the shelly tube. It is also furnished with a tuft of bristles on each side. The feet are composed of two branches. In the thoracic portion of the body the dorsal branch is armed with setaceous bristles, while the ventral is furnished with hooked ones. In the abdominal portion of the body (which is the longer) it is the ventral branch that is armed with the setaceous, and the dorsal with the hooked bristles. The branchiæ are attached to the vertex or first segment, consist of two divisions, and resemble a fine plume in shape of a fan, and are, in general, adorned with the most lively colours. Each of these divisions consists of a pedicle, the upper edge of which is furnished with a great number of filaments placed in a line, like the teeth of a comb, and each in their turn provided with a double row of movable barbules. Though these branchiæ serve the purpose of respiratory organs, it would appear, says Audouin, that it is not the only use to which they are applied; for Bosc has observed that these animals live on small worms, which they attract to their months by the whirlpool caused by the rapid motion of these organs in the water.—*Serpula cortortuplicata* (fig. 205) will illustrate the family.

FAMILY II.—TEREBELLIDÆ.

In general form the animals of this family resemble very much the preceding, being vermiform and cylindrical, without distinct head, and divided into thoracic and abdominal portions. The feet on the thoracic portion are similar to those of *Serpulidæ*, but on the abdominal portion the dorsal bristles, or both dorsal and ventral, are frequently wanting. The branchiæ are pectinated or much branched, rarely filiform, and placed laterally. These animals inhabit membranous

Fig. 205.



Serpula cortortuplicata.

tubes, which are coated with particles of sand, gravel, or broken shells agglutinated together, and open at both extremities.

FAMILY III.—SABELLARIIDÆ.

In this family the body of the animal is composed of few segments, and is divided into two distinct portions. The anterior portion has the segments provided with setigerous and uncinated feet; the posterior is narrow, without segments, and without feet, more like a caudal appendage. The first segment is large and truncate, disc-shaped, and having an operculum composed of several rows of flattish bristles. The mouth is placed in the centre of this disc, and encircled with a somewhat extensile lip. The feet are in two series; the upper prominent, armed on some of the anterior segments with flat, or sometimes hooked bristles, and on the following segments with small fascicles of capillary bristles. The branchiæ are in pairs on all the segments.

FAMILY IV.—MALDANIDÆ.

This family contains only one genus, *Clymene*, and this genus possesses as yet only one species. This is a very curious worm, destitute of branchiæ and tentacles, and living in a fixed tube of a membranous substance, but incrusted with shells, and open at both the extremities. The tube is hard, compact, irregular, constructed of sandy particles, united by an exudation apparently from the whole body, and fashioned chiefly during the night.

ORDER III.—TERRICOLA (*Abranchia setigera*) *Earthworms.*

The animals belonging to this order have all a very simple organization. The body is truly vermiform, cylindrical, composed of numerous uniform but narrow segments, which possess no soft appendages or cirrhi, but are furnished with spines, or spinets, or setaceous bristles partially retractile. These bristles are almost never grouped in bundles, but are arranged in pairs near each other, and upon the sides of the segments. There is no distinct head, and neither eyes nor antennæ are visible. The mouth is destitute of jaws, and there are no feet; the bristles or spines on the sides of the rings taking their place. No external organs of respiration exist; the vent opens underneath the last segment. As their name indicates, the worms of this order live in moist earth, or in mud saturated with water, which they swallow, and from which they extract their food. They unite both sexes in the same individual, and are oviparous or multiplied by spontaneous division. The young undergo no metamorphosis. The animals possess the power of reproducing portions of their body which have been amputated, and they may even be divided into several portions without destruction to life. Several species have been observed to excrete a phosphorescent fluid, and the skin of others is iridescent.

FAMILY I.—LUMBRICIDÆ (*Earthworms*).

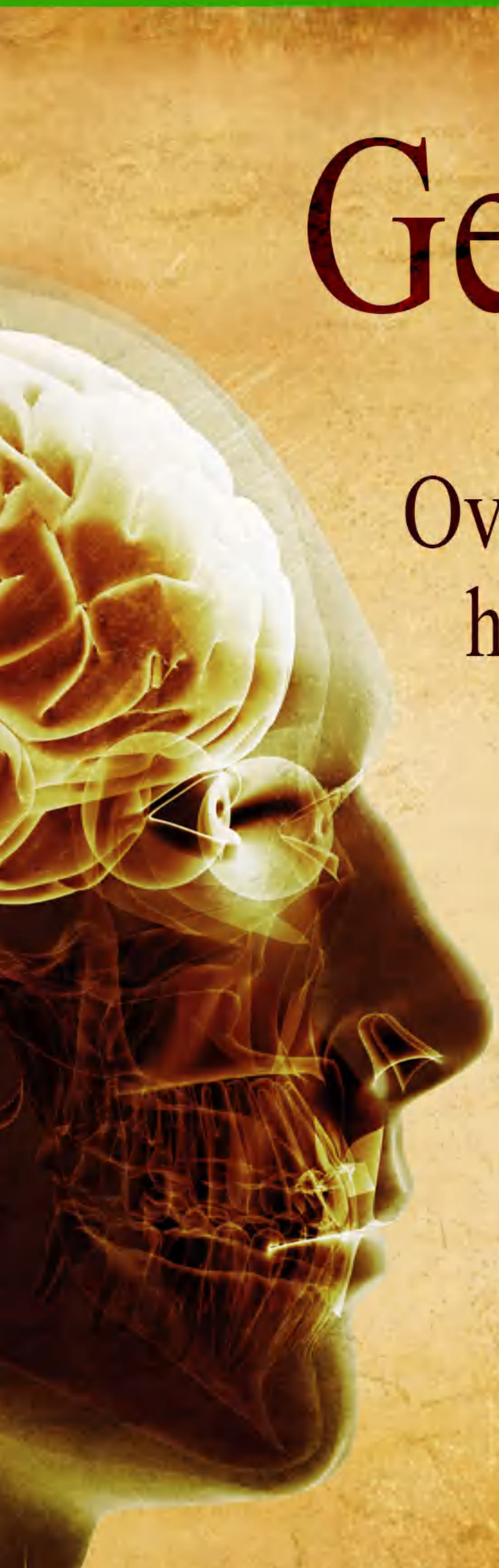
The animals of this family are distinguished by the head being indistinct, and all the segments of the body excepting the first being armed with setæ. The mouth is never furnished with tentacles, but is edged by two lips. The bristles which supply the place of feet are distributed over all the segments, and only rarely form fascicles. They are non-retractile, and never have the form of hooked bristles. The Common Earthworm (*Lumbricus terrestris*) is the type of the family, and is too well known to require description.

FAMILY II.—NAIDÆ (*The Naides*).

In this family the head is distinct from the body, and the first three or four segments are without bristles. The mouth is exactly terminal, whilst in the preceding family it is situate underneath a superior terminal lip. The *Naides* are small, pellucid, vivacious worms, differing from the Earthworms by the flatness of their segments, which are furnished with comparatively long setaceous bristles. They are all strictly lacustrine, living amidst subaquatic plants, or, half parasitical, within the shell of fresh-water Mollusca. They creep about actively, and can even swim. The segments of which the body is composed are less distinct than those of the *Lumbrici*, though the body is more elongate. The number of bristles which each segment is armed with, varies from two to ten, or twelve. They are of two kinds—spinets forked at the apex, and setaceous collected in small fascicles. The animals are zoophagous, and though most probably oviparous, they multiply easily by spontaneous division. This fact has been particularly noticed by British naturalists in the case of *Nais* (*Stylaria*) *proboscidea*, a small, linear, round worm, about half an inch long, that is common about the roots of aquatic plants in our ponds and ditches. When this process commences, says Mr. Lewis, who has watched the operation, the little worm begins to form a second head near the extremity of its body. After this head, other segments are in turn developed, the tail or final segment being the identical tail of the mother, but pushed forward by the young segments and now belonging to the child, and only vicariously to the mother. In this state, he adds, we have two worms and one tail.

ORDER IV.—SUCTORIA (= *Abranchia Nonsetigera*) *Leeches.*

This is a natural order of worms and more clearly defined and circumscribed than any of the preceding. The body is elongated, depressed in general, and divided into a great number of narrow segments—the anterior conformed into a more or less distinct sucker with the mouth in its centre or on its ventral side; the posterior forming a terminal, circular, cupped disc. The mouth possesses organs performing the functions of jaws, but usually has neither proboscis nor tentacles. On the dorsal face of the anterior rings there are in general several (from two to ten) small black points which are considered to be eyes, and are arranged in pairs. In most cases there are no special respiratory organs visible externally; and though there are no organs of taste, smell, or hearing, the sense of touch is exquisite and diffused. The animals belonging to this order, as the name indicates, are all more or less parasitical and aquatic. A few are zoophagous, devouring small mollusks, larvæ of insects, &c.; but by far the greater number suck the juices of other animals, as fishes, frogs, or animals which happen to go into the water in which they reside, lodging themselves occasionally in their palate, under the tongue, nasal fossæ, or even the œsophagus. Savigny informs us that during the French expedition to Egypt, they at times caused serious accidents to soldiers who drank at the fountains in which these creatures lived. When cold weather commences they bury themselves in the mud of ponds, and there pass the winter in a state of lethargy, from which they



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CLASS—TURBELLARIA (THE PLANARIAS, NEMERTINES, &C.)

THIS class of worms was established by Ehrenberg, and has been revised by Oersted. It contains, according to the arrangement of Dr. Johnston, all these non-parasitical worms the body of which is not divided into segments, and which is destitute of bristles on the sides, described in the previous class of Annelides as taking the place of feet. The extremities of the body are simple, and continuous with it, there being no distinct head visible. In form this body is either flat or subcylindrical; in substance soft, parenchymatous, or cavernous, and in general it is naked and lubricous. The whole body is covered more or less with vibratile cilia or with papillæ; it is often very contractile, assuming a variety of shapes at different times, and there are some species which break up voluntarily into pieces. The front portion of the body, the head being imperfectly defined or completely continuous with the body, has in most cases no tentacula, but in some genera there are two, prolonged from the surface. The mouth in some is terminal, in others ventral; and in the latter case it is situated in the anterior third, or near the centre, or towards the tail, and is often furnished with a protrusile proboscis. The intestine in one group runs undivided through the length of the body, and in another is dendritically branched; and in these latter this canal is without a vent. The Turbellaria are either of separate sexes, or they are hermaphrodite; most of them propagate by ova, but some by transverse fissuration. These worms are animal-feeders for the most part, though there are some which appear to make their diet, in part at least, consist of decaying vegetable matters. In general they are natives of salt or fresh water, though a few are found on land in moist places. Their mode of progression is by gliding smoothly along the surface of any body upon which they attach themselves, as under stones, on the leaves of algæ and submerged plants, &c., or by swimming, an act which they execute rather slowly. A few of the species are found taking up their abode in the deserted tubes of other worms, or even, though rarely, forming for themselves a sheath of dried gluten of considerable tenacity.

The class *Turbellaria* may be divided into two orders—I. *Planaria*, containing the true Planarias; and II. *Teretularia*, containing those long linear or riband-shaped worms, called *Lineus*, *Borlasia*, or *Nemertes*, &c.

ORDER I.—PLANARIA (*The Planarias*).

The body of these worms, as their name would indicate, is flattened, and usually not much longer than broad. It is covered with a ciliated epithelium, and is of a loose, cellular, parenchymatous structure. A few are destitute of eyes, but the greater number have them pretty well developed, and sometimes even numerous and arranged in clusters. The month is a simple pore, and often furnished with a protrusile proboscis. The intestine has no vent or posterior opening, and is either in form of an undivided tube, or branched like a shrub.

This latter character has been taken as a means of dividing the order into two sub-orders or large groups —*Rhabdocœla*, and *Dendrocœla*.

SUB-ORDER I.—RHABDOCÆLA.

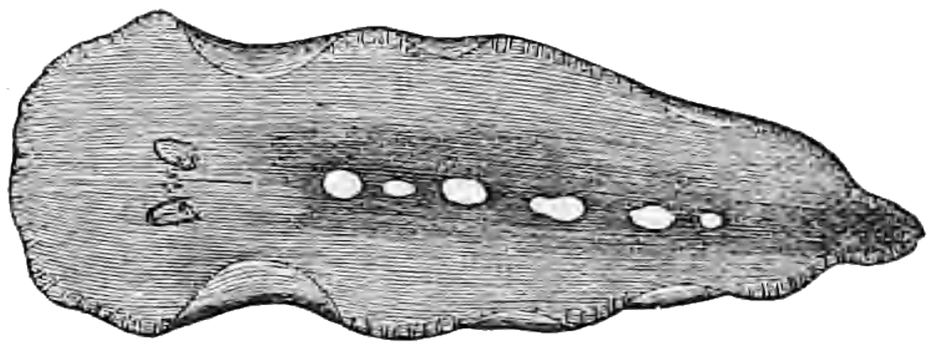
Alimentary canal simple and cylindrical; no protrusile proboscis; locomotion mostly natatory.

The animals of this group are small, aquatic creatures, living both in fresh water and salt. The body is of a parenchymatous consistency, and it is often difficult to trace any distinctly-defined viscera or their openings. It is contractile to a certain extent, and has an entire margin. There is no distinct head, and in some the eyes are altogether wanting, whilst in others they occur only two in number. The mouth is either terminal or nearly so. The fresh-water species propagate by ova, and these are laid inclosed in a cocoon or capsule. The marine species are less known. A good many species are found in this country; and one genus has been named *Dalyellia*, in compliment to Sir John Dalyell, the author of a very interesting account of British Planaria.

SUB-ORDER II.—DENDROCÆLA.

Intestinal canal dendritically ramified; a protractile proboscis; locomotion reptatory.

Fig. 206.



Planaria maculata.

This sub-order contains many more species than the preceding, and to it belong the true Planarias. The accompanying figure will represent the order *Planaria*.—See fig. 206.

ORDER II.—TERETULARIA (*The Nemertines*).

The worms of this order have a body linear in shape, and very much (in some cases nearly a thousand times) longer than broad. It is soft and glutinous, very often covered with vibrating cilia, and so contractile, that when extended in the act of moving through the water or mud, they exceed their length when at rest by three

or four times, or even more. The anterior extremity is, in general, marked by several black specks arranged on each side of it, but variable in number. These are considered to be the eyes. The mouth is anterior, and almost always terminal, in the form of a slit, and for the most part provided with a protrusile, long proboscis. The intestine is simple, descending down the centre of the body in a straight or undulating line to the opposite extremity, where it opens outwardly by a pore similar to the mouth. The sexes are separate, and they multiply by ova, or perhaps, also, by transverse sections. The species are all marine, and are found living under stones and in mud between tide-marks. They appear to dislike the light, and prefer to live in obscurity. The species are very tenacious of life; if cut into several pieces, each lives and moves, and perhaps each in time will grow up to a complete and perfect worm. Fresh water is a powerful poison to these worms; if placed in a vessel of this fluid, they instantly show by their violent contortions how painful and deleterious it is to them; they soon break into pieces, disgorge portions of their viscera, and speedily die and dissolve into a soft jelly. Some species progress like the leeches, moving in great undulations from side to side, from right to left. All of them can creep up solid plane surfaces by means of contractions which sometimes change their general form in a very singular manner. The number of males appears to be much inferior in proportion to that of females. As Quatrefages remarks, this is the case also with many of the intestinal worms; in proportion, he says, as the organization of the lower animals becomes degraded, it appears that the female sex predominates more and more.

CLASS—ENTOZOA (INTESTINAL WORMS).

As Siebold remarks, it is very difficult to characterize this class of worms, for it contains animals having widely dissimilar organization. Indeed this is so much the case, that some naturalists wish to suppress the class altogether, and it has been attempted to divide and isolate the orders amongst the various other classes of the inferior invertebrated animals. But such various difficulties have arisen from this, that in a work like the present it is much better to keep the class as a distinct one; for if we fail to perceive any common character in their organization, we can easily find one in their manner of living. The Entozoa are parasitical worms, which either during their whole life, or at least a part of it, inhabit the bodies of other animals, and derive their nourishment from them.

The nervous system is feebly developed, and has only lately been distinctly recognized. In the majority it consists of two ganglia or two pairs, which unite together by a median band or narrow commissure, and give origin to two long cords which run through the whole length of the body. In some no vascular system has been recognized, but in others it is well developed. The circulating liquid, however, or blood, is in general wholly colourless. The digestive organs vary very much in the different orders. In some, as the *Cestoid worms* and the *Acanthocephali*, neither mouth nor alimentary canal have been observed—(*Siebold*); but in other orders it is pretty well developed. No respiratory system has as yet been satisfactorily observed. The intestinal worms, as their name imports, are almost all inhabitants of the internal parts of other animals; there alone can they continue their species, and there alone can they obtain their nourishment. There is scarcely one animal that is exempt from these parasites; and in general each genus seems to possess one or more species peculiar to itself, though often several species infest the different cavities of the same animal at the same time. For instance, there are about twenty distinct species that are found either in some of the cavities or in the muscular substance of man. They are most frequently met with in the alimentary canal, but they occur also in the cellular tissue, and in the parenchyma of the most closely-invested viscera, such as the liver and the brain. Though they are very frequent in diseased states of the viscera, and, when numerous, are the cause of disease themselves, they yet occur abundantly in perfectly healthy subjects. Most of the Entozoa propagate by means of genital organs, which in some are situated upon a single animal, and in others upon two separate individuals. A few, however, multiply by fissuration, as is the case in the Tape-worms (*Tænia*). The old opinion, therefore, that intestinal worms were products of spontaneous generation, is now completely exploded. It is exceedingly difficult, however, to conceive how these creatures can get into some of the obscure and well protected organs and parts of the body in which they are found. Not only the liver and brain, as mentioned above, but the lungs and blood-vessels are infested with them; and it is affirmed they even occur in the unborn fœtus. Some of the species, too, attain a large size; and we must conclude that the germs from which they spring must be exceedingly minute, as they must be capable of being transmitted through capillary vessels and apertures too small to be discerned by the naked eye.

The Entozoa differ very much from one another in form and organization, and, according to Cuvier and Professor Owen, have been divided into two large orders — I. Nematoid or Cavitary Entozoa (=Cœlelmintha—*Owen*); those which have an intestine floating in a distinct abdominal cavity, commencing with a mouth, and terminating with a vent; II. Parenchymatous Entozoa (=Sterelmintha—*Owen*); those which have the viscera obscure, generally in the form of vasonlar ramifications, or even not discernible at all. By this arrangement, however, worms the most dissimilar in their general appearance are grouped together, and a more natural method has been generally adopted. Rudolphi divides them into five orders, basing his

arrangement upon that of Żeder. In the following pages we shall adopt a somewhat similar method, and divide them also into five orders:—

I. NEMATOID, *Round Worms*—those which have a slender, elongated, cylindrical body, more or less filiform, and rigid or elastic. The individuals have a true intestinal canal, and are of both sexes.

II. ACANTHOTHECA, *Sheathed-hooked Worms*—those which have a more or less club-shaped form, with a large head and the mouth in a depression of it, and surrounded with four strong, brown, simple hooks. The sexes are separate.

III. TREMATODA, *Suctorial or Fluke Worms*—those, the species of which have the body generally flat, soft, and furnished with suctorial discs. They have no intestinal canal, and the sexes coexist in the same individual.

IV. ACANTHOCEPHALA, *Hooked Worms*—those in which the body is slender, round, subelastic, and provided at the anterior extremity or head with a retractile proboscis. They have no intestinal canal, but distinct genital organs, and distinct sexes.

V. CESTOIDEA, *Ribband or Band Worms*—including the Cystic Worms or Hydatids (*Cystica* of Rudolphi); those that have an elongated, flattened, soft, continuous or jointed body, and a head either round and provided with a crown of small hooks, or flattened and furnished with two or four suctorial pits, called *bothria*. In these the two sexes are united in the same individual, and no trace of intestinal canal is to be seen. They multiply also by fissuration.

ORDER I.—NEMATOIDEA (*The Round Worms*).

This is the most highly organized order of all the Entozoa, and contains a great many species. It comprises also more species found inhabiting man, than any of the other orders. They may be defined as worms with a filiform, or very long cylindrical or fusiform body, covered with a resisting integument. The mouth is terminal or nearly so, and the vent is nearly terminal or preceding by a short distance a very slender tail. The intestine is straight. The sexes are separate. In size they vary much, some being scarcely a line long, others measuring an inch, and others again reaching the length of a foot. The greater proportion of them are found in the interior of the body of other animals, but a few are detected in the muscular system.

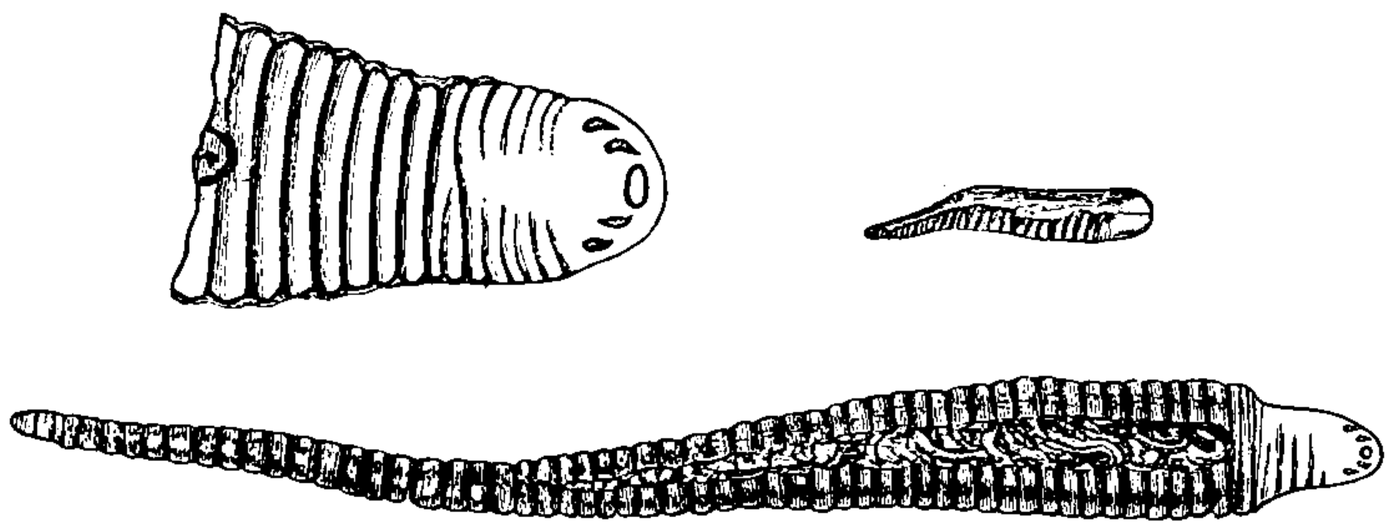
The most typical genus of Nematoid or Round Worms is the genus *Ascaris*. The *Ascarides* are almost always found in the intestines of vertebrated animals; and one species infests the alimentary canal of man.

ORDER II.—ACANTHOTHECA.

This order has been constituted to receive a few worms which Cuvier arranged amongst the *Nematoidea*, and Rudolphi amongst the *Trematoda*, but which differ from both these orders in several respects. The order may be defined as composed of worms having a straight intestine, with the mouth subterminal, and the vent terminal. The mouth is situated on the inferior surface, and is armed with two pairs of hooks, which are retractile into sheaths. They have a distinct nervous system, and the sexes appear to be separate.

GENUS PENTASTOMA.—This genus is almost the only one belonging to it. The species are never found in the intestines; they are only to be found in the frontal sinuses, in the larynx or the lungs of Mammalia and Reptiles, or in cysts or serous cavities. They are worms of an oblong or cylindrical shape, pleated transversely, or nearly ringed. The head is generally large, and the mouth is situated on the under surface, with a longitudinal slit on each side, from which issue two pairs of simple or double hooks, retractile into as many distinct cavities. The genus is represented by a figure of *Pentastoma tænioides*.—See fig. 207.

Fig. 207.



Pentastoma tænioides.

ORDER III.—TREMATODA.

This is a very natural order of intestinal worms. They are more or less elongated, and of a depressed form, and provided with one or more organs of adhesion or suckers, by means of which they attach themselves to the various animals upon which they live as parasites. They are provided with a mouth and an intestine, but have no vent. The two sexes are united in the same individual. In those species which have been particularly watched the ova are elliptical, and the embryos when first hatched are generally covered with vibratile cilia, and undergo distinct metamorphoses in their progress to maturity. The Trematodes are found in the various cavities of the body, in the tissue of certain organs, or even on the surface of the body; and exist in both vertebrate and invertebrate animals.

The various species which are found adhering to the external surface of the animals upon which they live, forming the families *Onchobothriidæ* and *Capsalidæ*, have, in consequence of their being outside parasites, been placed by several naturalists in the class *Annelida*.

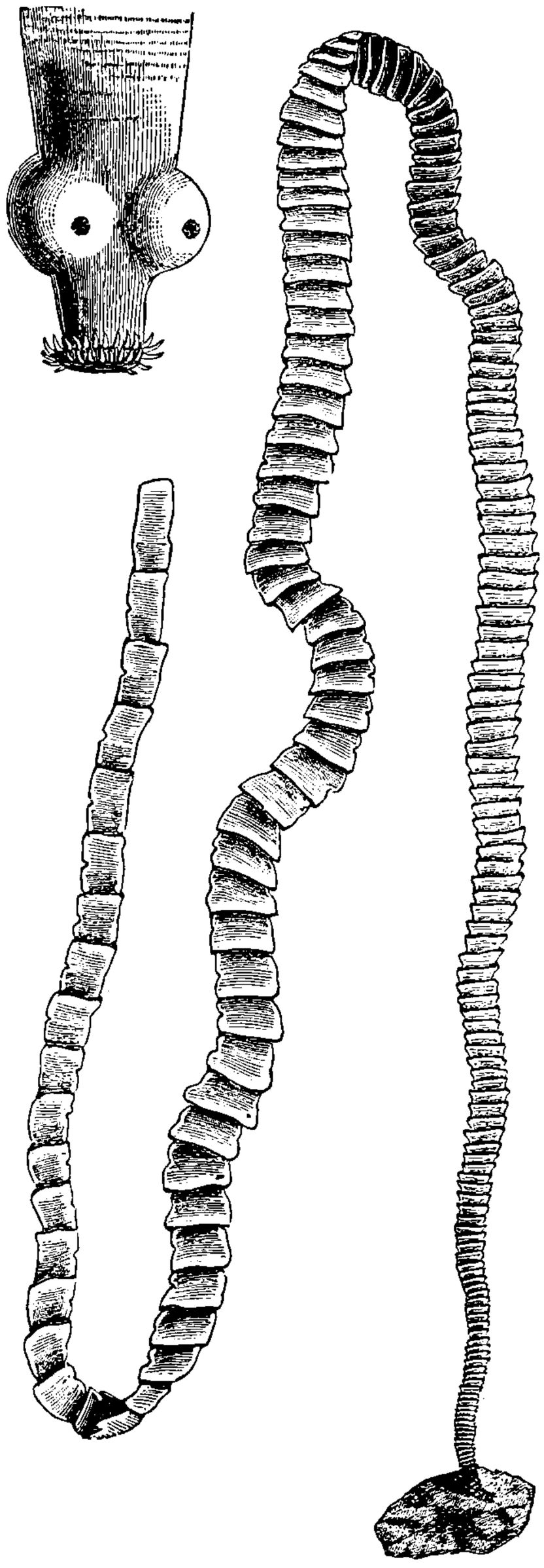
GENUS DISTOMA or *Fluke-worms*, the species of which are all found internally, may be taken as the type of the family. The body of these worms is generally depressed, sometimes of a cylindrical form, and is provided with two distinct and isolated suckers, one

increase in size, and at the end of eight weeks it was found to have grown from the size of a pea to the length of from thirty-six to thirty-nine inches.

The most generally known and perhaps the largest of all the Tape-worms, is the species which inhabits the intestinal canal of man. Fig. 208 is that of the *Tænia crassicollis* mentioned above.

The Cystic worms, formerly constituting a separate order, *Cestoidea*, and now provisionally a family, *Cysticidæ*, are only, as mentioned above, stray *Tæniæ*, which have assumed a vesicular form and have not developed genital organs. They are the produce of the microscopic ova of the Cestoid worms belonging to certain carnivorous animals accidentally introduced into the bodies of rodent or ruminant quadrupeds. In such situations these ova are not developed into elongated, articulated Tape-worms, but into Cystoid worms, the body being terminated by a vesicle of a bottle-shape and filled with fluid. They do not assume their perfect form till they have passed through the stomach of the Carnivora to which they originally belonged; but nevertheless while in their undeveloped form as Cystoid worms, they produce intense suffering, serious illness, and ultimately death, in the poor creatures in whose bodies they have taken up their abode. Such are the species of *Cysticercus*, *Cœnurus*, &c.

Fig. 208.—Tænia crassicollis.

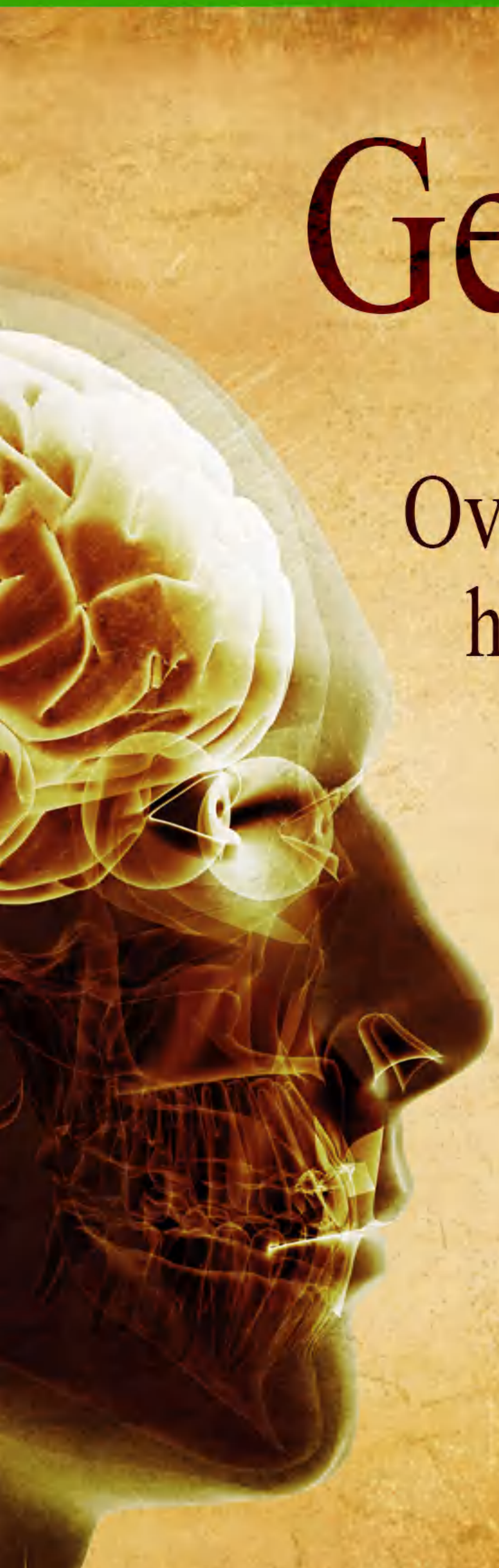


The history of the worms called Entozoa is full of interest, but in a work of this sort we must content ourselves with merely a brief sketch of the classification and leading families and genera. Enough, we trust, has been said to stimulate inquiry, and to aid the reader in pursuing it.

END OF CRUSTACEA, ETC.

INDEX.

CRUSTACEA—CIRRIPEDIA—ANNELIDA—TURBELLARIA—ENTOZOA.



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other centres, connected with the lower side of the esophageal ring, send nerves to the foot, viscera, and respiratory organ."—(*Woodward.*)

ARRANGEMENT OF MOLLUSCA.

Previous to the time of Cuvier, the animals which we now know under the name of *Mollusca*, were confusedly arranged, and very imperfectly known. They "were intermingled with worms and with zoophytes, while a great number of them stood detached from their allies under the ordinal designation Testacea, merely because they were inclosed in hard calcareous shells; the knowledge of the inferior tribes being then too little advanced to admit of the application of any characters but those that were derived from exterior form and consistence. By his numerous careful dissections, Cuvier was early enabled to detect and appreciate the unnaturalness of the prevalent systems; and when his labours had convinced him that their overthrow was necessary to the progress of science, they had at the same time furnished him with the materials out of which he sought to erect a new system, which has been of incalculable advantage to scientific conchology, and which remains untouched in all its grand lineaments, though his successors have certainly improved and worked out many of the minor details."—(*Johnston.*) It is to Cuvier, then, that we owe the grouping together the animals to which the name of *Mollusca* is now properly restricted.

This great naturalist took as the first division the possession or the want of a head, and arranged the various classes into two principal groups:—1st, Those which had a head more or less distinctly formed, the *Encephala;* and 2nd, Those which were destitute of that important appendage, the *Acephala.* In the first group he placed the *Cephalopoda*, or Cuttle-fishes; the *Pteropoda*, Winged or Floating mollusca; and the *Gasteropoda*, or Snails. In the second group he placed the *Conchifera*, or Bivalve shells; the *Brachiopoda*, Brachiopods, or Lamp shells; and the *Cirrhopoda*, or Barnacle shells. This last class is now ascertained to belong to the *Crustacea*, but may be replaced by the *Tunicata*, or Tunicaries—which he made merely an order of the *Acephala.* Various arrangements have been suggested by naturalists since Cuvier put forth his system, but we will only mention one, that of Dr. Gray; merely premising that however varied the methods propounded have been, they all hinge in reality upon that of the celebrated author of the "Regne Animal."

Cuvier divided the Mollusca into two great groups, according as they possessed or as they wanted a head.

Dr. Gray, in adopting the classes of Cuvier, divides them into two great groups also, but takes as the basis of his arrangement the possession or want of a foot. As this arrangement is the one adopted in our great national collection in the British Museum, and has the merit of being patent to all who wish to study Conchology; and as we shall have frequent occasion to refer to it in the following pages, we subjoin it as follows:—

SUB-KINGDOM MOLLUSCA.

GROUP I.—PEDIFERA, crawling on a foot placed under the body.

Class 1.—GASTEROPODA—*Gasteropods, Univalves,* or *Snails.*

Head distinct, with eyes and tentacles; body usually protected by a conical, more or less spiral shell, often furnished with an operculum.

Class 2.—CONCHIFERA—*Conchifers* or *Bivalves.*

Head indistinct; mouth placed between the gills; they and the body inclosed between the two leaves of the mantle, which are covered by two shelly valves united above by a ligament.

GROUP II.—APODA. Foot none, or very rudimentary.

Class 3.—BRACHIOPODA—*Brachiopods* or *Lamp Shells.*

Mouth placed at the base of two spirally-twisted ciliated arms between the two leaves of the mantle, which are covered with two separate shelly valves; they live attached to other marine bodies.

Class 4.—PTEROPODA—*Pteropods* or *Floating Mollusca.*

Head prominent, with one or rarely two pairs of fins on the side of the neck, by means of which they swim on the ocean; body often covered with a thin conoidal shell.

Class 5.—CEPHALOPODA—*Cephalopods* or *Cuttle-fishes.*

Head distinct, large, with eight or ten or more arms by which they walk head downwards.

To these we must add—

Class 6.—TUNICATA—*Tunicated Mollusca* or *Tunicaries.*

No distinct head; mouth at the bottom of the branchial sac; body protected by an elastic gelatinous tunic, with two orifices, one for the admission of water and food into the interior, and the other for the expulsion of excrementitious matters; no shell.

As in the preceding parts of this work, the plan followed has been, in general, to commence with the most highly-organized forms, descending to those lower in the scale, we will deviate here from the sketch just given of the arrangement in the British Museum, and begin with the Cephalopods. "The type of structure which characterizes the *Dibranchiate* order of Cephalopods," says Professor Owen, "places these mollusca not only at the head of that division of the animal kingdom, but in respect to its closer proximity to the vertebrate type, unquestionably at the head of the whole invertebrate series." Premising this, we will therefore commence with—

CLASS I.—CEPHALOPODA—HEAD-WALKING MOLLUSCS.

THE Cephalopods are the most highly organized of all the molluscs. They are symmetrical animals, having their right and left sides equally developed. They have a large distinct head, a mouth armed with powerful horny jaws, acting vertically like the mandibles of birds; a large and fleshy tongue, and large well-developed eyes, approaching in structure those of vertebrated animals. The body, which is soft and fleshy, is

enveloped in the mantle, which forms a muscular sac, open only in front. The head protrudes from this opening, is distinct from the body, and has placed round the mouth a number of flexible, fleshy appendages, called arms or feet, which serve both as organs of prehension and locomotion. These arms or feet are usually provided with cups or suckers, called *acetabula*, that act like cupping glasses, and are for the most part unarmed, though in some instances they are furnished with a long sharp claw. They form a single or double series on the inner surface of the arms, and are various in number. In those which are unarmed, the mechanism for producing adhesion is extremely interesting. From the margin of each cup, a series of muscular fibres converge toward the centre, at a short distance from which they leave a circular aperture, which is occupied by a cone of soft substance rising from the bottom like the piston of a syringe, and capable of retraction. So perfect is this mechanism, says Dr. Roget, that while the muscular fibres continue contracted, it is easier to tear away the substance of the limb than to release it from its attachment—it being apparently under the complete control of the animal. When the sucker is applied to a surface for the purpose of adhesion, this piston, having previously been raised so as to fill the cavity, is retracted, and a vacuum produced; but when the animal is disposed to let go its hold, the piston is at once pushed forward, and the vacuum produced by its retraction is in an instant destroyed.

The class *Cephalopoda* is divided into two orders—those which have the body naked, and have no shell, or only an internal one; and those in which the body is inclosed within an external chambered shell. The first group, the Naked Cephalopods, have all of them only two branchiæ, or gills; whilst the second group, the Shell-bearing Cephalopods, possess four. This essential character has been considered as the best for dividing them, as one of the families of the first group (*Argonautidæ*) is now generally allowed to possess a shell, though not a chambered one; and another (*Spirulidæ*) has a chambered shell, which though certainly an internal one, nevertheless in one of the species appears to contain a portion at least of the animal within its last chamber. Rafinesque, in dividing them into two groups or orders, proposed the names of *Antepedia* and *Polarnaxia* for them; but we here adopt the nomenclature first established by Professor Owen, who from the number of their gills calls them *Dibranchiata* and *Tetrabranchiata*.

ORDER I.—DIBRANCHIATA—TWO-GILLED CEPHALOPODS.

ANIMAL swimming, having the body naked, the shell being either altogether wanting or contained within the body (except in *Argonautidæ*). The head is distinct, separate from the rest of the body, and surrounded by eight or ten fleshy arms, provided with sessile cups or suckers. The eyes are sessile, prominent; the mandibles horny, like the beak of a parrot; and the walls of the siphuncle are entire. Gills two in number. Ink gland always present. The body of the animal is round, or elongated, and provided with fins; and when the shell is present (except in *Argonauta*), it is either horny or shelly, with or without air chambers. "The mantle is usually connected with the back of the head by a broad muscular band; but its margin is sometimes free all round, and is supported only by cartilaginous ridges, fitting into corresponding grooves, and allowing considerable freedom of motion."—(*Woodward.*)

SUB-ORDER I.—OCTOPODA (OCTOPODS).

THIS sub-order contains three families. The body is rounded, and seldom possesses fins; it is united to the head by a broad cervical band, and in the Argonauts is covered with a thin, single chambered shell. The head is large, and the eyes are fixed and incapable of rotation. The fleshy arms are only eight in number, and have no swimming membranes. The cups or suckers are sessile, flat, and without any horny ring. The branchial chamber is divided longitudinally by a muscular partition. "They are the most eccentric or 'aberrant' molluscs, superior in organization to all the rest, but manifesting some remarkable and unexpected analogies with the lowest classes of animals."—(*Woodward.*)

We have merely space to mention a few of the families and genera into which this order is subdivided:—

FAMILY. I.—OCTOPODIDÆ—(*The Sea Spiders.*)

In this family the arms are all similar, subulate in form, or conical and tapering, elongated, and united at the base by a web. The cups are short and sessile. The shell is altogether wanting, or is represented by two short styles encysted in the substance of the mouth.—(*Owen.*)

GENUS OCTOPUS.—The genus *Octopus* may be taken as the type of the family. It has two rows of cups on the arms, and the body of the animal is round, and destitute of lateral fins. It is warty, or covered with cirrhi, which disappear when in repose, or when preserved in spirits. The eyes are small, lateral, covered by the continuation of the surrounding skin, and often by one or two transparent eyelids. The

arms are unequal, and the siphuncle is elongate, conical, and slender. The Octopi live on rocks on the coast, swim well, and are very agile. They change their colour rapidly, and in the dark are slightly phosphorescent. The females deposit transparent eggs in bunches on sea-weeds, or in the cavities of empty shells. They are solitary animals, and are the "polypi" of Homer, Aristotle, Gesner, &c. "Professor E. Forbes has observed that the Octopus when resting, coils its dorsal arms over its back, and seems to shadow forth the Argonaut's shell."—(*Woodward.*)

THE COMMON OCTOPUS (*O. vulgaris*) is abundant on our coasts, and is found in the Mediterranean, Atlantic, and Indian oceans, and in the Red Sea. In swimming, it propels itself rapidly backwards, by repeatedly striking in a forward direction the whole of its arms, webbed at the base, at the same instant. It walks also with equal ease, dragging its body along the ground at the rate of about seven feet in a minute; and should it require or wish to accelerate its pace, it inflates its body until it resembles a distended bladder, then letting go all hold and casting itself forward, it rolls over and over with great velocity, and often effects an escape which would otherwise have been impossible.

FAMILY II.—PHILONEXIDÆ.

In this family the arms are elongate, tapering, and unequal; and the cups are fleshy, pedunculated, very extensible, and placed in two rows, which are sometimes far apart. The eyes are large and prominent. The shell is altogether wanting. The animals belonging to this family are all natives of the high seas, and are crepuscular or nocturnal in their habits of life. They are gregarious and sociable, and in some parts of the world are seen during the night covering the surface of the ocean in great numbers. They avoid the light, possess the faculty of changing their colour, and are voracious creatures, feeding upon floating mollusca and medusæ.

GENUS PHILONEXIS.—The genus *Philonexis* is the type. It has the arms free, not webbed, tapering; in some species the upper pair are very long, and the others short.

FAMILY III.--ARGONAUTIDÆ=OCYTHOIDÆ
(*Argonauts.*)

The family of the Argonauts is one which has given rise to a great deal of discussion; some authors maintaining that the animals, and the shell in which they are found, have no further connection with each other than the Hermit Crab has with the shell in which it takes up its abode—that the Cuttle-fish in fact which inhabits the Argonaut shell is a mere parasite; others maintaining, on the contrary, that the shell of the Argonaut is really secreted by the female, and that it serves as a nest for containing the ova. This latter opinion is now almost universally received by naturalists; and the experiments of Madame Jeannette Power, supported in most things by those of M. Sander Rang, are sufficient to convince most people. Professor Owen has given a very able report upon these experiments, the summing up of which is clearly in favour of the view of their intimate connection as one and the same. Dr. Gray, however, still considers the question unsettled; and in the catalogue of the *Cephalopoda Antepedia*, in the collection of the British Museum, he gives his reasons for remaining unconvinced. The animal, he says, is not attached to the shell by any muscle (unlike all other mollusca which form the shell they inhabit). The animal, when alive, does not fit the shell, so that the shell cannot be moulded on its body, as in other mollusca. The skin of the animal which inhabits the shell is of the same texture and appearance as in the other naked Cephalopods; and the presence of sand between the shell and the body appears to cause no uneasiness to the animal, as it does in all other shell-bearing mollusca, where the animal immediately rids itself of the irritation so caused by covering the sand, &c., with a calcareous coat. The animals, he continues, found in these shells are all females, and the apex of the shell is filled with very small eggs; while from the large size of the young shell, which is seen on the apex of the true Argonaut, we should expect the animal which formed that shell to have a large egg. Believing, however, that the shell of the Argonaut is formed by the animal which alone is found to inhabit it, we proceed to give the characters of the family. The animals were named *Ocythoe* by Rafinesque, who considered them distinct from the shells. Their body is of an ovoid shape, enlarged in front, and smooth. The head is oblique, and the eyes are lateral, very large, prominent, and covered on the upper edge with a very thin eyelid. The arms are tapering, very unequal, the dorsal pair being bent back on themselves, and furnished with a membrane or web at the extremity. The cups are in two rows, prominent, as if slightly pediceled. The siphuncle is very large and conical. The shell is exterior, symmetrical, and involuted. It is one-celled, thin, brittle, transparent, horny, and flexible when wet. The nucleus is very large and hemispherical. This shell is inhabited only by the female, and it is considered to be secreted by her webbed dorsal arms. The male is smaller than the female, has no shell, and the superior arms are not webbed or expanded as in the female, but are pointed at the extremities. Occupying the place of the third arm on the left side, there is in the male an organ developed within a coloured sac, which is in fact an irregularly metamorphosed arm, containing abundance of spermatozoa, and which is detached as soon as the seminal fluid has been deposited in it. It after this enjoys an independent life, and is the *Hectocotyle* of the Argonaut. These animals live on the high seas in the warmer regions, and have been taken from the stomach of a dolphin six hundred leagues from any land. Their food consists of floating mollusca. There is only one genus, called *Argonauta*, by those who believe in the identity of shell and animal, and *Ocythoe* by those who do not—the name of *Argonauta* being restricted by them for the shell alone.

THE PAPER NAUTILUS (*Argonauta-Argo*)—the animal being the *Ocythoe tuberculata* of the British Museum catalogue—(Plate 3, fig. 8)—is, from its being

careous. The head is smaller than the body, and the eyes are free in the orbit, turning in every direction in the very large orbital cavity. The arms are usually said to be ten in number—hence their name of Decapods. Two of these, however, differ considerably in their form from the others, and by many conchologists are termed *tentacles*. The real arms are eight in number, as in the Octopods, but are always shorter; they are fleshy, sessile, and often edged with membranes. The two tentacular arms are long, cylindrical and are expanded at the ends. The cups or suckers are oblique, peduncled, and armed with a horny ring. The siphuncle is almost always provided with an internal valve. The animals belonging to this sub-order are chiefly found in the open sea, but, it is said, make their appearance periodically in large shoals, like certain fishes, on the coasts and banks. The structure of the internal shell is well adapted for dividing the species of Decapods into three distinct groups or sections — those which have a solid horny shell, like a pen (*gladius*), CHONDROPHORA; those which have a cellular calcareous shell (*sepion*), SEPIOPHORA; and lastly, those which have a chambered, siphoned shell, (in recent species) calcareous or shelly, BELEMNOPHORA.

SECTION I.—CHONDROPHORA.

This section contains five families, but we have only space to mention two:—

FAMILY I.—CHIROTEUTHIDÆ.

The animals of this family are semipellucid, and have an elongate body, and the fins are placed on the hinder part of the back. The ventral arms are long, and the tentacular arms are external to the web, very long and slender, and not retractile into the cavities under the orbits. On the peduncular portion they have distant sessile cups, but on their expanded ends they possess four rows of cups placed on long cylindrical peduncles. The siphuncle has no valve. The shell is elongated and slender.

GENUS CHIROTEUTHIS. — The genus *Chiroteuthis* will represent the family. It has the arms free; the rings of the cups are contracted in the middle. The tentacular arms are extremely elongated, and the cups on their expanded ends are placed on long cylindrical peduncles swollen at the end, and bear a second pedicle which carries a hood-like horny ring, edged at the base, with a lateral aperture armed with teeth. The shell is very slender, and slightly dilated into a narrow lanceolate expansion at each end.

CHIROTEUTHIS VERANYI, one of the species, is a native of the Mediterranean. The body is scarcely four inches in length, while the tentacular arms are two feet and a half, and as slender as a thread. The habits of this animal appear in a great measure unknown; but, as has been well observed, a similar disproportion of parts is not to be found exampled among organized creatures. "How these slender organs are moved," says Dr. Johnston—"how their motions are propagated along the lengthened line—how the club at the end of such a flexible line is supported—and how the organs are preserved from amputation or injury—are all questions which start upon us as we contemplate the creature, and to which it is not easy to give a satisfactory answer." They are no doubt intended, and certainly appear admirably adapted for securing their prey, especially such as may be floating careless at a distance, and unconscious of danger from such a foe.

FAMILY II.—ONYCHOTEUTHIDÆ (*Uncinated Calamaries*).

This family consists of animals with an elongate fleshy body, furnished with fins on the hinder part of the back. The head is cylindrical in shape, and the eyes are naked, with a deep lachrymal sinus at the upper edge. The siphuncle has a distinct internal valve, and the tentacular arms have a rounded group of small sessile cups at their dilated extremities. The shell is lanceolate. One of the most striking characters of this family is the structure of the long tentacular arms and their suckers. These organs are provided with a double series of hooks; but besides these uncinated cups there is, as mentioned above, at the base of their expanded extremities a cluster of small, simple, unarmed cups. These they are supposed to unite, so that the tentacles are used in conjunction. "When these suckers are applied to one another," says Professor Owen, "the tentacles are firmly locked together at that part, and the united strength of both the elongated peduncles can be applied to drag towards the mouth any resisting object which has been grappled by the terminal hooks. There is no mechanical contrivance which surpasses this structure: art has remotely imitated it in the fabrication of the obstetrical forceps, in which either blade can be used separately, or by the interlocking of a temporary joint be made to act in combination." This family contains several genera, but we have only space to mention two:—

GENUS ENOPLOTEUTHIS.—This genus has both the sessile and tentacular cups armed with claw-like hooks. It contains several species with an elongate body furnished with fins on the hinder part of the back; sessile arms with a series of closed, horny, claw-like hooks, enlarged at their base and covered with a closely-fitting retractile membrane; tentacular arms slender, feeble, scarcely dilated at the ends, and armed with hooks only. Some of the species attain a large size, and the natives of the Polynesian islands, who dive for shell-fish, are said to have a well-founded dread and abhorrence of these formidable creatures. A specimen of *E. unguiculata* was observed by Banks and Solander, in Captain Cook's first voyage, floating on the surface in the Pacific Ocean, a single arm of which is preserved in the collection of the Museum of the College of Surgeons, from which it is evident that the animal must have been at least six feet long.

GENUS OMMASTREPHES.—This genus is characterized by having the body very long, acuminated behind, truncated and square in front, with very broad terminal fins; sessile arms, with two rows of suckers having oblique, toothed rings; tentacular arms short, thick, and strong, not retractile, webbed at the slightly enlarged extremity,

and having four rows of cups. The shell is as long as the body, narrow, with three diverging ribs and a hollow, conical apex. The Sagittated Calamaries, as they are called, live in the open ocean, where they occur in large troops, and are found in all climates. They are nocturnal animals, appearing on the surface of the sea only after evening has closed in. They are greedily devoured by cetaceans and pelagic birds.

THE COMMON SAGITTATED CALAMARY (*O. sagittatus*) is extensively used as bait in the cod-fishery of Newfoundland. Indeed, it is so attractive to this fish, that it is said one-half of all the cod taken at Newfoundland is caught with it. It is exceedingly abundant at times off that coast, occurring in vast shoals, which present a curious appearance by their strongly-twisted compact form. Their appearance is hailed by hundreds of vessels ready for their capture; and as a writer in the *Edinburgh New Philosophic Journal* says, "At this season of the year, the sea on the coast of St. Pierre is covered with from four hundred to five hundred sail of English and French ships, engaged in the Cuttle-fish fishery." "During violent gales of wind, hundreds of tons of these molluscs are often thrown up together in beds on the flat beaches, the decay of which spreads an intolerable effluvium around. It is made no use of except for bait; and as it maintains itself in deeper water than the Capelan, instead of nets being used to take it, it is jigged—a jigger being a number of hooks radiating from a fixed centre made for the purpose. The cod is in best condition after having fed on it." The Sagittated Calamary, as this species is more particularly called, is very quick and rapid in its movements. Dr. Gould, speaking of it, says:—"So swift and straight is their progress, that they look like arrows shooting through the water;" and Colonel Sykes informs us that several specimens of this active creature leaped on board the vessel in which he was returning from India, while the wind was light and the sea calm. Indeed, the common name for it amongst sailors is the "Sea Arrow," or "Flying Squid."

FAMILY—LOLIGIDÆ (*Calamaries*, or *Sleeve-fish*).

This family of Cuttle-fishes consists of animals which have an oblong, subcylindrical body, tapering behind, and much elongated in the males. The fins are situated on the sides of the hinder part of the back. The head is subcylindrical, and the eyes are covered by the skin. The sessile arms in general have the cups or suckers in two rows, and the rings are provided with a narrow prominent edge on the centre of the external surface. The tentacular arms have the expanded extremities generally with four rows of cups, and they are only partly retractile into the subocular cavity. The shell is lanceolate, pennate, or spathulate, and solid; and, as Professor Owen informs us, is multiplied by age, several being found packed closely, one behind another, in old specimens.

GENUS LOLIGO.—The genus *Loligo* is the type, and in it the horny rings of the suckers are dentated, and the tentacular club has four rows of cups. The head is separate from the body, and the mouth is free all round. The shell is as long as the back, is pennate, and has thin edges. The Calamaries are gregarious, many individuals uniting in companies, and sallying forth in the evening after sunset to scour the surface of the ocean for their prey. They swim with great rapidity, and also crawl head downwards on their oval disc. Fish, pelagic crustacea, and the oceanic molluscs, form their food.

LOLIGO MAGNA, or **VULGARIS** (*the Common Sleeve-fish*, or *Squid*), occurs abundantly on the coasts of Great Britain, and is eaten both by man and fishes. Mr. Couch tells us that they are used as food by the natives on the Cornish coast; and he avers that they are "excellent food, bearing a considerable resemblance to tripe." He informs us further that on the same coast it forms a favourite bait among fishermen, "few fish being able to resist it." These animals deposit their eggs in subcylindrical masses crowded together on sea weeds, and one such cluster has been estimated to contain nearly forty thousand eggs!

SECTION II.—SEPIOPHORA.

This section contains only one family:—

FAMILY—SEPIIDÆ (*Sepias*, or *True Cuttle-fishes*).

These have a short, oval or rounded, and depressed body, furnished with fins bordering the whole side of the body, and separated from one another behind by a free space or kind of neck. They have a broad head and large eyes, furnished with a lower eyelid. The sessile arms are short and strong, and provided with four rows of suckers—the cups being spherical, fleshy, oblique, and peduncled. The tentacular arms are entirely retractile into the cell at their base, are long and slender, and are broadly expanded at their extremities. The shell is internal, as long and as wide as the body, and consists of a broad calcareous cellular plate, terminating behind in a hollow imperfectly-chambered tip or *mucro*.

GENUS SEPIA.—This is the only genus in the family. The species are inhabitants of all seas, and some of them grow to a large size. One of these is common on our own coasts, and is well known on those of various parts of Europe and Africa:—

THE COMMON SEPIA, or **CUTTLE-FISH** (*Sepia officinalis*), is of considerable size, and is of a purple colour on the back, with darker cross bands, and with small white spots on the side. The shell is ovate, compressed, wrinkled above, semi-cartilaginous on the edge and behind, where it is rounded. When young, the apical beak is conical, prominent, and the upper part of the last internal plate occupied; in the adult, half the beak becomes immersed in the cartilages, and the plate is diminished to one-third the length of the cavity. The thickened part of this shell is composed of numerous very thin parallel calcareous plates, separated by thousands of small hollow columns placed upright in the spaces between every two laminæ, which render it very light and porous. Dr. Good says that the animals aid and regulate their motions by the power they have of introducing air at option

into the numerous cells of this shell, thus at will varying their proportionable weight to the sea in which they live; and M. d'Orbigny is of opinion that the use of the prominent mucro, or point, is to protect the animals in the frequent collisions they are exposed to in swimming backwards. The black liquid secreted by this species of Cuttle-fish is said to form at least the greater portion of the colour called *sepia*. Though now it is pretty well ascertained that the China ink of commerce is prepared from lamp-black or finely triturated charcoal, it was long believed to be furnished by this secretion; and Cuvier tells us that an ink is still prepared from this secretion in Italy, which only differs, he says, from genuine China ink in being a little less black; and that it was with this preparation he drew the designs which illustrate his memoir on the Mollusca. The *bone*, as it is called, or shell of the Sepia, is much used in the preparation of tooth-powder and pounce. It was formerly employed by medical men as an antacid, but is now little esteemed for that purpose. It is of more value, when powdered, for making moulds for silversmiths for casting articles of small work, such as spoons, forks, and rings.

SECTION III.—BELEMNOPHORA.

This section contains only one recent family:—

FAMILY—SPIRULIDÆ (*Spirulas*).

These animals have an oblong body, with minute terminal fins. The sessile arms have six rows of very minute cups, and the tentacular arms are elongated. The shell is entirely nacreous, discoidal, with the whirls separate, and chambered, the chambers furnished with a siphon. The last chamber is only large enough to contain a very small part of the animal; the rest of the shell being placed vertically in the posterior part of the body, with the involute spire towards the ventral side. However dissimilar, says Cuvier, this shell is in figure to the bone of the sepia, it does not differ much from it in the manner of its formation. "If we imagine that the successive layers, instead of remaining parallel and in nigh approximation, were to become concave towards the body, more distant, each growing a little in breadth, and making an angle between them, we should then have a very elongated cone, rolled up spirally on one plane, and divided transversely into chambers. Such is the shell of Spirula, which has these additional characters, that the turns of the spire do not touch, and that a single hollow column, occupying the interior side of each chamber, continues its tube with those of the other columns even to the extremity of the shell. This is what is named the *Siphon*."

GENUS SPIRULA (=*Lituus*).—The family contains only this one recent genus. Though the shell of *Spirula* has long been well known, specimens of one of the species being often found brought by the gulf stream, and thrown up on the shores of our own country, and thousands of them scattered along those of New Zealand, yet the animal has been very seldom seen. An imperfect specimen was brought home some years ago by Captain (now Admiral) Sir E. Belcher, and served Professor Owen as the specimen from which his memoir on the anatomy of the creature was drawn up; and more recently a nearly perfect specimen of another species has been found by Mr. Earl off the coast of New Zealand, which is now in the possession of Mr. Cuming, and was figured by Mrs. Gray in the Annals of Natural History, vol. xv. From the little we know of its habits, it is most probable that the Spirula is pelagic, and swims near the surface in calm weather towards evening, preying on acalephæ, and sinking below the surface during the day. Three species have been described.

ORDER II.—TETRABRANCHIATA.

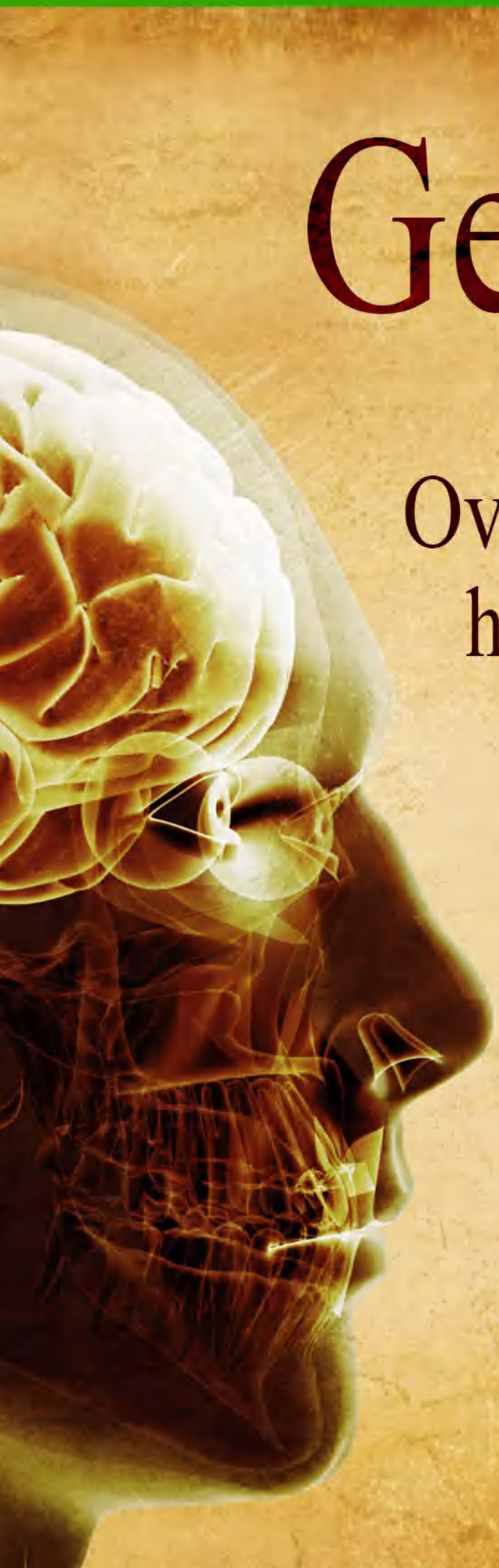
THE animal in this order of Cephalopods creeps instead of swims, and has its body protected by a shell. The body is destitute of fins, and is attached to the shell (unlike that of *Argonauta*) by adductor muscles, and by a continuous horny girdle. The head is retractile within the mantle, is not separate from the body, and is surrounded by a great number of cylindrical, annulated, retractile tentacles, destitute of suckers. The eyes are slightly pedicelled, the mandibles are calcareous, the siphuncle, or funnel, is slit; and, as the name of the order indicates, they have four gills or branchiæ. The shell is external, chambered, and is provided with a siphuncle. "The inner layers and septa are nacreous, and the outer layers porcellaneous."—*Woodward.*

This order contains three families, only one of which, however, possesses any recent species.

FAMILY—NAUTILIDÆ (*The Nautili*).

This family contains but few living representatives, but in former periods of the earth's history they appear to have been extremely numerous.

GENUS NAUTILUS.—This is the only genus belonging to the family. The tentacles which surround the head of the animal are very numerous. On each side of the head there is a double series of arms or *brachial tentacles*, as they are called, thirty-six in number, lamellated on their inner surface, and retractile within sheaths or digitations which correspond to the eight ordinary arms of the Dibranchiate species. There are also four groups of *labial tentacles*, twelve or thirteen in each group, which appear to answer to the buccal membrane of the ordinary



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to enable it to rise than the full unfolding of its organs, and their protrusion from the shell. "I incline rather to the conclusion," he says, "that the sole functions of the air chambers is that of the balloon; and that the power which the animal enjoys of altering at will its specific gravity must be analogous to that possessed by the fresh water testaceous Gasteropods, and that it depends chiefly upon changes in the extent of the surface which the soft parts expose to the water, according as they may be expanded to the utmost, and spread abroad beyond the aperture of the shell, or be contracted into a dense mass within its cavity. The Nautilus may likewise possess the additional advantage of producing a slight vacuum in the posterior parts of the chamber of occupation, which is shut out by the horny cincture and muscles of adhesion from the rest of that cavity."

The shell of *Nautilus pompilius* appears to have been known to Aristotle, and is mentioned in sufficiently precise terms by several of the ancient authors. It has long been used as an ornamental substance, and the Dutch have been for a great length of time fond of carving it with marine sketches—ships and dolphins, &c. In India, too, they ornament it in a similar manner, by carving and painting grotesque devices on its outer surface, and converting them into elegant drinking cups.

Four species have been described, two of which, however, have been considered by some naturalists as only the males of the other two. They are natives of the Indian Ocean, China Seas, and Persian Gulf.

CLASS II.—GASTEROPODA (UNIVALVES).

THE class of Gasteropods, the Univalves or Snails, are what may be called the *types* of the Mollusca. Of all the classes into which this sub-kingdom is divided, the Gasteropods present in the most prominent and most marked degree the leading and essential features of molluscous organization. The land snail and the periwinkle will give a very good general idea of the animals of this class. The animals have all a distinct head furnished with eyes and tentacles, and when full grown have a more or less distinct foot, placed under the body, by which they are enabled to creep on the ground or on the surface of the water. This foot in some is a broad fleshy disc (see *Murex*), in others it is narrow and formed like a furrow (see *Strombus*), or it is thin and presents the appearance of a slim plate placed in a vertical position. This organ is for the most part of a uniform structure throughout, its muscular fibres being interwoven with each other, and not collected into distinct and separate bands. Some have it very large, and it would appear that the larger and broader the foot, the slower is the motion of the animal, the narrower and more elongated it is, the quicker is its progress. They are, however, proverbially slow of pace, as every one must know who has watched the march of the common snail; and even it is one of the quickest walkers of the class. The heart is almost always composed of a ventricle and an auricle, and its position is near the back of the animal, but on the side opposite to that in which the reproductive organs are situated. The arterial system is generally well developed, but the veins are imperfectly so; the venous blood in many of the species flowing through open spaces among the different organs. Some of the Gasteropods are aquatic, while others are denizens of the dry land. The organs of respiration, therefore, are constructed in such a manner as to enable the animals either to breathe atmospheric air or respire water. Those of the former group are provided with lungs, which have an external communication to admit air, opening under the outer edge of the mouth. In the latter, respiration is carried on by means of branchiæ or gills, the exact position of which varies very much in different species; in many being inclosed in a cavity on the back, in some being lodged in a furrow between the mouth and the foot, and in others, being situated upon the back of the animal, and floating freely in the water. In general the respiratory organs are atrophied on the left side, though in some, as the Chitons, &c., they are repeated on both sides. Usually, also, the Gasteropods are unsymmetrical in conformation; the body instead of being developed lengthwise, in a straight line, taking somewhat of a spiral direction, so that the mouth and the excretory opening are brought in a slight degree near to each other, instead of being placed at the two extremities of the body.

Their food is either vegetable or animal; and the mouth is provided with a denticulated tongue. "This tongue is muscular, and armed with recurved spines (or *lingual teeth*), arranged in a great variety of patterns, which are eminently characteristic of the genera. Their teeth are amber-coloured, glossy, and translucent; and being silicious (they are insoluble in acid), they can be used like a file, for the abrasion of very hard substances. With them the limpet rasps the stony nullipore, the whilk bores holes in other shells, and the cuttle-fish doubtless uses its tongue in the same manner as the cat. The tongue, or lingual ribbon, usually forms a triple band, of which the central part is called the *rachis*, and the lateral parts *pleuræ;* the rachidian teeth sometimes form a single series, overlapping each other, or there are lateral teeth on each side of a median series. The teeth on the *pleuræ* are termed *uncini;* they are extremely numerous in the plant-eating Gasteropods. Sometimes the tongue forms a short semicircular ridge, contained between the jaws; at others it is extremely elongated, and when withdrawn; its folds extend backwards to the stomach. The lingual ribbon of the limpet is longer than the whole animal; the tongue of the whilk has one hundred rows of teeth; and the great slug has one hundred and sixty rows, with one hundred and eighty teeth in each row. The front of the tongue is frequently curved or bent quite over; it is the part of the instrument in use, and its teeth are often broken or blunted. The posterior part

of the lingual ribbon usually has its margins rolled together and united, forming a tube, which is presumed to open gradually. The new teeth are developed from behind forwards, and are brought successively into use, as in the sharks and rays among fishes."—(*Woodward.*) —See figures of Buccinum and Littorina—figs. 52 and 57. When first hatched, the youthful Gasteropods are always provided with a shell; but in many it is concealed when they reach the adult state, by a fold of the mantle, and in a number of species it is thrown off altogether at an early stage of their existence and never reappears.*

The species which respire atmospheric air, the pulmoniferous mollusca, undergo no change as they approach maturity. When born they resemble their parents in all things but size. But those which respire water, the branchiferous mollusca, undergo a considerable metamorphosis. They commence life in a small nautiloid looking shell, large enough to contain their whole body, and having the aperture closed by an operculum. The head is provided with a pair of ciliated arms or fins of considerable size, which enables them to swim freely in the water, instead of crawling at the bottom. At this early period of their existence, all these water-breathers resemble each other, so that "there is scarcely any difference between the young of *eolis* and *aplysia*, or *buccinum* and *Vermetus*."—(*M. Edwards.*) Development, however, soon commences; the mantle begins to secrete calcareous matter, and this, mixed with the epithelium or layer of animal matter, is moulded upon the body of the animal into the form which each genus is destined to assume. In form and general appearance the shells of the Gasteropods vary very much. They are usually, however, nearly spiral, though sometimes tubular or conical, and except in the family of Chitons, are composed of only one valve. The terminology used by conchologists, will be best understood by a reference to Plate 1, where the terms used are explained by the figures.

The class *Gasteropoda* is a very extensive one, and its division into orders and families has engaged the attention of many naturalists. A variety of methods have been proposed, but it would be uninteresting to the general reader to enter into details here. We shall simply state the arrangement of Dr. Gray as adopted in our great national natural history repository, the British Museum. In his classical "Introduction to Conchology," Dr. Johnston thus expresses himself with regard to this system, "There can, I think, be only one opinion as to the great merits of this method. Its superiority as a whole to any previous one can scarcely be questioned; and the new views taken as to the position of several of the families in their respective orders as well as in regard of the genera which are made to enter into the composition of the families, nothing less than the most extensive and critical knowledge of the entire class could have suggested."

The class GASTEROPODA, *Belly-walkers*, or *Snails*, is divided into two large groups or sub-classes, dependent upon the structure of their respiratory organs. In the first sub-class, the CTENIBRANCHIATA, equivalent to the PROSOBRANCHIATA of M. Edwards, these organs are in the form of branchiæ or gills; and they are comb-like, being formed of one or two series of lamellæ or plates under or on the inner surface of the mantle on the back of the neck (rarely round its edges). In the species composing this group, the gill cavity is open, and both adults and larvæ possess shells, the latter being provided, in addition to these, with deciduous ciliated fins on the head. They are either unisexual, or hermaphrodite and self-impregnating. In the second sub-class, the HETEROBRANCHIATA, equivalent to the OPISTHOBRANCHIATA of M. Edwards, the respiratory organs are variously formed; some having branchiæ or gills, which are exposed or only slightly covered by a fold of the mantle; others having a simple lung, or a closed cavity lined with a network of respiratory vessels, like the lungs of beasts and birds. The species are all hermaphrodite, with reciprocal impregnation.

The first sub-class, CTENOBRANCHIATA, is divided into two orders. The first, *Pectinibranchiata*, is characterized by the comb-like branchiæ or gills consisting of only one (rarely of two) longitudinal series of lamellæ on the left side of the mouth, over the back of the neck. The gill cavity is open, the mantle edge being free from the back of the neck. The animals are unisexual, and the shells are spiral, and generally provided with a distinct operculum. The second order, *Scutibranchiata*, have the gills consisting of two series of lamellæ, forming one or two series over the back of the neck or under the edge of the mantle round the foot. The animals are hermaphrodite, self-impregnating, and the shells are conical, spiral, or symmetrical.

The second large group or sub-class, the HETEROBRANCHIATA, is divided into three orders. The first, *Pleurobranchiata*, are characterized by the branchiæ or gills forming a tuft on the side of the back, under a fold of the mantle. The animals are hermaphrodite, with reciprocal impregnation, and the shells are spiral. The adult and young are both shell bearing, and the latter are provided with deciduous cephalic fins. The animal and foot are elongate, formed for walking. The second order, *Gymnobranchiata* (or *Nudibranchiata*), have the gills exposed or contractile into cavities on the surface of the mantle. The animals are hermaphrodite, with reciprocal impregnation, and the adults are destitute of shells, the larvæ only possessing that appendage. The third order, *Pneumobranchiata* (or *Pulmonata*), differs from all the others in the animals respiring free air in a closed chamber lined with pulmonic vessels. The animals are hermaphrodite, with reciprocal impregnation, and both adults and larvæ are shell bearing, the latter being formed like the parent and having no cephalic fins.

* This is the case with the order Nudibranchiata (*Gymnobr anchiata*); the larvæ being provided with a shell and fins on the head, both of which are lost soon after development begins to progress, the shell most probably disappearing at the tin e the animals acquire a locomotive foot.

SUB-CLASS I.—CTENOBRANCHIATA, *Gray*—PROSOBRANCHIATA, *M. Edwards.*

THE cavity in which the gills, in this large group, are placed, forms an open bag in the last whirl of the shell, over the back of the neck; and there is a constant current of water passing over the gills, entering at the front and making its way out near the inner hinder angle of the gill cavity, and mouth of the shell. The sub-class Ctenobranchiata comprehends within itself the greater part of the Gasteropodous mollusca, which are furnished with large and well-developed shells.

ORDER I.—PECTINIBRANCHIATA.

THIS order contains a larger number of species than any other order of Gasteropods, and is divided into three sub-orders, the characters of which are taken in a great measure from the structure and form of the teeth. In the first sub-order, *Toxifera*, the head is small, and the fleshy proboscis with which it is furnished is retractile within the body. The teeth are elongate, awl-shaped, and implanted in this proboscis. The eyes are sessile, that is, are not placed on a footstalk, but are situated on the outer side, near or on the end of the feelers or tentacles. In the second sub-order, *Proboscidifera*, which has the head small and the eyes sessile, as in the previous section, but the retractile proboscis more lengthened and capable of being extruded to a greater extent, the teeth are placed in one or several rows on the surface of a linear, elongate, cartilaginous tongue-membrane. In the third sub-order, *Rostrifera*, the head is produced into a beak or rostrum, and the teeth are disposed in seven longitudinal rows on an elongated linear tongue-membrane, partly received into the visceral cavity. This disposition of the teeth seems to be nearly connected with the habits of the animals belonging to these sub-orders. The *Proboscidifera* for instance are carnivorous, or animal feeders; and the *Rostrifera* are phytophagous or vegetable feeders; whilst the *Toxifera*, which are said to feed on both animal and vegetable matters, inflict rather severe wounds upon those who incautiously handle them.

SUB-ORDER I.—TOXIFERA.

THE structure of the teeth brings into this group several genera of shells, some of which have hitherto been placed wide apart from each other.

FAMILY I.—CONIDÆ (*The Cones*).

We commence with the Cones, a family rich in species, and the pride of collectors. The animal of the Cones crawls on a long and very narrow foot, which is truncated anteriorly, and bears upon its posterior extremity a small horny annular operculum, with an apical nucleus. This operculum is very small compared with the size of the shell, is much shorter than the aperture, and so narrow that it allows the animal to retract it deeply into the interior—fig. 50 *b*. The head is moderately small, and at the extremity of the proboscis, which is a prolongation of the head, is situated the mouth, which is surrounded by a funnel-shaped, rostrum-like veil, slit above.* The teeth, implanted in the substance of this proboscis, are in two rows, arranged in pairs, and are sharp pointed, more or less swollen at the base, but hollow and barbed at the tip. The mantle of the animal is entire, covers the interior of the shell, and is prolonged anteriorly into a fleshy siphon or canal, cylindrical in form and passing beyond the mouth of the shell, fig. 50 *c*. This siphon is open at its free extremity, and its use is to carry the water to bathe the gills. As the name imports, the shell is of a conical form, with generally a very short spire; in many cases the upper whirls being so compressed, and the spire so short and flat that the shell can stand erect when placed upon a flat or even surface. The last whirl, indeed, constitutes of itself the greatest portion of its whole surface, and terminates at the base rather by a depression than by a notch. The aperture is narrow, linear—occupying the whole length of the last whirl—and having the lips generally straight and parallel. The outer lip is simple and sharp-edged,

* In the Cones the foot is small and of weak muscular power, says Dr. Johnston, and we might hence conclude that the animal possesses little facility in locomotion, "yet so rich is all creation," he adds, "with proofs of contrivances adapted to annul a defect, that we might anticipate to find some remedy here—and it is so. The mouth of the snail is situated in a cavity, and this cavity it applies to aid its weakness; for it performs, like the oral aperture of the leech, the office of a sucker, by which the head is readily affixed to foreign bodies, *Adanson; Sénégal*, 89. Thus the animal facilitates its progress, and is enabled to drag along the shell, of a weight and size otherwise quite burdensome to it."—P. 127.

of the family, is of a cream-white colour, very handsomely marked with rows of brown spots. The Spotted Anger is from six to eight inches long, and of an elegant shape. It is a native of the southern seas and the Indian ocean.

FAMILY III.—PLEUROTOMIDÆ (*Slit-mouths*).

The family of SLIT-MOUTHS or PLEUROTOMAS (*Pleurotomidæ*), have somewhat nearer relations with the Cones than the Auger-shells. The teeth are simple, elongate and rather enlarged at the base, and the outer lip of the shell has a notch or slit at or near its upper extremity. The siphon is produced, and the mantle has a slit in the hinder part of the outer side, corresponding with the notch or slit in the lip of the shell. The foot is oval, short, thin on its edges, and carries on its posterior extremity a pretty thick, horny, annular operculum, which varies considerably, and forms a good character for separating the species into groups or sub-genera. The shell is fusiform, with a turriculated spire, more or less elongate, with roundish whirls, and the aperture, which is ovate, terminates in a more or less elongate, straight canal. The Pleurotomæ are carnivorous in their habits, and the family contains many species, which are world-wide, extending from Greenland to Australia, and from low water to one hundred fathoms. None of the species are of great size, the largest scarcely exceeding four or five inches in length.

THE TOWER OF BABEL (*Pleurotoma Babylonica*), a native of the Indian seas and the Moluccas, is the typical species of the genus. It is from three to four inches in length, turriculated, with convex whirls; is of a white colour, with circular keels or ridges which are spotted transversely with black square dots. The canal is rather long.

SUB-ORDER II.—PROBOSCIDIFERA.

THIS sub-order contains a much larger number of species than the preceding, and many exceedingly interesting and valuable shells are found amongst them. The animals are carnivorous, feeding upon living mollusca and other animals, and they are often found boring round holes in shells to arrive at their inhabitants. "Many wage war on their own relatives, and take them by assault; the bivalve may close, and the operculated nerite retire into his home, but the enemy with rasp-like tongue, armed with silicious teeth, files a hole through the shell—vain shield where instinct guides the attack! Of the myriads of small shells which the sea heaps up in every sheltered 'ness,' a large proportion will be found thus bored by the whilks or purples; and in fossil shell-beds, such as that in the Touraine, nearly half the bivalves and sea-snails are perforated, the relics of Antediluvian banquets."—(*Woodward.*) At page 184, we have described the teeth of the gasteropodous mollusca, and have mentioned there, that they are silicious in their composition; and being placed in the *Proboscidifera* or carnivorous species in several rows on a lingual ribbon, which is muscular in its structure, we can easily conceive what powerful weapons they prove in penetrating the hardest shells or coverings of their prey. As animals which live on animal food require the blood to be more perfectly aerated than those which feed upon vegetables, so in the Proboscidifera we find that they are provided with a siphon attached to the inner side of the front part of the mantle, which enables the water more freely to arrive at their breathing organs; and the shells are always formed with a canal placed in front of the pillar in order to protect this siphon from injury. The proboscis is long, and being furnished with a number of muscles, can be exserted a great way from the head, and withdrawn again like the horns of a snail, so as to be hidden within the body—see fig. 52, proboscis of Buccinum. The tentacles are placed close together at the base of the proboscis, or are united by a veil at that part; and the eyes are sessile, generally on the outer side near the base of these tentacles, though sometimes they are placed at the tip or behind them. The animals are unisexual, and the females are generally much larger, and have much more ventricose whirls to their shells, than the males. The eggs are contained in a kind of horny or leathery (*coriaceous*) cases, each holding many eggs, but only a few of which ever come to perfection. "The cases of *Buccinum undatum* (our common whilk) and *Fusus despectus* have been mistaken for the eggs of the oyster, and called *Oysterspat*. This error is the more remarkable as oysters are ovoviviparous, the young being found in the branchiæ of the parent in the month of July; the eggs of *Purpura* and other genera have, by a similar error, been described as a species of *Tubularia*."—(*Gray.*) The lingual ribbon of these animals is placed near the apex of the exserted proboscis, and the teeth are arranged in one, three, or seven rows; the gills are placed in two series along with some mucous filaments. The operonlum, when present, is horny and annular. The shells of the different species are subject to great variation, according to the roughness or smoothness of the sea they live in, and the quantity or quality of their food. Some of the common whilks (*Buccinum undatum*), for instance, are thick and rugose, others are very thin, even, and finely coloured. These have been described as distinct species. Examples may be seen in the fine collection of shells in the British Museum.

We will now, taking that magnificent collection as our guide, proceed to mention some of the more important families of this sub-order.

FAMILY I.—CASSIDULIDÆ (*Fig-shells*).

The family of Fig-shells (genus *Pyrula* of Lamarck; family *Cassidulidæ* of Gray) are the first in order. As constituted by the celebrated Lamarck, the genus *Pyrula* contains several types dissimilar amongst them-

selves; and of late, conchological systematists have made various alterations in it.

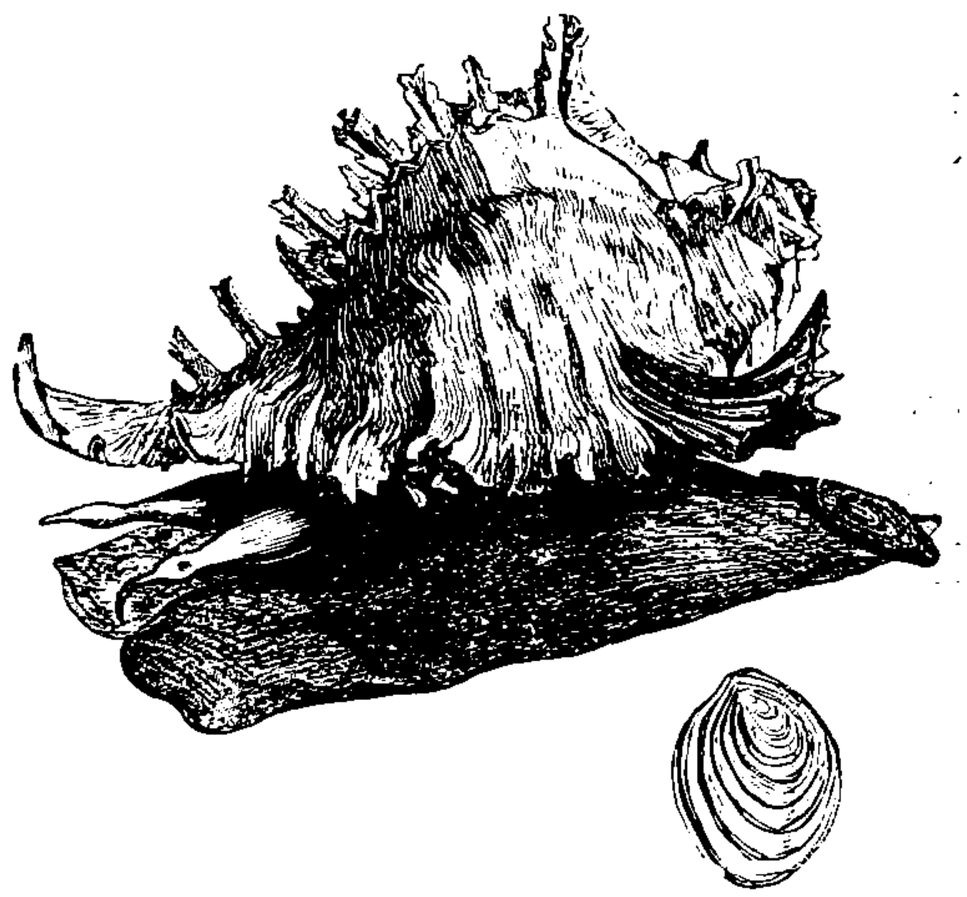
This family, as now constituted, contains those species, the animals of which have the siphon of the mantle and the canal of the shell long and straight, and the foot simple in front. The shell is spiral in form or pear-shaped, the pillar or co*lumella* smooth, the spire short, and the outer lip generally thin. The operculum is not always present, but when it does occur, it is of an ovate figure, small in size, and acute or claw-shaped. The species are not numerous, but many of them are of considerable size, as the *Pyrula* (*Cassidulus*) *patula*, from Panama, on the western coast of America, a rather ponderous shell with a large, ovate, expanded mouth, a broad, straight, open canal, and a very short spire; the *Fusus* (*Cassidulus*) *colosseus* of Lamarck with a very long canal, a rounded form, generally covered with a rough, strong, epidermis, and as its name imports, of considerable magnitude, being indeed one of the largest species of the sub-order to which it belongs. They are natives of tropical seas, and the animals of *patula* and *melongena*, the one found on the mud banks of Panama, and the other in Jamaica, are used by the natives as food. Some of the species, especially those belonging to the sub-genus *Fulgur*, are reversed shells, that is, the whirls turn from right to left, and the mouth is on the left side of the axis when the shell is in its natural position.

FAMILY II.—MURICIDÆ (*Rock-shells*).

The family of Rock-shells is the next in order. This is a very numerous family, and contains many of the largest and most beautiful shells that adorn our cabinets; shells remarkable alike for the delicacy of their sculpture and variety of colours with which they are endowed. The animals have the mantle inclosed, and the margin produces ridges or *varices* at intervals across the shell, becoming extended in front, and forming a straight, more or less elongate, siphon. The shell is spiral, often turreted, more or less extended at the fore part into a straight siphonal canal; and the columella or pillar is smooth. The operculum is horny, annular, and has the nucleus apical or sub-apical.

The **ROCK-SHELLS**, genus *Murex* of Linnæus, originally contained a great many species which are now referred to several distinct genera. De Blainville and Lamarck separated many of these, and since their time others have been removed altogether, while several have been formed into sub-genera or groups. The recent or living species are numerous and are world-wide in their distribution, being most abundant on the west coast of tropical America, and occur also in numbers in China, Africa, and the West Indies. They are in general handsome shells, and are remarkable for having the whirls ornamented with three or more continuous, longitudinal ridges or varices, secreted by the margin of the mantle, as already stated, and generally formed on the completion of about a third of a whirl annually.* These varices are sometimes rounded or spinous, at others they are branched or foliaceous, and in some species again they are lamellar. The aperture is generally ovate, and in some species is contracted in front into a long, narrow, tubular canal, in others into a moderate or short canal, recurved or bent up to the right, often partly closed, and occasionally tubular. The operculum is ovate, with the nucleus sub-apical, within the apex. Among the species which have the rounded or spinous varices, and the long tubular canal forming the restricted genus *Murex*, we may mention the *Murex cornutus* of the Indian seas, commonly known by the name of Hercules' Club, a prettily marked shell about seven inches in length; the *M. brandaris*, a native of the shores of the Mediterranean, and which is often used by the Neapolitans as an article of food; and the *M. crassispina* and *tenuispina*, well known to collectors by their names of the Thorny Woodcock and Snipe; names derived from their long and slender canals or *beaks*; the latter also, from its numerous regularly arranged spines, being known to collectors by the name of Venus' Comb. Among those species which have the varices garnished with plaited leaves torn or divided into branches (foliaceous), and the canal moderate or short and recurved (forming the genus *Chicoreus* or Endive-leaf rock-shells), we find the varices vary in number, being generally either three or six, though sometimes more. In those which have only three branched varices, there is on each of the alternate divisions of the shell a more or less well-

Fig. 213.



Murex (Chicoreus) inflatus.

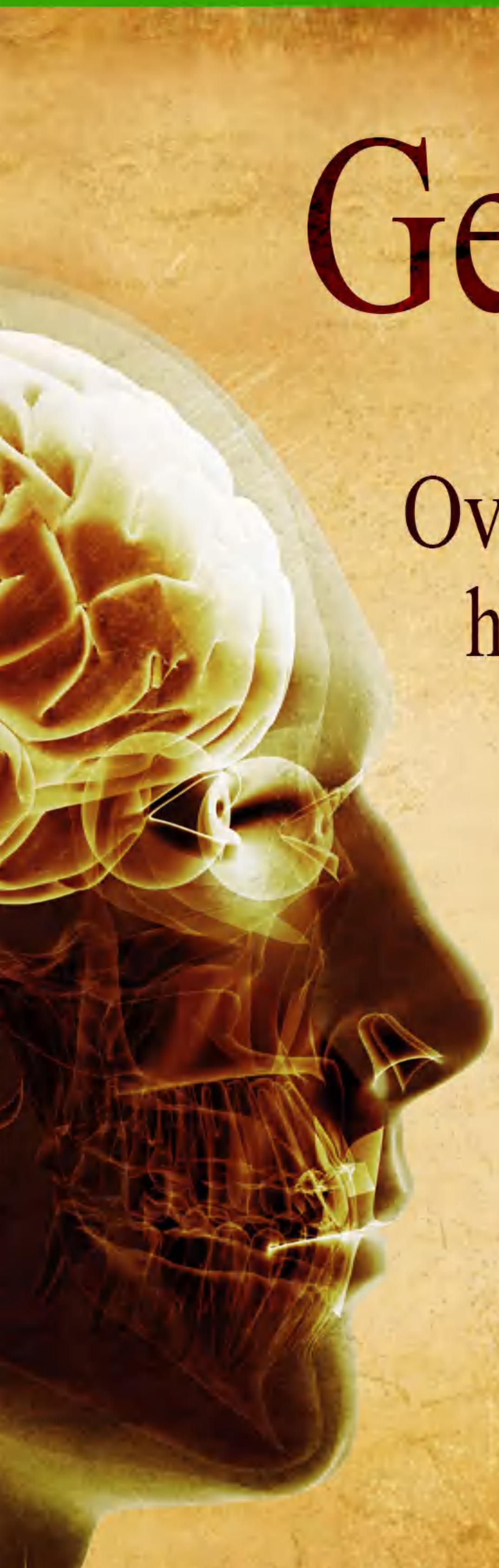
* The animal, at certain periods of its growth, expands the edge of its mantle, and during this time deposits appendages on the edge of its mantle for their protection; these expansions of the mantle are then gradually withdrawn, and the portion of the shell which the animal forms between this time and the next development of the appendages, is of the common shape; but the expansions produced for their protection are left on the surface of the shell, forming variously shaped bands across the whirls, which have been called *varices*, from some of them looking like dilated veins; these varices and the spines upon them, being formed on the expanded appendages of the mantle, exactly correspond to them in form, and afford good characters for the determination of the groups and species.—Gray, *Synopsis of British Museum*, 1842.

developed tubercle—see the accompanying figure of *Murex* (*Chicoreus*) *inflatus*, fig. 213. These tubercles, however, in many instances are themselves produced into varices, and then the species have six. Most of the species of *Chicoreus* yield a purple dye, and though the little common purple shell, *Purpura lapillus*, was for a long time considered the shell which yielded the celebrated Tyrian dye, later observations and researches would seem to prove, that perhaps the most common shell used by the ancients was a species of this genus, *Murex* (*Chicoreus*) *trunculus*. Fabius Columna, a Neapolitan nobleman, and the best authority on this question, maintained that the purpura of Pliny, who gives a good account of the manner in which this dye was procured, is the *Murex trunculus*, and his statement has been apparently confirmed by a late traveller who had visited the site of the ancient Tyre. In a communication made to the Royal Irish Academy, Dr. Wilde stated, that having been engaged in investigating the ruins of that ancient city, he discovered several circular apertures or reservoirs cut in the solid sandstone rock close to the water's edge, along the southern shore of the peninsula. These in shape resembled large pots, and varied in size from two to eight feet in diameter, and from four to five in depth. Some were in clusters, others isolated, and several were collected in pairs near a conduit about a foot deep. Many of these pots or reservoirs were filled with breccia, solely composed of broken up shells, bound together by carbonate of lime, &c. This mass, a portion of which was exhibited to the Academy, was exceedingly heavy, of adamantine hardness, and the shells of which it was composed, appeared to be all of one species, and from the sharpness of their fracture were evidently broken by art, and not worn or water washed. The shells, he says, were examined by eminent naturalists, and were pronounced to be the *Murex trunculus*. Pliny informs us that when the shells were small they were bruised in mortars or *certain mills;* and Dr. Wilde expressed it as his opinion that the reservoirs he discovered at Tyre were the vats or mortars in which the shells were broken up to obtain the dye. The liquor which composed the dye is contained in a vein placed behind the neck, and according to the old writers was at first of the colour and consistence of cream. This Tyrian purple was the most costly and brilliant dye of which we read in history. Wool which had been well dyed, in the reign of Augustus sold for about £36 per pound weight. None but those invested with the very highest dignities of the state were allowed to use it, and laws were enacted inflicting severe penalties, and even death, upon all who should presume to wear it under the dignity of an emperor. It was discovered by the Phœnicians, and is described by Pliny as "that glorious colour, so full of state and majestie, that the Roman lictors with their rods, halberds, and axes, make way for; this is it that graceth and setteth out the children of princes and noblemen; this maketh the distinction between a knight and counsellor of state; this is called for and put on when they offer sacrifice to pacify the gods; this giveth a lustre to all sorts of garments; to conclude, our great generals of the field, and victorious captains, in their triumphs weave this purple in their mantles, interlaced and embroidered with gold among. No marvel, therefore, if purples be so much sought for; and men are to be held excused if they run a madding after purples."—(*Holland's Pliny.*) About the middle of the twelfth century, the dyers at Tyre were interrupted in their pursuits, and from that time the knowledge of their practice seems to have died completely away. But though the art of dying purple was lost to the places which gave it birth, we find that a similar dye was used in our island at a very early period, and its employment continued down to the end of the seventeenth century. The mollusc, as we shall see when we come to the genus *Purpura*, used in this country was the *Purpura lapillus*.

THE SPINDLE SHELLS (genus *Fusus* of Lamarck) are characterized by the shells possessing only rudimentary or no varices, the inner lip being smooth, and the operculum ovate, acute, with the nucleus apical. The recent species are numerous, upwards of one hundred having been described, and varying a good deal from each other in several characters, have been distributed through four sub-genera or groups. They are world-wide in their distribution, being found in Asia, America, the Pacific ocean, Australia, New Zealand, and Africa. Some of them have the mouth of the shell produced into a long and nearly straight canal, the shell itself being spindle-shaped, and the spire elongate, many whirled, and conic. These constitute the genus *Colus*. In the species of this genus, the animal is red. The type is the shell which was described by Linnæus as *Murex colus*, the *Fusus colus* of Lamarck, and others.

Other species have the canal very short and straight, the shell itself of an ovate fusiform shape, with a conic spire and a papillary apex. These constitute the genus *Chrysodomus*, and in the species belonging to it, the animal is olive.

THE MUREX ANTIQUUS of Linnæus, the *Fusus antiquus* of Lamarck and succeeding authors, is the type of this group. The shell of *Chrysodomus antiquus* is oval, sub-fusiform, and densely and strongly striated, and large specimens measure seven inches in length, and five in breadth. It is a native of many parts of Great Britain, ranging from five to thirty fathoms, and preferring as its habitat, shell banks. It is a gracefully formed shell, and is used by the natives of Zetland as a lamp. It is suspended horizontally by a cord, and the cavity of the shell being filled with oil, the canal serves to hold the wick. A sketch of this primitive lamp may be seen in Dr. Johnston's Introduction to Conchology, and he exclaims, "examine the sketch, and then tell me if it is not probable that some of the most elegant patterns left us by the Greeks have been suggested by a similar primitive practice?" The animal is used by the fishermen on our coast as a bait. The egg capsules of this species and the young have been described by Edward Forbes and Dr. Johnston. The capsules are half an inch in diameter, convex outwardly, and concave on the inner side. They are coarse and corrugated, and are piled one above another in a conical heap, three inches or so high, two in diameter, and attached firmly by a broad basis to rocks in deep water. Previous to their being excluded, the young are perfectly formed,



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notch on the outer side of the acute apex. The species are natives of warm seas, being found in the Red Sea, those of Ceylon, and the Philippine islands, Australia, and the west coast of America.

FAMILY—BUCCINIDÆ.

The family of **WHILKS** (*Buccinidæ*), is the third family of the sub-order *Proboscidifera*. In this family the lingual ribbon is extremely long, and the teeth are implanted on it, in one hundred rows, being placed in three series. The shells never reach the size that many of the *Murices* and *Fusi* do, nor show the same diversity and brilliancy of colours; and in the great majority, the canal is short, abruptly reflected or reduced to a notch, and with very few exceptions, we see none of the varices so well marked in the genus *Murex* and *Chicoreus*. One of the chief differences, however, is found in the form of the operculum. This appendage is either oblong or ovate, and the nucleus instead of being apical is placed on or near the outer edge.

The family *Buccinidæ* is not so numerous in species as the preceding, but contains some very interesting shells.

GENUS PURPURA.—The shell is ovate, and the spire short; the aperture is large, with its outer lip simple but lined or toothed within, and the inner lip concave or flattened; canal of shell very short. The operculum is ovate, with the nucleus external. The species of *Purpura* are very numerous, upwards of one hundred having been described; they are distributed over most of the globe, and range from low water to twenty-five fathoms. Many of them produce a fluid which gives a dull crimson or purple dye; hence they are known generally by the name of *Purples*. This fluid may be obtained by pressing on the operculum. Our common little Purple, or Dog periwinkle, as it is sometimes called (*Purpura lapillus*), so common and abundant on most of our shores, contains this purple liquid along with others, and in all probability was used along with *Murex trunculus* (see p. 190) by the ancients to furnish the celebrated Tyrian dye. The receptacle of the creamy secretion which furnishes the purple dye, lies behind the animal's head, and Montagu observes that it appears whiter than the rest of the animal. The purple hue is not developed until after exposure to air and light. As already mentioned (p. 190), the dye obtained from the common purple was used at a very early period by the natives of this country. "The venerable Bede, who wrote in the eighth century, mentions the art as a thing known in his days, and he was familiar with the beauty and permanency of the colour. The same fact is mentioned by Richard of Cirencester, and also in a translation of Higden's Polichronicon made in the year 1387." —(*Johnston.*) It would appear from what these authors state, that the art was familiarly known and followed, but from its limited utility, and perhaps still more from its expense, it seems gradually to have gone into disuse, until at length only a few families preserved the knowledge of its use, and handed it down to their posterity as a family secret. In 1684 it was employed in Ireland for dyeing fine linen, and Mr. William Cole of Bristol, having been informed of this, instituted some experiments, which proved that the dye was easily procurable from the animal of the *Purpura lapillus*.

GENUS CONCHOLEPAS.—Concholepas is a purpura with a very large wide aperture and a very short spire. The shell altogether is ear-shaped, and the outer lip has two or three small teeth in front.

GENUS MONOCEROS (*Acanthiza*).—Monoceros is a purpura with a spiral groove on the whirls, which ends in a prominent spine or strong tooth on the outer lip.

GENUS RICINULA (*Sistrum*).—Ricinula differs from purpura in having a tuberculated or spiny shell with a narrow mouth, which is contracted by callous projections or large teeth on both inner and outer lips. Some of the species are adorned with lively colours; they are about twenty-five in number and are natives of India, China, the Philippine islands, Australia, and the Pacific.

Some of the *Purpurina* are remarkable for the peculiar habit they have of living in or on coral. One of these, which by some authors is considered a distinct genus, and named *Rhizochilus*, lives on a species of *Antipathes* or Gorgonia. When young, the shell is free, but when it has assumed its adult form it frequently acquires more or less irregular solid shelly extensions of the outer and inner lips which clasp the axis of the coral, and at length close the mouth, with the exception of the anterior siphonal canal, which is converted into a shelly tube. In process of time the animal becomes permanently fixed to the coral, and dies there eventually.

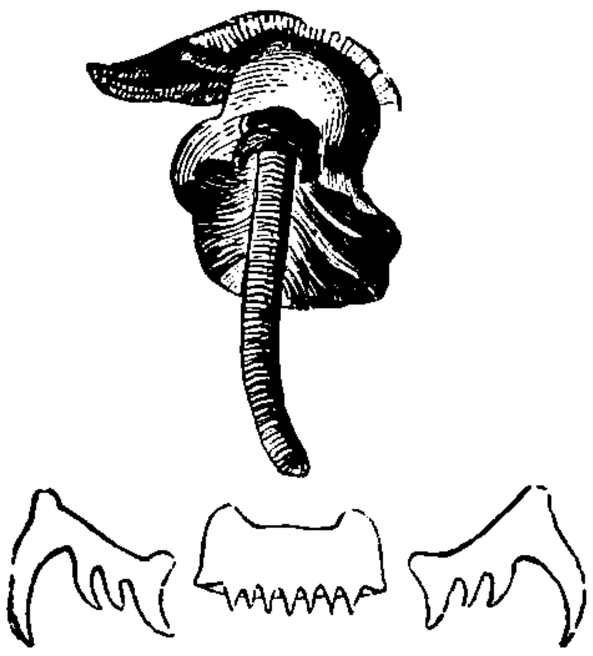
GENUS MAGILUS.—Magilus is another peculiar genus. When young it has a thin spiral shell, but when adult it becomes solid, of a white colour, spiral for three or four whirls, and then produced into a straight or flexuous tube, solid posteriorly, but with a small cavity at the end for the reception of the body of the animal, and a siphonal keel on the left side. This curious genus lives in holes in the substance of masses of coral; and this inordinate extension of the shell is to enable the animal to keep on a level with the surface of the coral as it continues to increase in size, and thus enable it to procure its food. As the shell extends, the tube behind becomes filled up with solid calcarious matter, and is left fixed in the substance of the coral. This curious shell has been mistaken for a stalactite or mineral concretion by some authors, and as the shelly tube of an annelide or worm-shell by others.

GENUS BUCCINUM.—The shells of this genus are of an ovate form, with a moderately extended spire. The whirls are few and ventricose, the mouth large, and the canal very short and reflected. The outer lip is rather sinuous, and the pillar rounded. The operculum is ovate, with a small nucleus placed near the front end of the outer edge. The species are not very numerous, only about twenty true typical ones remaining. They inhabit the northern and antarctic seas, and are found from low water to one hundred fathoms.

THE COMMON WHELK (*Buccinum undatum*) is one of our most common shells, being universally distributed around the British shores; indeed, it is one of the most widely distributed of Atlantic shells, as well as one of the most variable in characters according to its locality. Its general outline is ovato-conical, passing through various degrees of elongation; from a short, squat, ventricose shell, to one remarkable for

slenderness and graceful curvature. The surface of the shell is usually invested with an epidermis, often soft and hairy, sometimes shiny and membranous, less frequently altogether wanting. It varies also considerably in colour, and grows to the length of six inches by three wide. The animal of the Whelk is very slow in its movements. Though it generally resides on the surface, it has the power of burrowing in the sand when in search of its prey. This action is produced by means of its foot, which it is able to distend to a size nearly equal to that of the shell. It is eminently carnivorous, and its proboscis—fig. 214—enables it to

Fig. 214.



Proboscis and teeth of Buccinum undatum.

drill holes through the hardest shell of any bivalve. It is said to be very destructive to the common scallop or clam (*Pecten opercularis*), by slily insinuating its foot, and seizing upon the unwary inmate as it lies with its valves unguardedly open. This is at least mentioned by Montagu as the opinion of the fishermen of the coast, who, he says, acting upon this supposition, dredge for this Whelk, and either destroy the animal or use it for bait. At Portpatrick it is called the Hen Buckie, and is much used by the fishermen on that coast as bait. It is caught for this purpose in baskets containing pieces of fish, which are let down in about ten fathoms of water, and are drawn up daily to be emptied of the shells which have crept into them to feed upon the dead fish. "Each shell serves to bait two hooks; so that reckoning the number of hooks used by all the boats at four thousand five hundred, about two thousand two hundred and fifty of these large shell-fish must be destroyed every time the lines are shot, and probably not fewer than seventy thousand every year. Yet the supply, chiefly obtained from a space of no great extent, seems to be even more abundant than ever."—(*Wilson.*) The Whelk is also used as food by man. Thousands are exposed in the fish-shops and stalls in the metropolis; they are simply boiled and eaten with a little vinegar and pepper—"a poor man's delicacy, but by no means a wholesome morsel," says Professor Forbes. "A repast, sufficiently wholesome, and certainly not destitute of relish," says Dr. Johnston.

FAMILY—CANCELLARIIDÆ.

The shells of this family are generally rough, with striæ or ribs, or have a cancellated surface. The spire is short; the mouth ovate, channeled in front; and the columella, or pillar lip, is marked with several strong oblique folds. No operculum has been observed; and though the animal has been seen in some of the species, the proboscis and teeth have not been examined. The character of the shells would lead us to believe that they belong to the carnivorous group, but M. Deshayes asserts that the Mediterranean species, *Cancellaria cancellata*, is a vegetable feeder. The Cancellariæ are marine shells, many of them of rather an elegant form, and much sought after by collectors. The number of recent species are about seventy, and their native countries are the Mediterranean, West Indies, Western Africa, India, China, and California. They have been dredged in from seven to forty fathoms.

FAMILY—OLIVIDÆ.

The family of **OLIVES** (*Olividæ*) are distinguished by the animals having a large elongate foot, with a cross groove on each side, often inclosing a part of the shell. The mantle is inclosed, the siphon recurved, and the canal of the shell reduced to a notch. This is rather a large family, and contains the *True Olives*, the *Ancillariæ*, and the *Harp Shells*.

GENUS OLIVA.—The True Olives have a subcylindrical, smooth, polished shell, with a deep channeled suture round the whirls, and the columella plaited in front. The large foot is raised up on each side, in order to envelope the shell, and secretes the enameled, shining, and brightly-coloured layer, which covers the outer surface of the shell. The mantle has an elongated appendage, situated behind, and lodged in the deep channel of the sutures of the spire. This is a remarkable character of the Olives. The species are numerous, nearly one hundred and twenty recent forms having been described. They are carnivorous and voracious animals; are active; and can turn over when laid on their back. Near low water they may be seen gliding about, or burying themselves in the mud as the tide retires. They are subtropical shells, and have been found in America, Western Africa, India, China, and the Pacific, from low water to twenty-five fathoms. As these shells are much sought after by collectors, they are often obtained by fishing for them by a line baited with a piece of raw flesh.

THE PANAMA OLIVE (*O. porphyrea*), the largest and one of the finest species, is a native of the coasts of South America. It is marked with numerous fine, brown, angular, or zig-zag lines, upon a flesh-coloured ground, and frequently attains to five or six inches in length.

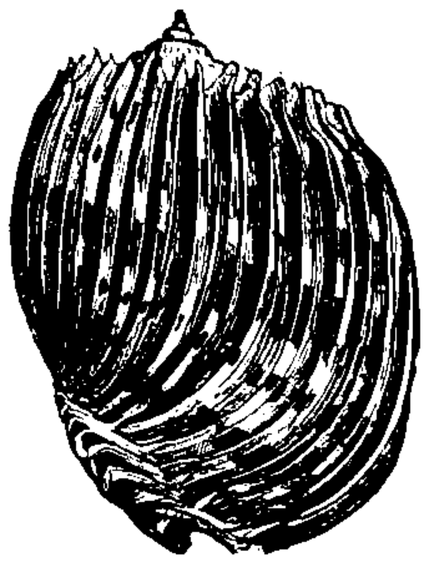
GENUS ANCILLARIA.—The Ancillariæ, with a subcylindrical polished shell, have the suture of the spire covered with a smooth, shining, thinnish callosity, instead of a groove or channel. The mantle is destitute of the posterior, elongated appendage of the Olives. The shell is more or less covered with a fine coat of enamel; in some species leaving a naked space on the whirls, but in others covering the whole shell. This arises from the fact, that the foot of the animal is much expanded on both sides, and curling upwards and inwards during the ordinary progression of the animal, folds itself on the

shell, and almost entirely conceals it from view. Being smooth and provided with a slimy mucous secretion, it thus covers the surface of the shell with a fine layer of bright enamel. Some species possess an operculum, but others have none.

GENUS HARPA.—The Harp shells are well known to collectors, and are favourite objects of their research; the richness of their colours, and the elegance of their forms causing them to be much sought after. They are swollen ventricose shells, with an ample mouth and a short spire. They are all distinguishable at first sight by a number of elegant longitudinal ribs, and a highly-polished callosity on the front part of the columella. At present nine species have been described, but at the time of Linnæus only one was known, which he described as a species of Buccinum (*B. harpa*). The animal which inhabits the shell was not known even to Lamarck, when he founded the genus *Harpa*. M. Raynaud, however, a surgeon in the French navy, was enabled to give some details of a species found by him alive in India, and his observations were afterwards confirmed by MM. Quoy and Gaimard. It resembles that of the Olive shells, having a very large foot, which is divided into two portions. The anterior half is broad, but the posterior portion is elongate, terminates in a sharp point, and is nearly as long as the whole shell. It is so disproportionately large indeed, that it cannot be quickly withdrawn within the shell. The animal, therefore, has the power, when suddenly attacked by an enemy, of spontaneously detaching this hinder portion, by pressing it firmly against the lip of the shell, or by means of a sudden contraction, and thus enabling it to withdraw the rest of its body within the shell. It possesses the faculty also of reproducing the lost portion after a time. There is no operculum, as such an appendage would be of no use to the animal, since it would be separated by the rupture of the foot.

THE SWOLLEN HARP (*Harpa ventricosa*) "glories in a rich vermilion red skin." At the Mauritius it is caught, like the Olives, with lines baited with small pieces of flesh. "It is the amusement of the place,"

Fig. 215.



The Many-ribbed Harp (Harpa imperialis).

says Mr. Broderip, "to watch over the trim apparatus of lines hung over some sandbank to tempt the various brilliant species of Oliva which there abound, or to wait for the more rare approach of the Harp shell, till the rich hues of its inhabitant are seen glowing through the clear blue water, in the rays of a tropical rising sun."

THE MANY-RIBBED HARP (*Harpa imperialis*) is one of the rarest and most beautiful, and perhaps the most precious of all the species. Though now much depressed in value, it was at one time a shell of high price—fig. 215.

Placed here by Dr. Gray, comes a small family of molluscs, very unlike any of the preceding, as far as the shell is concerned, but brought amongst the *Proboscidifera*, by the structure of the teeth and the form of the animal.

FAMILY—LAMELLARIIDÆ.

This family have a thin, pellucid, spiral, ear-shaped shell, with a large patulous aperture, and a receding inner lip. The mantle is large, and completely covers the shell; the proboscis is elongate, strong, and retractile; and the tongue is linear, and spirally twisted behind, as in *Purpura*. The family is represented in Plate 1, figs. 1–4, by the species *Ermea perspicua*, which is a native of Great Britain, and fig. 5, *Coriocella nigra*.

FAMILY—FASCIOLARIIDÆ.

This family contains the Tulip shells and the Mitres.

GENUS FASCIOLARIA.—The Tulip shells are fusiform, elongated, and swollen, with a conical spire. The whirls are round and smooth, or angular and waved; the mouth is ovate, outer lip crenated, grooved within; columella tortuous with several oblique folds in front. The canal of the shell is elongate, and the operculum claw-shaped, with the nucleus apical, sometimes radiately grooved. The species are not numerous, only about sixteen having been described; but they have a wide range in their distribution, being found in the Mediterranean, Cape Verd islands, West Indies, Ceylon, Philippine islands, Australia, Western Africa, and South America. One of the species, the Gigantic Tulip shell (*Fasciolaria gigantea*), from the South Seas, is very large, sometimes attaining a length of nearly two feet.

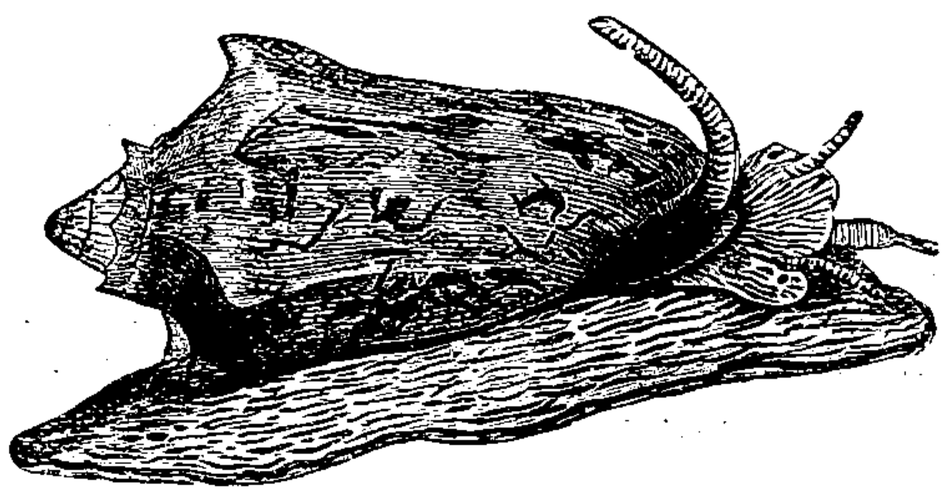
GENUS MITRA.—The Mitres have a fusiform shell with a conical, elevated spire, compressed whirls, a small mouth, and a short canal. The columella is obliquely plaited with about five folds, and the operculum, when present (it is wanting in the larger species), is very small. The mantle of the animal is inclosed, and the foot is small, folded longitudinally when contracted. The proboscis is generally very long and large, that of *Mitra episcopalis* being more than one and a half times the length of the whole shell, and being capable of being projected to the distance of five inches. The species are numerous, exceeding three hundred and fifty, and vary very much in form and sculpture. They are found chiefly harbouring in the Philippine Archipelago and other groups of islands, few occurring on the shores of continents, and in deep water from fifteen to eighty fathoms. When irritated, some of them emit a purple fluid having a nauseous odour. The larger species are said to be sluggish animals. This seems

The young are large when born, not leaving their mother till they are an inch in length. Four or five are found in each animal. Adanson in his voyage to Senegal, informs us that one species of these shells, the "Yets" as they are called (*Yetus Neptuni*), are thrown up by the high winds of April, in such quantities as sometimes to cover the shore, and that the animals, which often weigh five or six pounds, are smoked and preserved by the natives of Senegal against times of famine, to which they are frequently exposed. The nucleus or apex of the Yets is very large, callous, and irregular; it is often thrown off entire. The species of *Yetus* are chiefly natives of Africa. The remainder of the Volutes are oviparous, the young being arranged in the oviduct of the female in a long string without egg shells.

GENUS CYMBIUM.—The genus Cymbium has a ventricose shell with a short, depressed spire, which is frequently crowned with a diadem of strong spines. The aperture is very large and expanded, and the nucleus or apex of the shell is regularly spiral and persistent. The foot is not so large as in the Yets, and the mantle is inclosed. The surface of the shell is covered with a smooth, greenish-brown epidermis, and the shell itself usually ornamented with a variety of colours. Some of the species are very large, and they are almost all natives of New Holland, and the great islands of the Eastern Archipelago. One or two of the larger, such as *Cymbium æthiopicum* and *diadema*, are used by the natives of these seas as vessels for baling the water out of their canoes.

GENUS SCAPHA.—A number of species of Volutes, instead of being ventricose, are fusiform or ovate in shape, and covered with a thin, smooth epidermis. The last whirl is often spinose or tubercled, and the nucleus is smooth or crenulated. As the shells increase in size the animals fill the nuclei of the spire with solid calcareous matter. These belong to the genus *Scapha*. They are tolerably numerous, and are principally found natives of the East Indian islands, though some are found also in Australia. Some of the shells are very beautiful, very elegant in form, and the rarer amongst them, as *Scapha Junonia*, for example, fetch very high prices. The same may be said of *Scapha mamilla*,

Fig. 216.



Scapha vespertilio and animal.

from Van Diemen's Land, remarkable for the large nucleus of the spire, and the size of the shell. Specimens scarcely exist in any other collection than that of the British Museum, which is peculiarly rich in this family. Fig. 216 represents the *S. vespertilio* and animal.

GENUS VOLUTA.—The name Voluta, as a generic appellation, is now restricted to a small number of species. The shells are of a dense structure, of an ovate shape, and the pillar or columella has four or five strongly-developed oblique plaits or folds in front, and several smaller transverse ones behind. The surface of the shell is generally ornamented with transverse interrupted bands and striæ, so disposed as to resemble a bar of music.

THE VOLUTA MUSICA or MUSIC SHELL, from the West Indies, has obtained its name from this circumstance; and the peculiar appearance of notes of music is equally well exhibited in the *Voluta hebræa*. This is the only genus of the family in which we find an operculum. It is horny, annular, and distinct.

GENUS VOLUTELLA.—In the several genera we have briefly noticed the mantle of the animal is inclosed within the shell. But a considerable number of species are remarkable for having the lobes of the mantle produced, and partially covering the shell. These constitute the genus *Volutella*. In one of the most remarkable of the species, the *Volutella angulata*, these lobes are largely expanded, and overspread the spire entirely, which is generally much produced, and covered with a smooth, glassy deposit. In others, these lobes are more moderately expanded, and only cover the lower side of the spire, leaving a callous band on the suture of the upper side. Such are the fine large, and rather ponderous *V. imperialis*, with its spire crowned with a circle of strong spines; the beautiful and elegant little *V. Cymbiola*, &c.

THE DATE SHELLS, *Porcellanina* (genus *Marginella* of Lamarck), are remarkable for the brilliancy and variety of their markings. The mantle lobes are expanded and spread over the shell, which is covered with a highly-polished coat laid over the epidermis. The animals are said by some to resemble those of the Cowries (*Cypræa*), but they have the retractile proboscis, the lingual membrane, and disposition of the teeth of the *Volutidæ*. The form of the shell also, with its conic spire, its plaited columella, and its thickened outer lip, marks its relation with this family. The species are numerous, upwards of ninety having been described. They prevail more especially along the shores of Africa, but are found also in the West Indies, Brazil, India, China, and Australia. They are quicker and more lively in their movements than the Cowries, crawling pretty briskly, and moving their tentacles in different directions. The foot of the animal appears to be double-edged in front, and this part is said by Mr. A. Adams, who has had opportunities of seeing some of the species in their native localities, to be endowed with acute sensation, the animal making use of these two portions of the body as feelers. Their favourite locality is shallow water on clear sands; and when seen in full activity, they are said to be objects of singular interest and beauty.

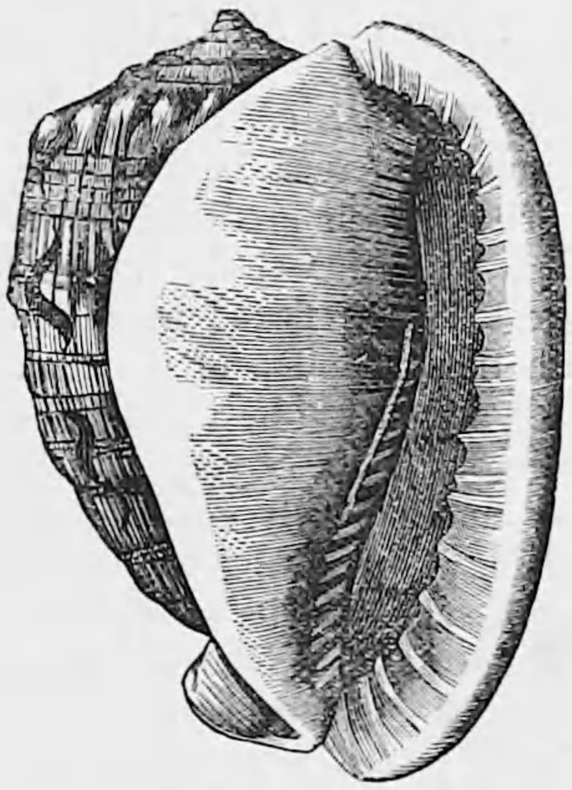
FAMILY—CASSIDIDÆ.

The family of **HELMET SHELLS** (*Cassididæ*) have the foot largely dilated; and the operculum, which it bears near its posterior extremity, is annular, ovate, or

oblong, and has its nucleus in the middle of the inner edge. The shell is ventricose, somewhat globular, and the whirls often marked with varices. The aperture is either elongate and narrow, or ovate, and the canal, in which is lodged the siphon of the mantle, is, like it, recurved. The Helmet Shells are often very large, and, indeed, comprise amongst them some of the largest known Gasteropods. They form a very natural group, and principally inhabit the warmer regions of the globe. The species are rather numerous, thirty-four having been described, and they are distributed through several genera.

GENUS CASSIS.—The genus Cassis (which gives the name to the family) has an oblong or subtrigonal shell, with a short, nearly flat spire, a long aperture or mouth, the outer lip of which is thick, reflected, and toothed within, the inner spread over the body whirl, callous and plaited; the canal sharply recurved; the operculum is oblong, narrow, and small. The animals are active and voracious. They live in shallow water, in sandy localities, often concealing themselves in the sand, and attacking the bivalve shells that abound in such places. The shells of some of the larger species are extensively used in the manufacture of cameos. Like most other shells, they are composed of three layers or plates, and these differ from each other in relative thickness as well as in colour. The central plate is generally the thickest, and is differently coloured from the outer. The cameo cutters appear to be well aware of this structure in the Helmet Shells and some others, and avail themselves of it in cutting their cameos, so as to produce white or rose-coloured, &c., figures on a dark ground. In the economic collection of shells in the British Museum, for instance, we may see cameos carved on the shell of the Horned Helmet from Madagascar, *Cassis cornuta*, showing white figures on an orange ground; on the Black Helmet Shell, as it is called, *Cassis Madagascariensis*, from the West Indies, and on *C. tuberosa*, showing white on dark claret colour; and on the Red

Fig. 217.



Red Helmet Shell or Bull's Mouth (Cassis rufa).

Helmet Shell or Bull's Mouth, *C. rufa*, from the Indian seas- fig. 217 (which is the one most extensively used), showing pale salmon colour on orange ground. In 1847 Dr. Gray, at a meeting of the Society of Arts, gave some very interesting details upon the subject of cameos. For many years the art of cutting cameos from shells was confined to Italy, but a little more than twenty years ago an Italian commenced making them in Paris, and in 1847 about three hundred persons were employed in that branch of trade in that city alone. The number of shells used in this manufacture is immense; and Dr. Gray stated that at the period mentioned above there were used in France nearly one hundred thousand Helmet Shells alone, of the value of upwards of £8000. Of the different kinds, the greatest number were the Bull's Mouth (*Cassis rufa*), which amounted to eighty thousand, the average price being 1s. 8d each, equal to £6400. Next to these were the Black Helmet (*C. Madagascariensis*), which amounted to eight thousand, averaging 5s. each, equal to £1800. The average value of the large cameos made in Paris is about six francs each, giving a sterling value of £32,000; and the value of the small cameos is about £8000, giving a total value of the cameos produced in Paris for 1846 of £40,000!

FAMILY—DOLIIDÆ.

The family of the **TUN SHELLS** (*Doliidæ*) are known by their large, light, ventricose shells, marked with transverse ribs or furrows. The animal has the mantle inclosed, a very large foot, truncated in front, without an operculum. The species are not numerous, only fourteen or fifteen having been described, but many of them attain a large size. They are found in the Mediterranean, in Ceylon, China, Australia, and the Pacific.

GENUS DOLIUM.—The genus Dolium (from the species of which the English name *Tun* given to the family has been derived) has a rather delicate, light, nearly globular, and ventricose shell, with a short spire and a large ovate mouth. The surface is marked with spiral grooves or ribs, and the last whirl forms nearly the whole of the shell. The outer lip is more or less thickened, waved internally, the pillar lip rather twisted, and the canal short and suddenly curved backwards. One of the largest species, *Dolium galea*, inhabits the Mediterranean. Some of the species are found on reefs.

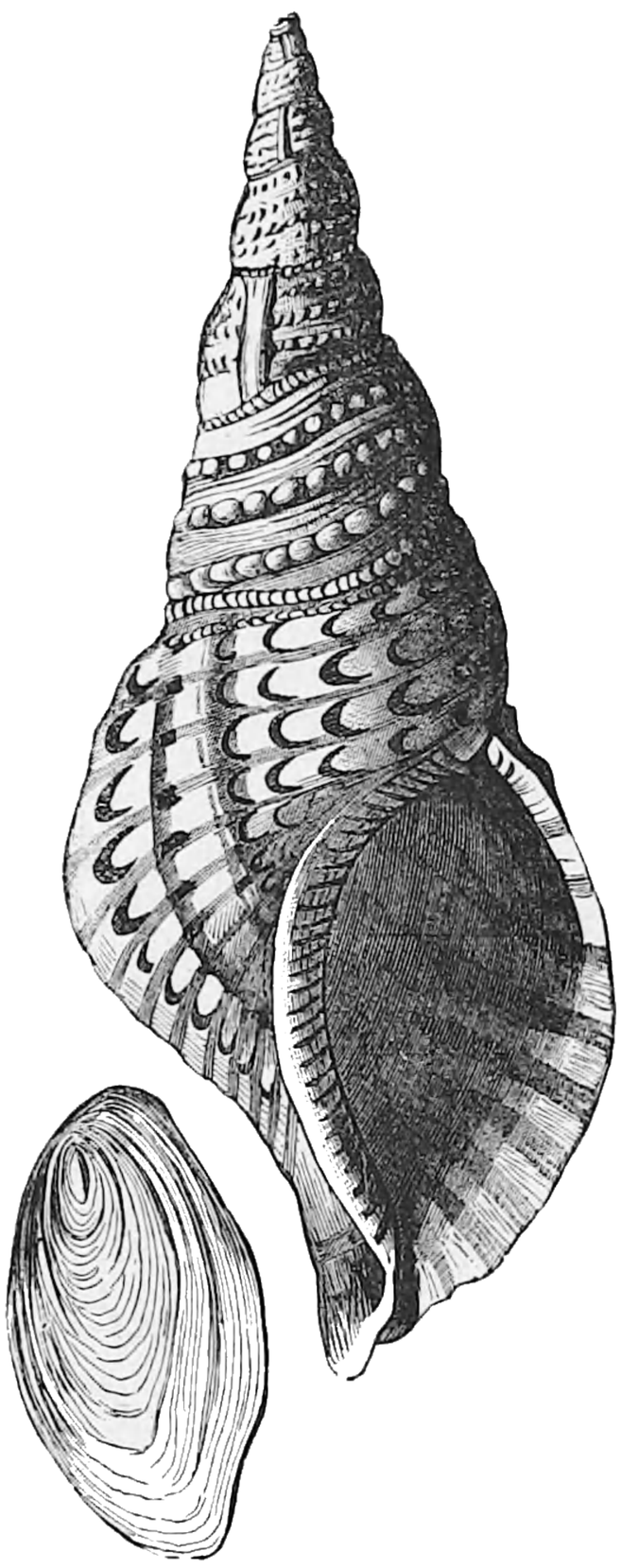
FAMILY—TRITONIDÆ.

The family of **TRUMPET SHELLS** (*Tritonidæ*) contains a large number of species, about one hundred and fifty having been described as living at the present day. They range from low water to ten or thirty fathoms, and are distributed through the Mediterranean, the West Indies, Africa, India, China, the Pacific, and Western America. The animals have a small foot, and an annular, ovate, or triangular operculum, with the nucleus subapical. The shells are ovate, with a conical spire, and are generally strongly marked with varices on their whirls. The aperture is ovate, the columella veined or grooved, and the canal in front is straight. This family contains two large genera, the shells of which differ from each other in the disposition of their varices.

GENUS TRITON.—The True Trumpet shells have the varices disconnected, and so arranged as to form three interrupted longitudinal ribs. The canal is prominent, and the lips denticulate. The species are principally equatorial in their geographical distribution, belonging more especially to Asia. Those which have a much produced canal are obtained from deep water; those which have a cancellated surface are from sand in deep water; and those covered with an epidermis are chiefly from sandy mud, in from six to thirty fathoms.

TRITON VARIEGATUS is the shell well known by the name of "the Marine Trumpet or Triton's Shell," and is one of the finest, as it is certainly the largest

Fig. 218.



Triton variegatus.

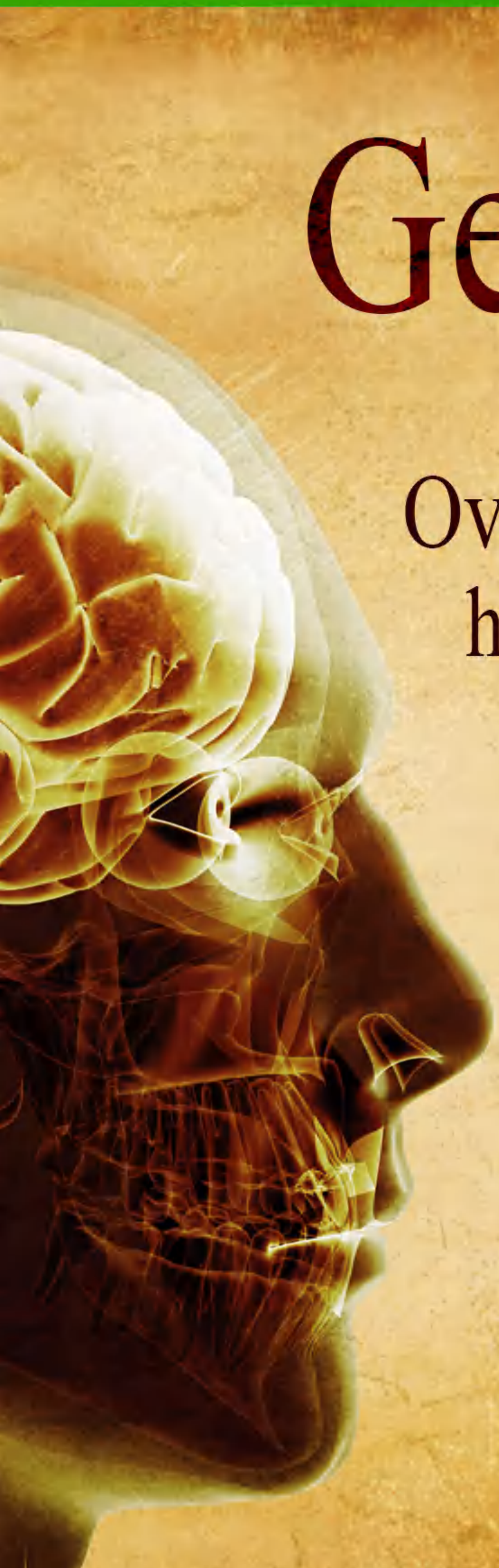
species (fig. 218). It is elongate, conical, trumpet-shaped, ventricose in the last whirl, and girt with very obtuse smooth ribs of a white colour, elegantly variegated with red and bay. The aperture is red, and the columellar lip is wrinkled with white. This large shell is a native of the West Indian and the Pacific oceans, and is the conch used by the Australian and Polynesian islanders as a war trumpet. Captain Cook remarks, that during his visits to the Australasian islands, he never knew the blowing of the conch amongst the natives to portend good; it always seemed to be the signal for a hostile attack. Mr. Ellis, in his "Polynesian Researches," however, informs us that these conches were blown in processions to their temples, at the inauguration of a king, during their worship at their temples, or when a tabu or restriction was imposed in the name of the gods, as well as when their warriors marched to battle. "We have sometimes heard them blown," he says. "The sound is extremely loud, but the most monotonous and dismal that it is possible to imagine." This trumpet is also used in the West Indian islands to summon the negro labourers to their work. A species somewhat similar is found in the Mediterranean (*Triton nodiferus*), and it is no doubt of this shell that Dr. Johnston speaks when he says, it is "clearly the original of the war trumpet."

GENUS RANELLA.—**THE FROG-SHELLS** or RANELLÆ (*Apollon*) have their varices arranged two on each whirl, and so disposed as to form a border to the shell on each side. The shell is compressed, and has a short, straight canal. The species are mostly tropical, the majority being from the Eastern seas. Upwards of fifty species have been described, ranging from low water to twenty fathoms. The variegated species, which have the whirls nodosely armed, are found in rocky places and on coral reefs; the winged species, with a smooth surface, are from deep water. They move about with considerable animation, and crawl rapidly. As observed by Mr. A. Adams, in the Philippine islands the Ranellæ seemed to move about much more briskly than might have been anticipated from animals furnished with such a heavy shell; thrusting out their head, protruding their tentacles and proboscis, and ascending even perpendicular substances with considerable facility. "One species," says Mr. Adams, "dredged from twenty fathoms water, was furnished with a very extensive proboscis, which it was able to exsert to the distance of two inches from the head, using it as a perceptive organ, in the same manner as the elephant does its trunk."

Passing by the families Sycotypidæ and Velutinidæ, we come to the—

FAMILY—NATICIDÆ.

The family of **NATICAS** (*Naticidæ*) are remarkable among the proboscidiferous mollusks for their very large foot. It is much produced in front, and is there provided with a well-developed fold, which becomes a great lobe, reflexed upon and concealing the head, with the exception of the tentacles, which are rather small, and united by a transverse membrane. The operculigerous lobe is very largely developed, reflected upon and partially covering the sides and back of the shell, which indeed has the appearance of being as it were sunk into its substance. The operculum is spiral, horny, or covered with a shelly external coat, and though of good size is not very apparent on the animal, being placed transversely and hidden by the extremity of the shell. The mantle is inclosed and has no siphon, the mouth of the shell being also entire in front and destitute of a canal. The species present marked characters—the shells being in general spiral, more or less globular, and usually smooth and polished on their surface. The epidermis is generally



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power of retracting the float. In rough weather, however, they are driven about by the agitated sea, and their floats are then broken or detached; but even then the shells are found floating on the surface. In this state they are frequently drifted to our own shores, especially on the southern and western sides of the island; and in Swansea bay, we are told, the animals have been found quite fresh. The favourite food of the Ianthinæ appears to be the gelatinous *Velellæ*, and M. Deshayes informs us that he has often witnessed them feeding upon these animals, and apparently making use of them at the same time as a raft to float them on the surface. It has been said that in consequence of feeding upon these blue-coloured Acalephæ the Ianthinæ obtain their violet hue. It is certain that they have the power of secreting a quantity of violet fluid, and that when molested they exude it in considerable abundance.

THE COMMON VIOLET SNAIL (*Ianthina communis*), according to the late Professor Forbes, secretes this fluid rapidly, and the purple dye, he says, was so strong, that some paper which he painted with it in 1837, retained its colour strongly in 1853. M. Lesson tried to prove that this was the very shell which Pliny described as the one from which the Tyrian dye was obtained. It occurs frequently in the Mediterranean; but the colour of the fluid of this mollusk is purple on its emission, and is remarkably defective in permanency. The species of Ianthina are not numerous, but some of them are diffused over a great part of the world, the shells being thrown up on the sea-coasts by gales of wind. At certain seasons the beaches of St. Helena and the island of Aseension are entirely covered with them. Mr. A. Adams found them cast up by thousands on the shores of the Meiaco-shimah islands, but he says he never observed them make the slightest attempt to crawl, though he frequently noticed them adhering together in masses, attached by the anterior part of the foot, which acted as a sucker.

FAMILY—SCALARIIDÆ (*The Wentle-traps*).

The Wentle-traps are very different-looking shells from the Violet Snails, but the arrangement of the teeth in the animals is nearly the same. The shell is spiral, turreted, with varices, or elevated longitudinal ribs, on the whirls. The aperture is rounded, entire, and exhibits scarcely any trace of a canal. The operculum is horny, spiral, few-whirled. The species are numerous, about one hundred species being found recent, and an equal number having been described as inhabitants of our globe at an earlier period of its existence.

The genus SCALARIA, the "Wentle-trap" is the only one of the family, and the species are chiefly from the eastern tropical seas. China and the Philippine islands harbour the greater number, but five species are natives of the British isles.

THE ROYAL STAIR-CASE or WENTLE-TRAP, "la vraie Scalata" (*Scalaria pretiosa*), is the most remarkable and the most valuable of all. This shell, always distinguished for its beauty, and once famous for the enormous value set upon it by collectors, is a native of the Chinese seas. It grows to more than two inches in length, is conical, umbilicated, and twisted into a loose spire, so that the whirls only touch each other by their projecting ribs. It is of a pale yellowish colour, with white ribs or varices. "The specific name given to it by Lamarck" (*pretiosa*), says Mr. Broderip, "was at one time well deserved on account of its rarity, and the great price which a fine specimen would bring in the market, especially when it exceeded two inches in height; such a specimen has been sold in former days for twenty-four hundred livres, or one hundred louis. But these times are gone by; the shell is no longer rare, and good specimens only fetch shillings where they once brought pounds. A very fine example still, however, commands a considerable sum. That in Mr. Bullock's museum, supposed to be the largest known, brought £27 at his sale, and was in 1815 estimated at double that value." Da Costa, in his "Elements of Conchology," informs us that in 1753, "at the sale of Commodore Lisle's shells at Longford's, four Wentle-traps were sold for £75 12s.; viz., first day, February 21, lot 96, one not quite perfect, £16 16s.; third day, lot 98, a very fine and perfect one, £18 18s.; fourth day, lot 101, one for £16 16s.; sixth day, lot 83, one for £23 2s. At the present day the value is very much reduced.

The animals of some of the species exude a purple fluid when molested, and Montagu in his "British Shells" has described the liquor discharged by the common species of the Mediterranean, *S. clathrus*. As much can be procured, he says, from five individuals as is sufficient, when mixed with a few drops of spring water, to cover half a sheet of paper. The colour at first was very bright, and appeared for some months unchanged by the action of the air or sun; but being exposed for a whole summer to the solar rays, in a south window, they almost vanished. Like the *Ianthina*, just mentioned, this *Scalaria* has been supposed by some naturalists to have been one of the shells employed by the ancients to furnish the celebrated Tyrian dye, but the same objections apply to it as to the purple fluid of the Ianthina.—See above.

The remaining families of the Proboscidifera, *Acteonidæ*, *Cerithiopsidæ*, *Pyramidellidæ*, and *Architectomidæ* (Solarium), are of no particular interest, and so we hasten on to the next sub-order.

SUB-ORDER III.—ROSTRIFERA.

THE Rostriferous mollusca are equally numerous as the Proboscidiferous; but instead of being carnivorous in their habits, they are essentially vegetable feeders. The animals have a moderate-sized head, with a more or less elongated, produced, transversely-annulated rostrum, which is furnished with contractile muscles

only, and is not retractile, as is the ease in the previous sub-order. It varies in length and shape—in some being very long, but in a great many being short. The tentacles are awl-shaped, far apart, and placed on the sides of the base of the rostrum. The eyes are situated on the outer side, or behind the base of these organs. The lingual membrane is often very long, extending a good way into the visceral cavity of the animal, and the teeth are arranged upon it in seven serics, 3, 1, 3. The foot of the animal varies in shape a good deal. In some genera we find it expanded, depressed, and formed for crawling, *Platypoda;* in others it is roundish, truncate, or club-shaped, *Protopoda;* in a third set, it is compressed and adapted for leaping, *Leptopoda;* while in another series, it is fin-like, and furnished with a small sucker, *Heteropoda.*

FAMILY—AMPULLARIIDÆ (*The Apple Snails*).

The animals of this family have the rostrum produced, and the tentacles long and filiform. They have only one well-developed gill, the left being nearly rudimentary, but the mantle has a large pulmonary sac on each side; the foot is simple, and the opereulum annular and regular; the shell is sub-globose, and covered with a hard, polished, olive-coloured epidermis; the mouth is entire.

The Apple Snails are fluviatile in their habits, and represent, in the ponds and rivers of the tropics, the Pond Snails of more temperate climates. They live chiefly in marshes, which are subject to periodical inundations, and are never found in rapid running streams. Where they do occur, it is generally in large numbers, for they are abundant, and cover a large space of country. They have the power of living a long time out of water when the marshes dry up. This faculty appears to have been first made known to us by M. Caillaud, who is well known as connected with the natural history of Egypt. After his return to France from a residence in Egypt, he had a number of specimens of *Ampullaria ovata* sent to him from the Nile. They were packed up with a number of other animals in a box filled with saw-dust. At the end of upwards of four months, upon opening the box, he found many of the objects in a state of putridity. The contents of the box he threw into a tub of water, and next morning he was surprised to find all the Ampullariæ alive, and walking about apparently in a perfectly healthy state l M. Deshayes, struck by this fact, and by the information he received from several other travellers that these animals buried themselves in the mud, and could support their existence for a length of time when the water was dried up and the mud hardened, examined several specimens with great care, and found in the branchial cavity a large open sac quite in the hinder part, and immediately above the base of the gills. He perceived also that this cavity was always full of water; and that after the Snail had withdrawn itself, and tightly closed the aperture by means of its close-fitting operculum, the water is retained in this sac, and the gill thereby kept in a moist and unshrivelled condition; while, perhaps, as Dr. Johnston remarks, its contact with a living surface prevents the retained fluid running into putrefaction. The Apple Snails are oviparous; the eggs are large, globular, and contained in capsules. These are disposed in masses, and attached to plants, &c. Specimens may be seen in the collection of mollusk eggs in the British Museum. The species are upwards of fifty in number, and are separated into several genera. The operculum, as well as the shape of the shell itself, affords good generic characters. In some this operculum is horny, with a shelly external coat, and the inner edge of the mouth of the shell is thickened, so as to afford some support to the thick shelly operculum. Such is the genus PACHYSTOMA—Plate 1. fig. 1—(*Pachystoma solidum*). Others have the operculum simple and horny, and the edge of the shell thin. Such, for example, is the restricted genus AMPULLARIA. The species of this group inhabit chiefly the rivers and lakes of South America and the West Indies. The South American Indians term them "Idol Shells," and are said to hold them in great veneration.

FAMILY—AMPHIPERASIDÆ (*Poached Eggs*).

The family of Poached eggs (the genus *Ovulum* of Lamarck; family *Amphiperasidæ* of Gray) is the second family of the Rostrifera. In this family, and in the succeeding family of Cowries, *Cyprœidæ*, the mantle of the animal, when adult, is expanded, and often reflexed over the shell, giving the surface a fine polished appearance. There is no operculum. The shells are involute, have a linear aperture, and a smooth inner, and toothed or crenated outer lip. When young; they are spirally striated, but when full grown, are covered with a smooth enamelled coat. The aperture in many of the species is prolonged into a canal both in upper and lower extremities. The species are about thirty-six in number, and for the most part are distributed through the warm seas of the West Indies, Mediterranean, China, and West America—one or two also occurring on our own coasts. They vary much in shape, and have thus given origin to several genera. Those which are ovate and ventricose, with a narrow aperture, the extremities not prolonged into a broad, inflexed, rounded, and crenulate outer lip, and long canals, form the genus OVULUM (*Amphiperas*). These are the true Poached eggs, and their shells are never ornamented with rich or varied colours, but are usually white, pink, pale violet, or. yellow, without exhibiting any particular markings or pattern. Those in which the shell is fusiform, with an inflexed, toothed, outer lip, and the extremities of the aperture produced only into short canals, form the genus CALPURNUS. One of the species of this genus is a native of the seas of the Philippine Islands, and the appearance of the animal and its habits have been well described by Mr. Adams. It is a very slow-moving and sluggish creature, he says, but exhibits a singularly beautiful and striking appearance under the calm shallow water, as it glides tranquilly along the bright sandy bottom. The head is pure, opaque white, with the exception of one large black spot placed in the centre of the forepart, which, with its large black eyes

and black tipped tentacles, gives it a very peculiar appearance.

FAMILY—CYPRÆIDÆ (*Cowries*).

The family of Cowries which come next in order, like the preceding, have the mantle of the adult animal expanded, and generally reflexed over the shell, giving it a fine polished appearance. The foot is simple, and there is no operculum. The lobes of the mantle are often ornamented externally with forked or pointed beards or filaments, and the end of the siphon with which it is furnished is frequently fimbriated. The shell is involute, ventricose, with a linear mouth, toothed lips, and the canal recurved like a notch. The surface is of a porcellanous structure, and there is no appearance of an epidermis. The family, indeed, is remarkable for the exquisite beauty of the shells, as well as their inhabitants. The great majority are natives of tropical regions, delighting in warm climates; and, as they glide along among the coral reefs, and in the shelter of rocks, with the lateral lobes of their mantles adorned with showy colours, they present to the eye of the pleased spectator objects of singular interest and beauty. They are shy creatures, and crawl slowly. "The difference of aspect," says Professor Forbes, "between these mollusks when crawling, with all the beautifully-coloured soft parts exposed, often completely concealing their enamelled shells, and their appearance when, after being seized, they suddenly and instantaneously withdraw their bodies and mantle lobes, and expose the shell only, is very curious and surprising." Individuals of the same species vary greatly in size—a difference so great that it has been attempted to be explained by the theory that the animals shed their shells as lobsters do their skins. This, however, is not the case, for we often find young shells much larger than adult specimens in the same species. In the young state, they are also very dissimilar in form from the adults, and thus mistakes have been often made with regard to species.

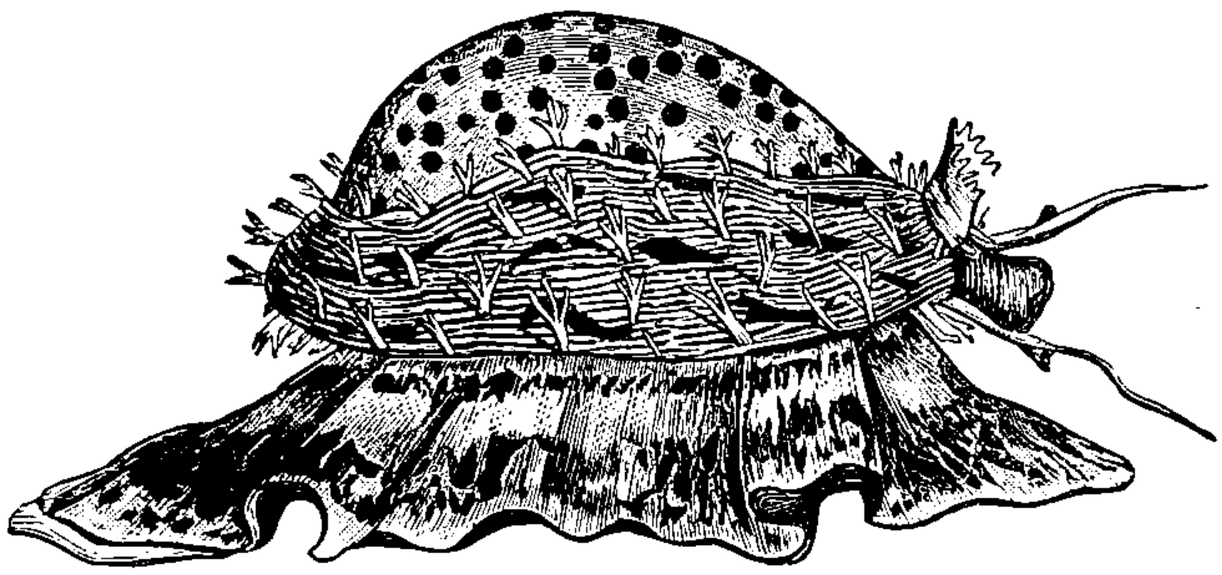
GENUS CYPRÆA.—This genus, as now restricted, contains some of the handsomest, largest, and most valuable of all the Cowries. The Orange Cowry, for instance, at one time fetched an enormous sum for a single specimen. It is a native of the South Pacific ocean, and is worn as an ornament by the natives of the Polynesian islands. "The highest order of dignity among the Friendly Islanders is the permission to wear the Orange Cowry."—(*Johnston.*) There are one or two species in the collection of the British Museum, the specimens of which are unique—such, for example, is the *Cypræa leucodon.*

THE C. PRINCEPS is perhaps the most beautiful of all the Cowries. It is also exceedingly rare, only two other specimens being known besides the splendid one in the National collection.

THE TIGER COWRY (*Cypræa tigris*) is one of the most common, but at the same time a very beautiful species—fig. 219. It is a thick, oval, and swollen shell, of a bluish-white, dotted with a great number of rounded, scattered, black spots, and a dorsal line of ferruginous colour above, and very white beneath. It is a native of the Indian seas from Madagascar to the Moluccas.

Other fine species are the MAP COWRY (*C. mappa*), and the BLOTCHED or SPOTTED COWRY (*C. guttata*), specimens of which have lately sold for £40.

Fig. 219.



Cypræa tigris (Tiger Cowry).

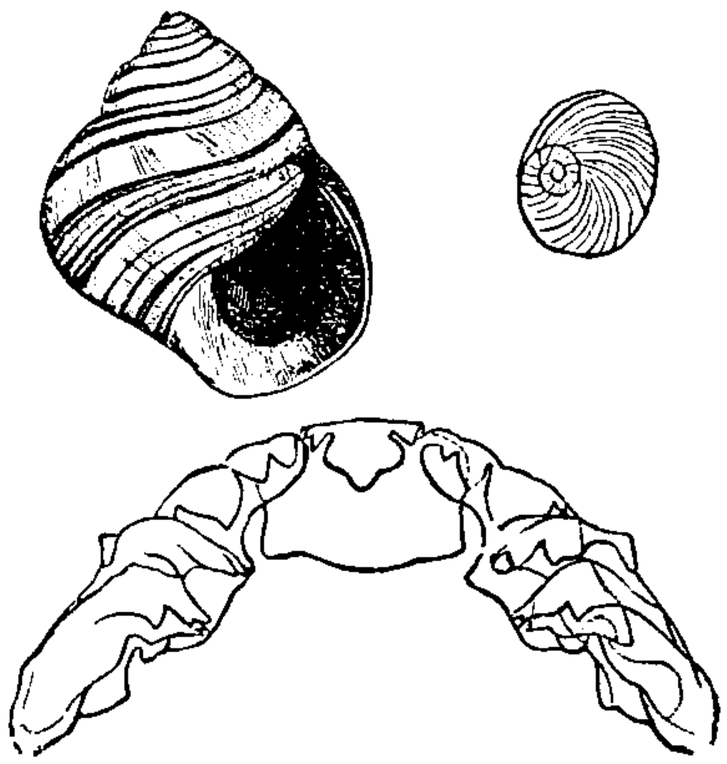
GENUS ARICIA.—This genus contains several elegant and beautiful species; but perhaps the one of greatest notoriety is the Money Cowry (*Cypræa moneta*). It is a small, oval, depressed, and somewhat noduled shell, flat and white beneath, with thick edges, and of a yellowish-white or pale citron colour on the upper surface. It inhabits the Pacific ocean and the Indian seas from the Moluccas to the Atlantic ocean. "Many tons weight of this little shell are annually imported into this country, and again exported for barter with the native tribes of Western Africa. In the year 1848 sixty tons of the Money Cowry were imported into Liverpool; and in 1849 nearly three hundred tons were brought to the same place, according to the statement of Mr. Archer in the Industrial Exhibition." (*Woodward*). This little shell, as well as the *C. asellus*, a small white-coloured shell, with three dark bands running across the upper surface, is extensively used as current coin in India. We have often seen the two species used indiscriminately in the villages in Bengal.

GENUS CYPRÆOVULA.—This genus contains few species the most remarkable being the *Cypræa umbilicata.* A specimen of this shell, in the collection of the British Museum, was long considered unique. A few years ago two additional specimens were sent to this country by Mr. Ronald Gunn from Van Diemen's Land, which were valued at about £35 a-piece. A few more specimens having since then been imported from the same locality, their value has been in consequence very much reduced.

GENUS TRIVIA.—The genus Trivia, or Pig-shell, contains a number of small shells of a sub-globose figure, and generally ribbed across the back. The species are about thirty in number, and are widely distributed, inhabiting Greenland, Great Britain, the West Indies, South Africa, Australia, the Pacific, and Western America. "Our native Cowry (*Trivia*

in their habits; many of them seem to prefer spots where they can be covered only at high water, and myriads of our common species may be seen, when young, clustered in hollows of rocks that are many feet above the highest tides. Some of the species found on the shores of South America are stated by M. D'Orbigny to prefer dry land to sea-water. *L. Peruviana*, he informs us, is abundant in the hollows of rocks, so high above the highest water-mark that they can only be wetted by the spray during tempests. If placed in sea-water they develope themselves, and quickly search for means of escaping from it, and reach some dry place. Though marine, they are found in the Baltic, within the influence of fresh water, in which situations they often become distorted. The Common

Fig. 220.



Littorina littorea—shell, operculum, and teeth of animal.

Periwinkle (*L. littorea*)—fig. 220, and Plate 1, fig. 1 (animal)—is oviparous, and is well known as affording an article of food. In times of scarcity, limpets and periwinkles are the daily fare of the poor inhabitants of several of the western isles of Scotland. An allied species, *L. rudis*, "is viviparous, and the young have a hard shell before their birth, in consequence of which the species is not eaten."—(*Woodward.*)

FAMILY—LACUNIDÆ.

This family, composed of only one genus, *Lacuna*, have a turbinated shell, with a short spire, a half-ovate mouth, and the pillar lip flattened, with a deep umbilical groove. In one of the species, *L. pallidula*, the animal is said to be furnished with a long cylindrical proboscis. None of the animals as yet examined possess jaws, but all the known species are found to feed on sea-weed. They eat "the surface of the frond or stem, often forming holes through the former, and deep holes in the latter, into which many specimens often crowd themselves. They are also often found crowded together in the crevices among the roots of the plant."—(*Gray.*) Lovèn observed that when the sea-weed upon which they feed is of a brown colour, the animals become green; but if red, they assume a rosy tint. They are chiefly northern species, and are natives both of Great Britain and North America.

FAMILY—TRUNCATELLIDÆ (*Looping snails.*)

The family of Looping snails have little interest as regards their shells. The animals, however, are interesting little creatures, from the manner in which they walk. They progress by means of their foot and the fore part of their muzzle, fixing one as a point of support, and then drawing the other after it, as the caterpillars of some lepidopterous insects (the geometric caterpillars) do; hence the name of Looping snails.

In the eight succeeding families, unlike the three preceding, the respiratory organs or gills are composed of a few laminæ (see page 299), twelve to fifteen in number, disposed in regular descending spiral series on the left side of the mantle cavity.

FAMILY—PLANAXIDÆ.

This family consists of shells bearing a resemblance to those of *Littorina*, but the animals differ from them in their gills, and in their mantle furnished with a produced siphon in front.

GENUS LITIOPA.—This is the most interesting genus in the family. The species are quite pelagic, and found floating in the open ocean. The animals have the sides of the foot and the operculigerous lobes furnished with tentacular filaments, and they have a horny operculum. The shell is thin, horny, semipellucid, and conoidal, with an acute spire and an oval aperture, emarginate anteriorly. They are all very small, and are found living on the gulf-weed. The animals are remarkable for having the power of spinning a byssus of glutinous threads, by which they attach themselves to the stems of the fuci on which they reside. Dr. Johnston gives a very interesting description of the habits of this little creature—"This is a small snail," he says, "born amid the gulf-weed, where it is destined to pass the whole of its life. The foot, though rather narrow and short, is of the usual character, and having no extra hold, the snail is apt to be swept off its weed; but the accident is provided against, for the creature, like a spider, spins a thread of the viscous fluid that exudes from the foot, to check its downward fall and enable it to regain its pristine site. But suppose the shock has severed their connection, or that the Litiopa finds it necessary to remove, from a deficiency of food, to a richer pasture, the thread is still made available to recovery or removal. In its fall, accidental or purposed, an air-bubble is emitted, probably from the branchial cavity, which rises slowly through the water, and as the snail has enveloped it with its slime, this is drawn out into threads as the bubble ascends; and now, having a buoy and ladder whereon to climb to the surface, it waits suspended until that bubble comes into contact with the weeds that everywhere float around."

FAMILY—RISSOIDÆ.

This family consists of numerous species of small, generally white, spiral, more or less turreted shells, with a simple ovate aperture, furnished with a very

slight canal in front. The operculum is horny, spiral. The species are numerous, about seventy having been enumerated, and are found distributed throughout all parts of the world. They are most abundant, however, in the north temperate zone, and live among sea-weed in shallow water.

FAMILY—MELANIIDÆ.

This is a numerous family, containing within it upwards of one hundred and sixty species. The shell is spiral, turreted, and covered with a dark olive epidermis. The aperture is ovate or circular, sometimes entire in front and at others channeled; and the operculum is ovate, horny, and spiral. The animals of this family are fluviatile, being inhabitants of fresh-water lakes and rivers throughout the warmer regions of the globe; and the apex of the spire of the shell is often eroded by the action of the water in which they live. In the southern states of North America they are numerous and form peculiar groups. Some of the species are Viviparous. The animal of one species, *Melania amarula*, is very bitter, and in the Isle of Bourbon and some of the adjacent islands it passes for an excellent remedy for the dropsy. The variety of form which characterizes many of the shells has necessitated their being grouped in different genera, and a good many have accordingly been formed. The principal character depended upon for dividing them is the form of the aperture. The family is represented in Plate 1, figs. 1 and 2, by Melania (*bibex*) Byronensis.

FAMILY—CERITHIIDÆ.

The Cerithia have the shell ovate, spiral, many-whirled, and covered with a thin epidermis. The aperture is ovate or subquadrate, and more or less channeled in front. The outer lip is often expanded, especially in adult specimens. The operculum is horny and spiral. The species are numerous, upwards of one hundred having been described, and they present various modifications of form and habits of life. Two forms are represented in Plate 1, figs. 1 and 2, by *Cerithium lævе* and *Tympanotomus muricatus*; and the operculum is represented by that of *Telescopium fuscum* in fig. 3. The operculum here offers a good character for assisting in separating them into groups. Some of the species are marine in their mode of life, while others dwell in the mouths of rivers or in salt marshes. Some of the marine species emit a green fluid when molested, which becomes purple in drying. "Two specimens of *Cerithium armatum* were brought alive to London from the Mauritius," says Dr. Johnston, "kept, during their long voyage, in a dry state, affording a remarkable illustration of tenacity of life. The animal was apparently healthy, and beautifully coloured. It emitted a considerable quantity of bright green fluid, which stained paper of a grass-green colour. It also coloured two or three ounces of pure water. This green solution, after standing for twelve hours in a stoppered bottle, became purplish at the upper part; but the paper retained its green colour though exposed to the atmosphere. A tincture made by immersing the animal of *Cerithium telescopium* in spirits, became of a dark verdigris colour, which it retained for some weeks." These shells are found in all parts of the world, the typical species, however, being tropical.

The fluviatile or salt-marsh species, forming the genus TELESCOPIUM, are few, and are found inhabiting the salt marshes and swampy tracks near the mouths of rivers in the East Indies and their islands. There they may be seen, with their pointed spires sticking out of the mud, in incredible numbers. We have seen them in great abundance on the muddy shores of Saugor island at the mouth of the river Hooghly in the Bay of Bengal; and we are told that their numbers are so great that they are collected for the purpose of being burnt into lime. Great heaps are formed and exposed to the sun to kill the animals. In the island of Borneo the animals are eaten by the natives.

FAMILY—TURRITELLIDÆ).

The family of **TURRET** or **SCREW SHELLS** (*Turritellidæ*) have the operculum horny, circular, and many-whirled, the whirls fringed on the edge. The shells are spiral, many-whirled, imperforate, and the aperture is rounded and simple in front. This is strictly a marine family; the species, which are tolerably numerous—upwards of fifty having been described—ranging from low-water mark to the depth of one hundred fathoms. Their geographical distribution is world-wide, one species living in our own seas. The term "Screw-shells," by which they are familiarly known, is derived from their peculiar spiral form. They live buried and fixed in tenacious mud, mixed with shelly debris, and can only protrude the head and tentacles from the mass. They walk very slowly, owing to the shortness of the foot.

GENUS TURRITELLA.—This genus gives its name to the family, and contains a considerable number of species, the shells of which are turreted, and have a subquadrate-shaped aperture, simple in front. They are chiefly natives of tropical countries.

Passing over the family **BARLÆIDÆ**, the species of which are few, small, and obscure, we come next to the RIVER SNAILS:—

FAMILY PALUDINIDÆ (*Viviparidæ*).

In this family the shell is spiral, turbinate, covered with an olive-coloured epidermis. The aperture is ovate and simple in front. The species of River Snails, amounting to upwards of sixty, are fluviatile, inhabiting lakes and streams over the greater part of the world. They have a good deal the external appearance of the Apple Snails (*Ampullariidæ*).—See page 201.

GENUS PALUDINA (*Viviparus*).—This genus has a thin, horny, annular operculum, with the nucleus near the middle of the inner side—Plate 2, fig. 3. The shell is ovate, thin, and covered with a thin epidermis beset with hairy bands. The species inhabit the rivers and lakes throughout the Northern hemisphere. The animals are sluggish, feeding upon living

and decayed vegetable matter, preferring nearly stagnant waters, or very sluggish rivers, with a bottom of soft mud. The females of the American and European species are Viviparous, and the young fry are not forsaken by their parent until the end of the second month of their existence. At first they are covered with spiral bands of hairs, but these soon disappear. The genus is represented in Plate 2, figs. 1 and 2, by *P. bengalensis* and *P. costata.*

The animals of the three following families have the gills laminar, disposed in such a way as to form an oblique line across the mantle cavity, the plates or laminæ being elongate and linear. The shells of these families are free and sub-spiral, with a large expanded mouth; and the animals are generally sedentary in their habits, rarely, indeed, changing their place of abode.

FAMILY—CALYPTRÆIDÆ.

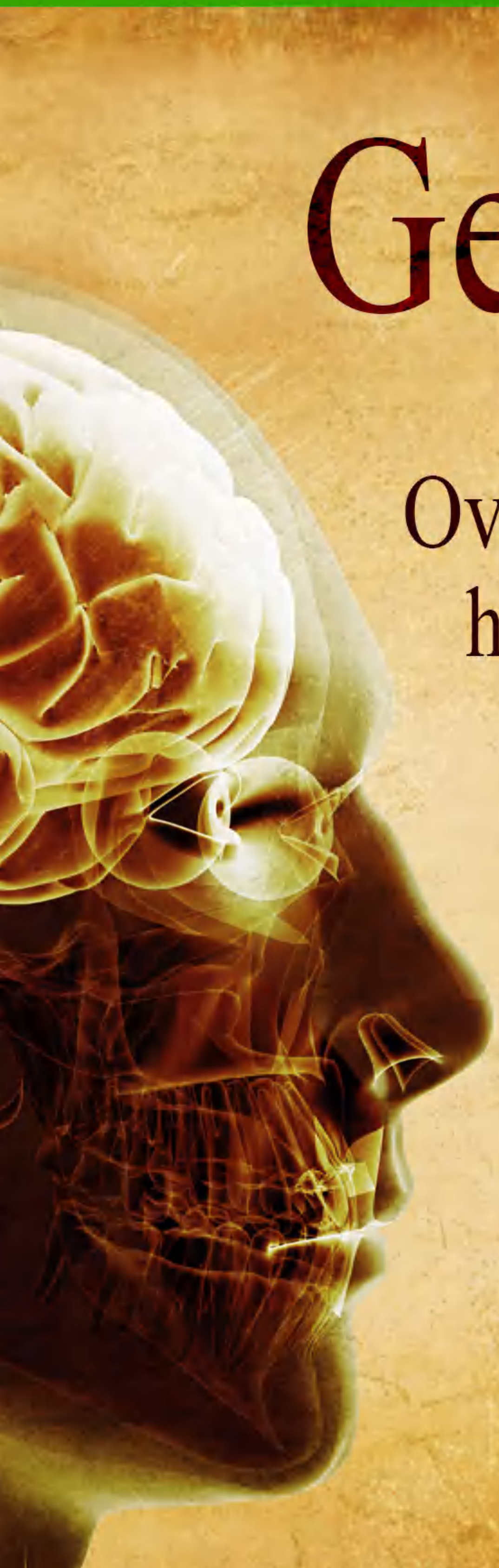
This family is an extremely natural one both as regards the shells and the animals. The animals are the shell is, in external shape, like the limpet (*patella*); destitute of an operculum (see Plate 2, figs. 1 and 2), and the apex being more or less spiral, and in the young shell regularly so. The aperture is wide, and the interior is furnished with a shelly process, variously shaped, and which, as Dr. Johnston observes, is a very remarkable structure. The animals of these shells carry and hatch the spawn under the neck in front of the foot. The eggs are inclosed in a thin membranous bag in small groups, and the mother "appears literally to sit upon and hatch the eggs." She disposes them under her belly, and preserves them, as it were imprisoned, between the foot and the foreign body, to which she adheres, "her patelloid shell thus serving not only to cover and protect herself, but as a shield to her offspring. The young are developed under this kind of maternal roof, and do not quit it until they have strength to attach themselves to the rock, and until their own shell is hard enough to afford protection when so attached."—(*Johnston.*) The species are numerous, about one hundred and ten having been described, and they are world-wide in their distribution. They are found adhering to stones and shells. The animals of most of them appear never to quit the spot on which they first settle, as the margins of their shells become adapted to the surface beneath, whilst some wear away the space beneath their foot, and others secrete a shelly base. Both the form and colour of the shells depend on the situation in which they grow. Those found in the cavities of dead shells are nearly flat, or even concave above, and colourless. They are presumed to feed on the sea-weed growing around them, or on animalcules.—(*Woodward.*) The internal testaceous appendage described above varies considerably in shape, and forms a good character for separating them into groups. In one this appendage is horizontal, covering the posterior half of the elongated aperture. —See Plate 2, figs. 3, 4 and 6, *Crepidula dilatata* and *C. unguiformis.* The shell is depressed horizontally, the apex being sublateral and placed somewhat posteriorly. These form the group of Slipper-shells, CREPIDULINA, of which the genus *Crepidula* is the type and chief representative. Upwards of forty species have been described, the greater number of which are natives of South America, though several are inhabitants of Australia, the West Indies, the Mediterranean, China, and Senegal. They are sedentary on stones and shells in shallow water, and, according to M. Adanson, seem to prefer those places where the sea beats with the greatest violence. They are often found adhering to one another in groups of many successive generations. Another group have the internal testaceous appendage cup-shaped, ascending obliquely, and the shell conic, subspiral, with its apex superior, subcentral. These form the group GALERINA, the "Cup and Saucer Limpets."—See Plate 2, fig. 5, *Crucibulum auriculatum.* In some of the species of this group, as in the genus *Galerus*, this shelly plate is subspiral, lateral, and adherent. One of the species of this genus is British (*Galerus Chinensis*), and is exceedingly diversified in colour, varying from white, hyaline, and yellow, to reddish or dull violet. It varies in form also, sometimes very conical and smooth, at others slightly depressed, and the surface covered with small, arched, elevated scales. Sometimes it is smooth on one side and rough on the other. Several other modifications may be observed, but these must suffice.—See Plate 2, figs. 7 and 8.

FAMILY—CAPULIDÆ.

The family of Bonnet Limpets (*Capulidæ*) are also destitute of an operculum, but the foot is folded on itself, and often secretes a shelly plate or forms a cavity in the body to which it is attached.—See Plate 2, figs. 1 and 2, *Capulus ungaricus.* The shell is conical and cup-shaped, with a sub-spiral apex (in the young regularly spiral); and the interior is simple, without any shelly appendage. The muscular impression is horseshoe-shaped. The egg cases in this family are membranaceous, and attached in a tuft on the front of the foot. The animals are said to feed on the sea-weed that grows around them. They are inhabitants of nearly all the countries of the world, and appear to be possessed of but limited locomotion, being generally observed adhering to stones and other shells; the margins of the aperture becoming modified according to the surface on which they live.

The genus CAPULUS has a conical, striated shell, usually covered with a horny epidermis. The apex is posterior and spirally recurved, and the aperture is round and expanded.—See Plate 2, figs. 3 and 4, *Capulus ungaricus.* The animal is rather sluggish and sedentary, and sometimes secretes an imperfect shelly plate from its foot. In the genus HIPPONYX the foot of the animal secretes a truly testaceous plate, which is adherent by its outer surface to living shells and other marine bodies, and leaves an impression of a horseshoe-shape. The shell is thick, obliquely conical, with a posterior apex.—See Plate 2, figs. 9 and 11, *Hipponyx Cornucopiæ.* The genus AMALTHEA is represented in Plate 2, figs. 7 and 8.

Passing by the three succeeding families, *Valvatidæ*, *Aciculidæ* and *Rissoellidæ*, we come to those species which have the foot round, truncated, or club-shaped.



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elongated aperture, with a long recurved canal in front, and ending posteriorly in a canal ascending the spire. The outer lip is thickened, expanded, and produced into tubular spines or claws, in the young shells appearing in the form of open canals, but in the adult becoming closed and solid. The species are only about ten in number, and all come from the Indian and Chinese seas.

FAMILY—PHORIDÆ (*The Carrier Shells*).

The species of this family have a trochiform shell, with the aperture simple in front. The operculum is large, horny, somewhat annular, triangular in shape, with the nucleus external. We are indebted to Mr. A. Adams for a very interesting account of the animals of these curious shells, whose history at present is so little known. "The *Phori*," he says, "are very numerous in the China and Java seas, living in from fifteen to thirty fathoms water, and generally preferring a bottom composed of the detritus of dead shells and sand mixed with mud. As a curious adaptation of means to answer a certain purpose, the mode of progression of these singular Molluscs is peculiar, and deserving of notice. They crawl like a tortoise, by lifting and throwing forward the shell, with the tentacles stretched out, the proboscis bent down, and the operculum trailing behind. As they invariably inhabit places where the surface is rough and would not admit of a gliding motion, Nature has ordained that they should progress by a succession of small jumps or tumbling evolutions. They are small for the size of the shell, and have much the general appearance of the animal of *Strombus*, like which they appear to walk; but their eyes are sessile. In order to enable them to escape from their enemies, Nature has instructed them to cover their shells with the same materials as those of the banks which they inhabit. Sometimes for this purpose they select sand, often small stones, and more frequently the debris of dead shells belonging to other genera." They are called, in consequence, Mineralogists and Conchologists by collectors.

GENUS PHORUS.—*Phorus* has the trochiform shell concave beneath, with the whirls flat, the spire depressed, the aperture wide, and the umbilicus small. The species appear each to have its own peculiar method of collecting the fragments of shells and stones which cover the ground where it lives, and each cements to the outside of the shell its particular kind of materials. "The adventitious pieces of shell are so disposed as not to curve downwards beyond the edge of the shell, so as to impede the progress of the animal, but are usually placed with their concave sides uppermost."—*Adams*.

In the two preceding families the foot of the animal was compressed, *narrow, and adapted for leaping*. In the two succeeding ones this organ is compressed, *erect, and fin-like*. It is generally furnished with a small flat disk, or sucker, on the hinder edge. The body of the animal is more or less spiral in form, and the creatures appear adapted for floating on the surface of the water. The head is distinct, with an elongate proboscis. The gills are not regularly comb-like, but are tufted.*

FAMILY—PTEROTRACHEIDÆ.

GENUS CARINARIA.—This is the only genus in the family that is provided with a true shell. The species are well known by the name of Glassy Sailors. The shells are hyaline, symmetrical, conical, compressed, with a recurved apex, and a fimbriated dorsal keel, like the keel of a boat. It is exceedingly small for the size of the animal, which is large and translucent, and indeed only covers and protects the nucleus, which is peduncled, and in which are contained the more delicate organs essential to life. They are found in the Mediterranean, and in the Atlantic and Pacific oceans. They are swift in their movements, and dart with great rapidity through the water in a reversed position and by a continuous effort, their body straightened, and their caudal fin undulating from side to side, and acting as a powerful natatory organ. They appear to prefer the twilight, when they may be taken by the trawl in considerable numbers. They are supposed to feed upon *Acalephæ* and small Pteropods.

FAMILY—ATLANTIDÆ.

GENUS ATLANTA.—This is the only genus that has a calcareous shell; it is spiral, compressed, glassy, transparent, and underneath conspicuously keeled. The Atlants are beautiful and sprightly little creatures, twisting their bodies about, and swimming in every direction, at the same time probing every object within their reach by means of their long muzzle-shaped heads.

The genus OXYGYRUS is distinguished by having a cartilaginous shell.

ORDER II.—SCUTIBRANCHIATA.

THIS order of Molluscs is much less numerous in species than the preceding. They are, with few exceptions, as *Proserpina* and *Neritina*, marine, and chiefly littoral in their habits, living upon the sea-weed covering the rocks along the shore. The animals are hermaphrodite and self-impregnating, the sexes not being separate as in the Pectinibranchs.

FAMILY I.—PROSERPINIDÆ.

In this family the shells have the aperture lunate, the lips simple and sharp, and the throat furnished

* The species belonging to this group have by many authors been arranged in a distinct sub-class by themselves, under the name of *Heteropoda* or *Cyclobranchiata*.

with spiral laminæ. The axis is covered with a callous deposit. The species are from the West Indies, and are pretty, smooth, and shining shells of a yellow colour. They are terrestrial shells, and, like the Cyclostomidæ to be afterwards mentioned, they breathe free air. They have no operculum, and their dentition agrees with the other scutibranchiate genera.

FAMILY—NERITIDÆ = NERITINIDÆ, (*The Nerites.*)

This family contains a number of species that are either marine or fluviatile in their habits. The animals are destitute of the membranous fringes and tentacular filaments which garnish the sides of the foot of several of the other genera of this order. They are littoral in their mode of life, being generally found on stones and rocks along the shore, and feeding on the sea-weeds that abound in such situations. They appear to be more active during the night than in the day. The shells are hemispherical in shape and flat beneath. The spire is lateral and very short; the inner lip is flattened, transverse, and the cavity is simple, owing to the absorption of the internal portions of the whirls. The aperture is semiovate, and not pearly within. The operculum is peculiar in its formation, being furnished with a process on the inner side under the nucleus, which forms a kind of hinge with the inner lip of the shell.—See Plate 3, fig. 2.

GENUS NERITA.—The species of this genus are numerous, are all marine, and are chiefly found in warm or tropical seas.—See Plate 3, fig. 1 (*Nerita undulata*).

GENUS NERITINA (= *Neritella*).—The species of this genus are fresh-water Nerites, and are found in almost all parts of the world. Though inhabitants of fresh water for the most part, some of the species are found in brackish, and even salt water. Some of them are to be met with crawling on the stones in shallow water, while others are found at greater depths, half buried in the mud. Some, according to Mr. Adams, are amphibious, clinging to the roots of the Nipah palms and other trees on the margins of rivers, while a few inhabit the foliage of tall trees that overhang ponds and rivulets. Many of the species have the apex of their shells eroded; and Dr. Shuttleworth is of opinion that this is caused by the animal's filing off the tips by its teeth, the marks of the teeth, he says, being left on the surface of the erosion.—See Plate 3, figs. 3, 4 (*Neritina Oweniana* and *N. cariosa*).

GENUS NAVICELLA (= *Catillus*).—This genus has an oblong, depressed, smooth, limpet-like shell, covered with a thin epidermis. The apex is small, reflexed posteriorly; the aperture is as large as the shell, and has a small columellar shelf and elongated lateral muscular scars. The operculum is very small, almost rudimentary, shelly, and is applied to the dorsal surface of the foot.—See Plate 4, fig. 1 (*Terms used in Conchology*). The species, of which nearly twenty have been described, are usually found on the banks of rivers in warm countries, as India, the Mauritius, the Philippines, Moluccas, &c. In general they are met with adhering to floating sticks, and to the petioles and roots of the Nipah palms and other plants that live near rivers. In the island of Bourbon, the *Navicella elliptica* is commonly used to make a soup for the sick.

FAMILY—TURBINIDÆ (*Top-shells*).

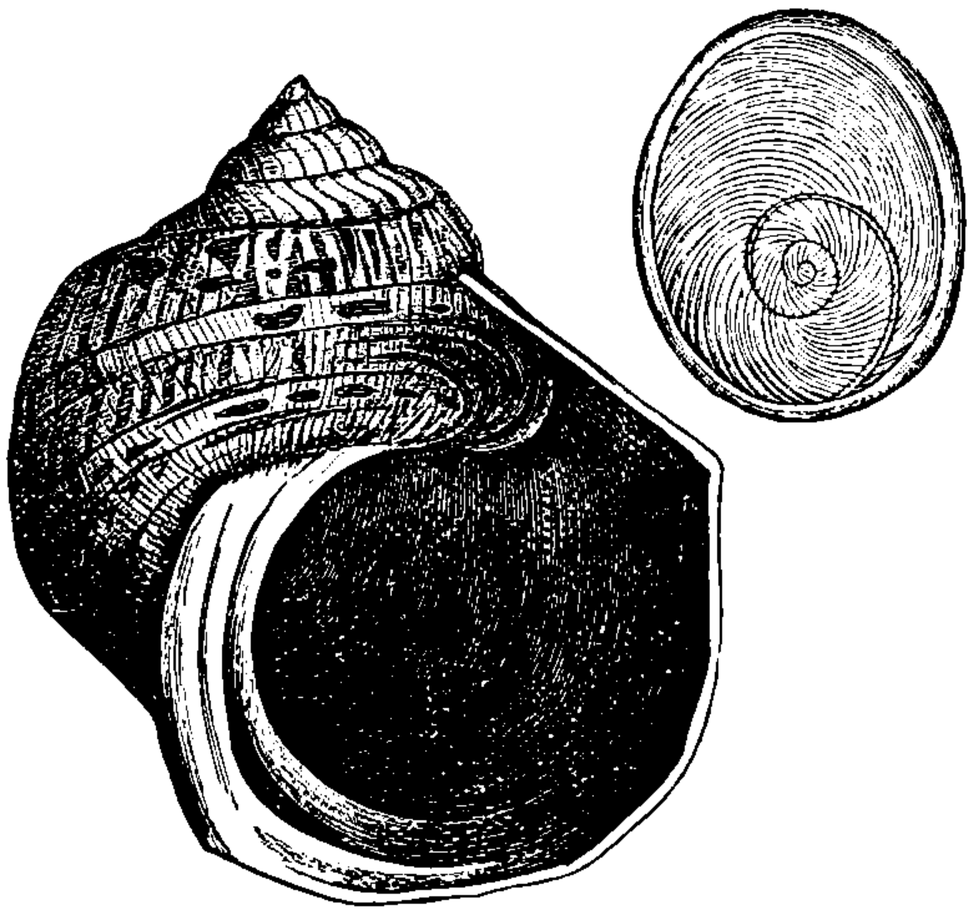
The TOP-SHELLS have a spiral top-shaped shell, the last whirl rounded and ventricose, the aperture subcircular, the inner lip smooth and simple, and the interior brilliantly pearly or nacreous. The operculum is subcircular, horny, with a solid, external, convex, shelly coat. The species are numerous, and diversified in external appearance, and the animals are all marine, feeding upon sea-weeds. The Top-shells may be divided into three large groups, characterized by the form of the body of the animal—affecting of course the shape of the shell—and by the form of the operculum.

GROUP I.—TURBININA (*True Top-shells*).

In this group the body of the animal is cylindrical, and the shell is top-shaped, with a subcircular aperture and operculum.

The genus TURBO may be taken as the type. The shell of Turbo is solid, and covered with a thick epidermis. The convex whirls are often grooved or tuberculated, and the aperture slightly produced in front. The operculum is very solid, externally convex, and covered with granules, and internally horny and few-whirled.—(See fig. annexed, and Plate 3, fig. 3.) The described species are about sixty in number, and are chiefly found in the islands of the Eastern archipelago, Australia, New Zealand, &c. The shells of nearly all are brilliantly pearly when the epidermis has been taken off and the outer layer of shell removed.

Fig. 222.



Turbo olearius and operculum.

THE TURBO OLEARIUS (see fig. annexed) is used by the trade in the manufacture of papier-maché articles and other ornamental goods where mother-of-pearl is employed. The inner layer of this large species is beautifully iridescent, and is imported in considerable

quantities under the name of "Snail mother-of-pearl." De Montfort tells us that he has seen a necklace formed of the nacred part of the *Turbo smaragdus*, much more brilliant and beautiful than any of the finest orient pearls.—(*Johnston.*)

GROUP II.—IMPERATORINA (*Sun-trochuses*).

In this group the body of the animal is subquadrate; the aperture of the shell is angulated outside, brilliantly pearly within; and the operculum is oblong or ovate.

The genus IMPERATOR is the type. The shell of Imperator is trochiform, thick, with a flat or concave base, and keeled or stellated whirls. The species of Imperatorina number between twenty and thirty, and are all from tropical climates.—See Plate 3, fig. 1 (*Imperator gibberulus*).

GROUP III.—PHASIANELLINA (*Pheasant shells*).

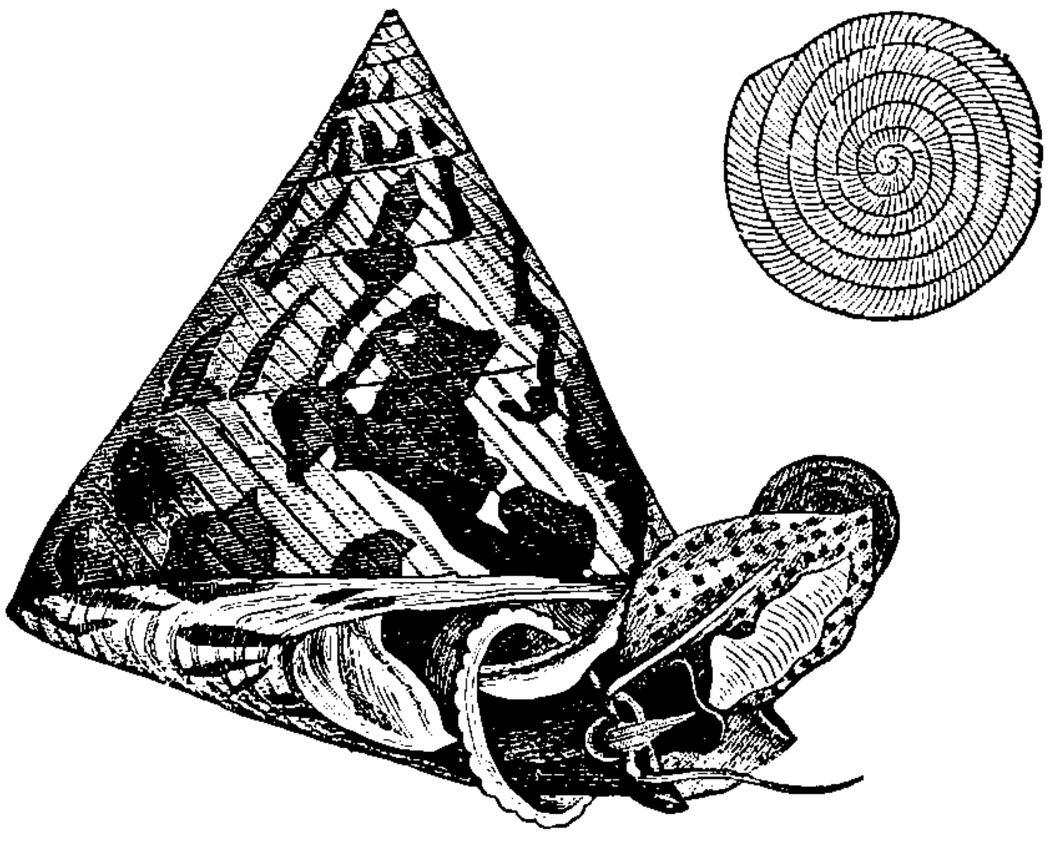
This group is characterized by the body of the animal being ovate, and the aperture of the shell and the operculum partaking of the same form.

GENUS PHASIANELLA (= *Eutropia*).—This genus, so called because of the beautiful pheasant-like disposition of the colours on the shell, is the typical one.—See Plate 3, figs. 4, 5 (*Phasianella Australis* and *operculum*).

FAMILY—TROCHIDÆ (*Hoop-shells*).

The Hoop-shells, with the animal nearly the same as that of the Turbinidæ, have a horny operculum, thin, not covered with a calcareous coat, orbicular, and composed of many gradually enlarging whirls.—(See Plate 3, fig. 2.) The shell is generally pyramidal in shape, with a nearly flat base, and the last whirl more or less angulated at the circumference. The aperture is contracted and of a quadrangular shape, pearly inside, and with a thin outer lip. The columella is twisted, slightly truncated.—(See Plate 3, fig. 1, 3, 4.)

Fig. 223.



Trochus niloticus and operculum.

The genus TROCHUS is the typical one of the family; and the Nilotic Trochus, *Trochus niloticus*, perhaps the largest, and one of the handsomest species of the whole family, will illustrate the genus (see fig. annexed).

GENUS TROCHISCUS.—This genus is remarkable, and only distinguished as belonging to this family by its operculum. It has a widely umbilicated shell, with an obtuse spire, a simple columella, and smooth whirls, covered with an epidermis.

T. NORRISII, the only species, is extremely like a species of Turbo, and might be considered as belonging to that genus, were it not for its operculum. This is horny, of many gradually enlarging whirls, and is remarkable for having the outer edge of each spiral volution free and membranous, with the margin curled.

GENUS DELPHINULA (= *Angarus*).—This genus has a depressed shell, orbicular in form, and umbilicated. The whirls are few in number, angulated, rugose, or spiny; the aperture is round, pearly within, and the peristome is continuous. The species are of tolerable size, about twenty in number, and are distributed through the warm seas of India, the Philippines, China, Australia, and the Red Sea.

GENUS ELENCHUS.—This genus has a turreted, smooth, and polished shell, with rounded whirls and no umbilicus. The aperture is ovate, and brightly pearly within, and the pillar lip has a single more or less produced tooth in front. The whole shell, when the outer layer has been removed, is of a fine pearly iridescent hue; and several of the species, which are all Australian in their geographical distribution, are used by the natives about Bass' Straits and Flinder's Island, when strung together, as bracelets and necklaces.

FAMILY—SCISSURELLIDÆ (*Little Slit-shells*).

The Little Slit-shells, though containing only one genus, SCISSURELLA, and eleven species of very small and insignificant-looking shells, has many representatives—in a fossil state—of a former period, but much larger in size. The shell is spiral, of very small size, depressed, transparent, and widely umbilicated; the whirls are keeled, the aperture rounded, and the outer lip has a slit or narrow fissure in the margin; the operculum is thin, horny, and circular. The species are natives of the northern seas, being found in Norway, off the Orkneys in seven fathoms, and in deep water to the east of the Shetland isles. They are also found in the Mediterranean.

FAMILY—HALIOTIDÆ (*Ear-shells*).

The Ear-shells are much larger, and are a great deal more numerous, than the preceding family. The shell is ear-shaped, with a very large and finely nacred aperture; and the outer lip is perforated with a series of holes over the mantle fissure. There is no operculum.

GENUS HALIOTIS, or *Ear-shell*.—This genus has has a depressly ovate shell with a small flat spire, a very wide and in many cases a highly-beautiful and iridescent aperture. The left side is characterized by a spiral ridge with a series of round holes in front, which become gradually filled up behind as new ones are

forated by a hole greatly resembling that of an ordinary key-hole—hence the name of "Key-hole Limpets."—See fig. 225.

FAMILY—DENTALIIDÆ (*Tooth-shells*).

The Tooth-shells are very different in external appearance from the *Fissurellidæ;* they are elongately conical, tubular, curved, open at each end, and attenuated posteriorly. Notwithstanding this apparent difference of structure, the most usual way of regarding the Tooth-shells "has been to consider them as elongated Fissurellæ, with the eyes and tentacles wanting, and the foot rudimentary and tubular; the perforated small end of the shell corresponding with the orifice of the vertex of Fissurella and subserving the same purpose." —(*Adams*). The body of the animal is formed like the shell, tapering gradually to the posterior extremity, and is attached to the shell near its posterior orifice. The stomach is furnished with a strong gizzard, and they are decidedly carnivorous animals. They feed upon Foraminifera and small bivalve shells, and are usually found buried in the sand, or sandy mud, in from ten to one hundred fathoms. About thirty species are described, and they are found in India and the West Indies, in the Mediterranean, on the coasts of Norway, and the shores of Great Britain.

GENUS DENTALIUM.—This genus has a tubular, tapering, and curved shell, with a smooth or longitudinally striated surface, and a circular and entire aperture.

GENUS ENTALIS.—This genus is distinguished by merely having the circular aperture longitudinally fissured on the dorsal or hinder margin.

FAMILY—TECTURIDÆ (*False Limpets*).

In external appearance, the shells of this family bear so close a resemblance to the rock limpets (*Patellidæ*) that it is exceedingly difficult to distinguish them. Of almost all the genera of Mollusca that present a similarity of appearance, these two are probably, says Dr. Gray, the most remarkable examples, "on account of the extreme dissimilarity of their animals, which are referable to two very different orders; while the shells are so perfectly alike, that, after a long-continued study of numerous species of each genus, I cannot find any character by which they can be distinguished with any degree of certainty. The agreement in the internal structure of their shells is equally complete; yet the animal of Patella has the branchiæ in the form of a series of small plates disposed in a circle round the inner edge of the mantle, while that of Lottia (*Tectura*) has a triangular pectinated gill, seated in a proper cavity formed over the back of the neck, within the mantle. This difference in the respiratory organs of animals inhabiting shells so strikingly similar," continues Dr. Gray, "is the more anomalous, inasmuch as those organs commonly exercise great influence on the general form of shells—a circumstance readily accounted for when we reflect that a principal object of the shell is to afford protection to those delicate and highly-important parts." The *Tecturidæ* have a large foot, but no operculum. The shells are depressed, conical, or cap-shaped; the aperture is large, and generally of a beautifully porcellanous appearance internally. The species are probably numerous; they are littoral in their habits, and are usually found between tide marks feeding on the sea-weed. "Their locomotion is very limited, and in their geographical distribution they are found both in temperate and tropical countries." —(*Adams.*)

FAMILY—PATELLIDÆ (*Rock Limpets*).

We have already briefly described the difference in the structure of the respiratory organs between the Rock limpets and the False limpets, and mentioned the striking resemblance in the shells of the two families. The Rock limpets have a short muzzle, subulate tentaeles, and fringes on the margin of the mantle. The shell is simple, conical, with a sub-central apex and a wide aperture, smooth within, but not of so rich a porcellanous appearance as in the False limpets. The species of *Patellidæ* are very numerous, upwards of one hundred having been described. They are strictly littoral in their habits, and are world-wide in their distribution.

GENUS PATELLA.—By far the greater number of species belonging to the family are contained in this genus. These shells are usually found fixed upon rocks on the shore; hence their name of Rock limpets. Some of the species on the coasts of South America and California attain a large size. Mr. Cuming informs the writer, that the species known as the *Patella mexicana* is often used by the natives as a wash-hand basin!

The *Patellæ* possess the power, in a certain degree, of excavating holes in the rocks and other bodies upon which they live.

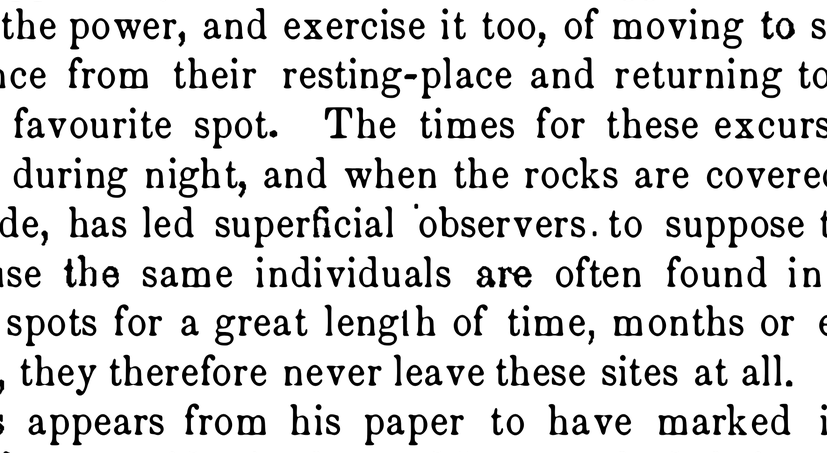
THE SPOON LIMPET OF THE CAPE (*Patella cochlear*) lives almost exclusively attached to a large species of the same genus, and on the surface of this it forms a flat disk, exactly the size of its mouth. To form this disk and increase its size, it has been observed to absorb any coralline or other similar substance with which the larger shells are abundantly covered. Some of the species of the preceding family of False limpets possess the same power; as for instance the *Tectura parasitica*, which obtains its specific name from its habit of living upon other shells, and upon the surface of which it forms a hollow answering to the size and shape of the rim of its shell. But in no species has this been so well observed as in the Common limpet of our own coasts.

THE PATELLA VULGATA is in the habit of hollowing out a space in the site upon which it has settled, and which varies in depth according to the softness or hardness of the rock upon which it has taken up its abode. In the soft calcareous rocks of the Isle of Thanet, the pits so made are half an inch deep; but upon hard limestones the depressions are much shallower, and it is in the case of adults only that we find the rock worn down, the margin of the shell often accommodating itself to the inequalities of the surrounding surface. The limpets adhere very firmly to the rocks upon which they are located, and it is often very difficult to remove them. Reaumur ascertained that a weight of twenty-eight or thirty pounds was required to overcome their

adhesion, "They adhere very firmly by atmospheric pressure (fifteen pounds per square inch), and the difficulty of detaching them is increased by the form of the shell."—(*Woodward.*) Dr. Johnston, on the strength of Reaumur's experiments upon this subject, affirms that this cohesion entirely depends on a glue, or kind of paste, which, though invisible, produces a very considerable effect. Reaumur cut the animal from top to bottom in two halves, as it stood fixed perpendicularly upon the rock; and he made other deep incisions in a horizontal direction, destroying in this manner all the muscular power of its base, and all supposable vacuity between it and the stone: but the adhesion continued as firm as before the experiment. Even the death of the animal does not destroy its cohesion. There seems to be some doubt as to how far these animals are stationary on the rocks, or whether they have the power of moving to some distance and returning to their roost. Mr. Clark, in his "Mollusca," says, "How some Patellæ live is a mystery;" they are often fixed for months, perhaps years, on rocks, at altitudes where they can rarely, if at all, be aspersed by the sea, and are debarred access to marine vegetables; their recorded descents from high levels, and periodical exits from and returns to the identical hollows they have made, after feeding on algæ, have almost a fabulous complexion; zones of sand fifty yards wide often intervene between them and such food, and their exceeding slow locomotion is opposed to such manœuvres. Mr. Lukis of Guernsey, however, in a paper published in *Loudon's Magazine*, has apparently shown that these sluggish creatures have the power, and exercise it too, of moving to some distance from their resting-place and returning to the same favourite spot. The times for these excursions being during night, and when the rocks are covered by the tide, has led superficial observers to suppose that, because the same individuals are often found in the same spots for a great length of time, months or even years, they therefore never leave these sites at all. Mr. Lukis appears from his paper to have marked individuals, to avoid mistake, and has watched their roamings and followed the tracks left by them for several yards. These tracks are very peculiar, and when once seen are not to be mistaken.

This Common limpet, of which we have spoken so much (see fig. annexed), is much used as an article of

Fig. 226.



Patella vulgata and animal.

food. In the north of Ireland, Mr. Patterson gives a very interesting account of the use made by the poor of this, to them, valuable article of subsistence. Many tons weight are annually collected near the town of Larne alone. In Guernsey, Mr. Lukis tells us, great quantities are daily consumed; "scarcely a cottage on the coast is seen, where a heap of empty shells does not form a prominent feature near the door." *Patella vulgata*, he adds in a note, "seems to have been used by the inhabitants of these islands from the earliest times, as appears from masses of its shells now found in ground which has lain waste and unturned for centuries."

This shell is much used by fishermen as bait. In the Berwickshire Club Transactions, Dr. Johnston informs us that, on the coast near Berwick, there were for many years nearly twelve million collected yearly for that purpose; but they have decreased in number so much of late that they no longer repay the trouble of gathering them.

FAMILY—CHITONIDÆ (*Sea Wood-lice*).

In this family the shell consists of a series of eight transverse valves situated on the middle of the animal's back, each valve being inserted into the mantle, and having a deep lateral notch on each side. The border of the mantle into which these valves are inserted, is of a coriaceous texture, and is either smooth and bare, or covered with minute scales, spines, or hairs. There are several anatomical peculiarities possessed by the animals of this family, of such a nature as to induce some naturalists to remove them from the Mollusca altogether. "A Chiton," says Dr. Williams, "has a carapace like an isopod crustacean; a dorsal vessel like an annelid; bilateral, symmetrical, reproductive viscera like an acephalous mollusc; a head and foot like a patelloid gasteropod; a posterior anus like the *Fissurellidæ*, and branchiæ like those of the brachyurous Crustacea! Such manifold affinities at once unite and sever this odd group from several most dissimilar classes." As Cuvier, however, has shown, their gills are like those of the *Patellidæ*, their foot is that of a true gasteropod, and in their lingual dentition they resemble the *Ctenobranchiata*. The hinder valve of the shell was at one time considered by Dr. Gray as homologous with the shell of the *Patellidæ*, the other valves being only so many portions successively detached from it. The species of *Chitonidæ* are very numerous, more than two hundred having been described. They are world-wide in their distribution, occurring in all climates. Though by far the greater number are found on rocks at low water, they are occasionally taken by the dredge in from ten to twenty-five fathoms water; and some of our small British species range as low as one hundred fathoms. "In the tropics," says Mr. A. Adams, "the Chitons appear to be more vivacious than those found farther north. If turned over on their backs, they will gradually bend their calcareous jointed bodies in every direction, contracting and dilating their ventral disk until they assume their natural position. Their progressive motion is scarcely perceptible, however; the principal object, apparently being again to fix themselves to the surface of the rocks which Nature has given them to inhabit. Their food consists of fuci and other algæ with which the rocks and stones are covered." In the West Indies there are several species which grow

to a considerable size, as the *Chiton squamosus*, &c. (see fig. annexed); these are eagerly devoured by the negroes, who call them beef. The thick fleshy foot is cut away from the living animal, and swallowed raw, while the viscera are rejected. The Chitons deposit their eggs, closely united in clusters, on stones, each egg being inclosed in a thick, vesicular, folded envelope. The young, when first hatched, have no shell; that covering not being developed until some time after. The back of the newly hatched creature, however, is marked with seven cross furrows, and between them, the first rudiments of the shell make their appearance in the form of close granulations. As the animal increases in size, the furrows become more distinctly separated, and the first shell is then seen in the form of seven narrow bands with irregular margins. In a family containing upwards of two hundred species, it may easily be imagined the varieties in form, &c., must be considerable. The Chitons accordingly have been divided into no fewer than twenty-three different genera, and in the most recent arrangement of these, Dr. Gray has selected, as characters, the forms of the plates of insertion of the various valves. We must refer to his "Systematic Arrangement" for the details of the various genera. We will content ourselves in this place with merely stating, that they may all be arranged in two groups or sub-families depending upon the structure of the mantle.

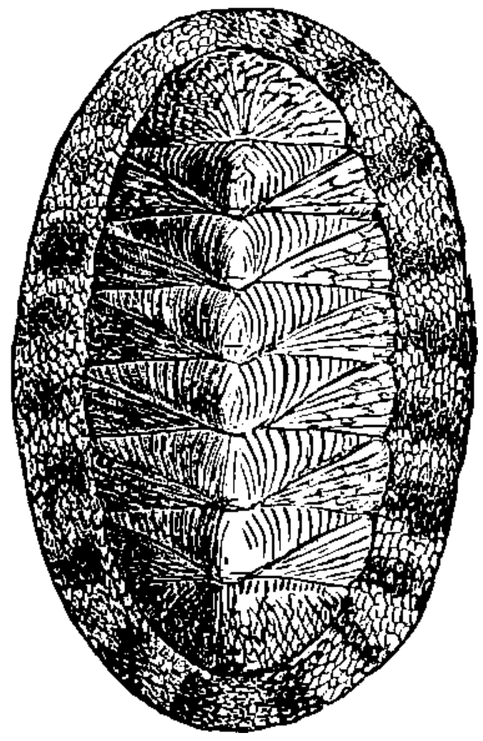
The true Chitons, the *Chitoninæ* of Adams, have the mantle simple, and without pores on it furnished with tufts of bristles or spines. The *Cryptoplacinæ* of Adams, the second group, have the mantle furnished with pores which are beset with subulate, flexible bristles, or with tufts of bristle-like calcareous spines.

GROUP I.—CHITONINÆ.

This group is by far the most numerous, and the edge of the mantle is variously covered by scales or calcareous thick bristles, like spines; or it is smooth and naked. In the genus CHITON, the mantle margin is covered with regularly disposed, imbricate, smooth, polished scales.—(See fig. annexed of *Chiton squamosus*).

In the genus ACANTHOPLEURA, the mantle margin is covered with uniform shelly spines or elongated scales; and in the genus TONICIA, the mantle margin is naked, smooth, and covered with a hard shining skin beneath. In all these the exposed part of the valves, or the part not covered by the mantle of the animal, is broad and band-like; but in the curious genus *Cryptochiton*, the

Fig. 227.



Chiton squamosus.

valves are entirely covered by the mantle, and this is set all over with numerous close, uniform tufts of calcareons spicula, which in a dry state resemble at first sight particles of saw-dust.

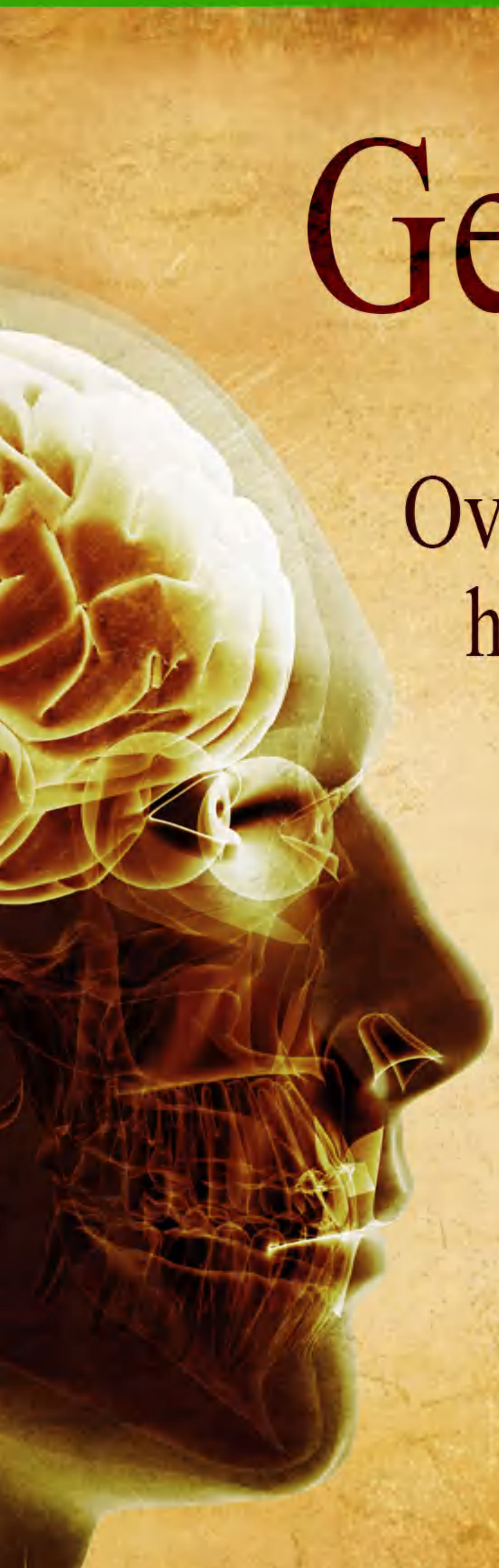
GROUP II.—CRYPTOPLACINÆ.

This group contains fewer species, and some of these present a good deal of similarity to annulose animals, from the smallness of the exposed portion of the shell, and the tufts of spines along the edge of the mantle. In *Plaxiphora* the pores of the mantle are furnished with subulate, flexible bristles. In *Acanthochetes* the pores are furnished with tufts of bristle-like calcareous spines, which are generally large and often iridescent. The exposed part of the valves is moderately broad. In *Chitonellus*, the mantle is covered with short, crowded, calcareous spines, and the pores on the sides are small, with similar spines; but the exposed portion of the valves is rather small, and the body of the animal is elongate, subcylindrical, and the back is convex. It is this peculiar form of the animal that causes them to resemble so much some of the Annelids.

SUB-CLASS II.—HETEROBRANCHIATA.

IN this sub-class of Molluscs, the gills are not, as in the former sub-class (see p. 186), inclosed in a special cavity, but are more or less exposed on the back, or at the sides towards the hind part of the body. Their respiration, however, is aquatic as in the ctenobranchiate orders; and the animals are hermaphrodite, the male and female organs being found in the same individual.

The number of species contained in this sub-class is very considerable, though certainly inferior to those of the preceding; and many of the genera have no external covering or shell in the adult state. The young or larvæ, however, are in all of them provided with a spiral shell, the aperture of which is closed by an operculum. Their head is furnished with two lobes or fins, fringed at the margin with vibratile cilia, which serve as organs of locomotion, but which disappear as they reach the mature state.



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side lobes of the foot are dilated, and free for swimming (see Plate 4, fig. 1—*Aplysia punctata*); and the shell is subcartilaginous and covered by the mantle. It is oblong, convex, flexible, and translucent, with the apex acute and slightly incurved. The species of Sea-hares, or Aplysiæ, are rather numerous, upwards of forty having been described; they are found inhabiting the seas of the West Indies, the Mauritius, China, the Mediterranean, Norway, and Great Britain. They are chiefly vegetable feeders, living principally on sea-weed. They are said to devour animal substances also; but Cuvier, Pessonel, and others have sufficiently proved that marine plants are their ordinary food. Dr. Johnston tells us that he kept a specimen of the *Aplysia mustelina* for nearly three months in a state of confinement, during which it was fed on sea-weed alone, and that it ate these greedily, showing a certain degree of preference for the dulse (*Fucus palmatus*). The Aplysia is of quick growth, the Mediterranean species being said to attain its full size of about four inches in one or two months. When irritated these animals pour out an abundance of a fine purple-coloured fluid, so much so that a single individual can colour the water for some yards around it. "This fluid is secreted in a gland of a triangular figure, situated under the base of the fleshy coverlid of the branchiæ, and oozes out from all the free surface of this coverlid."—(*Johnston.*) Cuvier says that, in drying, the secretion assumes the beautiful deep hue of the sweet Scabious (*Scabiosa atro-purpurea*), and remains unaltered by long exposure to the air. The smell is faint; there is nothing peculiar to the taste, nor has it any irritating quality, for it may be applied a long time to the skin with perfect impunity. Besides this innocuous purple fluid, the Aplysiæ occasionally discharge, though only in small quantities, a whitish liquid of an acrid nature, which is secreted by a gland composed of little round hyaline grains, and emitted through a circular aperture opening externally a little behind the aperture of the oviduct. On this account, and from their grotesque forms, in olden times they were viewed with fear and superstitious dread; they were considered, by the Romans especially, as possessing a deadly poison. "It was held, or was supposed to hold," says Dr. Johnston, "such a noxious sympathy with man, that the 'only aspect thereof' was poisonous to some; to women great with child the sight produced untimely labour, and hence it was employed to discover concealed pregnancy; the touch of it was fatal, some say, to the man who handled, others to the mollusc, which latter doubtless would be the more probable result; while others affirmed only that the hair fell from the parts with which it came in contact; and all agreed that the odious fœtor which issued from the body occasioned sickness and overturnings of the stomach. That such a creature should afford a potent poison was a reasonable inference; and it certainly formed one ingredient of some of the poisonous draughts so much resorted to in the corrupt days of Rome. Locusta used it to destroy such as were inimical to Nero; it entered into the fatal potion which she prepared for the tyrant himself, and which he had not resolution to swallow; and Domitian was accused of having given it to his brother Titus. The operation of the poison was not immediate; but the victim lived as many days as the hare had lived subsequent to its removal from the sea. What proportion of truth there is in this account it is not easy to decide. I am not prepared to reject the whole, as some modern authors have done, who believe that the singular conformation of the Aplysia, and the power it possesses of discharging at pleasure large quantities of a fluid of the richest purple colour, have given rise to the whole tale." Our British species appear to be perfectly inoffensive and quite harmless; but there may be other species in warmer climates, which, at particular times, may possess a fluid of deleterious quality. Bohadtch, an author of some repute, mentions that one species which abounds in the Bay of Naples, (the *Aplysia leporina*), when removed from the sea and placed in a vessel, exuded a large quantity of fluid which exhaled a sweetish, sickening, peculiar smell. When placed on a plate for the purpose of more narrowly examining its structure, the room, he says, was filled with a most fetid, nauseous odour, which he could scarce endure without going out repeatedly to breathe a purer air. His hands and cheeks swelled after handling the creature for any length of time, and when he applied some of the liquid to the chin, the hairs fell from the part touched. In a large species which occurs at St. Iago, in the Cape de Verd Islands, Mr. Darwin informs us that, besides emitting a purple fluid which stained the water for the space of a foot around, it discharged an acrid secretion from all over its body, which caused a sharp, stinging sensation similar to that produced by the Physalia or Portuguese man-of-war. *Aplysia depilans* is the most common of the species in our seas, and obtains its specific name from its supposed depilatory powers.

FAMILY—UMBRELLIDÆ (*Umbrella Shells.*)

The UMBRELLAS have a regularly calcareous, external shell, but very disproportionate to the size of the animal. The foot is very large, thick, tubercular on its sides; it is flat beneath and deeply notched in front. In this fissure is placed the mouth, which is furnished with a retractile proboscis. The shell is limpet-like, orbicular, flattened, with a slightly raised, conical, subcentral apex. Externally it is marked by concentric lines of growth, and internally it has a central coloured and striated disk.—See Plate 5, figs. 1, 2 (*Umbrella umbellata* and animal).

ORDER II.—NUDIBRANCHIATA (= GYMNOBRANCHIATA.)

THE Nudibranch or Naked-gilled Molluscs, or "Sea Slugs," as they are frequently called, are all natives of the sea. They have no shell in their adult state, and carry their gills, which are of various forms, on some part of the back, exposed to the direct influence of the water in which they live. They possess an elongate

foot which is adapted for walking, and accordingly they are generally found crawling slowly along, either on the rocks near low water mark, on the firm rocky bottom at no great depth, or clinging to sea-weeds out at sea. They do not appear to have the power of swimming through the water; but they are frequently to be seen floating on the surface in an inverted position. The species are numerous, and are found in all parts of the world. The British species have been studied with greater care than the exotic, and no fewer than one hundred have been described by Messrs. Alder and Hancock as inhabiting our own coasts. They exhibit a very great variety of form, a high state of organization, and an astonishing variety of lively and beautiful colours. The gills being contractile into cavities on the surface of the body, they present in the living state extremely interesting objects of observation, as they keep extruding them and withdrawing them at frequent intervals. In some they present the appearance of flowers; in others they are arborescent or tree-like, or feathered like an ostrich plume; and in others they are disposed in rows of papillary tubercles on the sides of the body. The greater number of these Sea-slugs are carnivorous, and appear to be very voracious. They feed chiefly upon zoophytes and sponges; some adding to their bill of fare the gelatinous Porpitæ and Velellæ that are found floating on the surface of the ocean; while others again have been seen devouring other Nudibranchs, and even making a repast upon their own spawn. Messrs. Alder and Hancock tell us that large individuals of the *Eolis coronata* feed on their own species; and should a small or weak specimen be within their reach, they seize hold of it by any part which may be nearest to them. "The tail, however, is generally first seized, and fierce and determined is the onset. The devourer raises and shakes his papillæ in the manner that the porcupine shakes its quills when irritated, and then, laying back the dorsal tentacles and curling up the oval ones, fixes the protruded mouth and jaws upon his prey, when, with a convulsive shrinking up of the body, morsel after morsel is appropriated. In this manner it is not uncommon to see an individual entirely devour another, half its own size." These animals deposit their ova in coils, long ribands, or spiral chains. The eggs are very numerous. Mr. Darwin notices particularly a species found on the shore of the Falkland Islands. The ova were contained, from two to five in number, in a spherical little case; and these were arranged two deep in transverse rows, forming a riband about twenty inches in length. By computation of the number of rows, and the number of little cases in each row, he reckoned that in that riband there could not be fewer than six hundred thousand eggs! Upon escaping from the ovum the larva, or young, is extremely minute, and is described as resembling a rotiferous animalcule more than a mollusc. It is inclosed in a transparent, calcareous, nautiloid shell, with an operculum. In lieu of the tentacles which are possessed by the adult, this young creature has two veils, shaped somewhat like ears, and which give it the power of moving rapidly through the water. At a later period these veils disappear; the foot becomes enlarged and the shell falls off; the creature begins to crawl like a Gasteropod, and the gills make their appearance. When the veils fall off, and the tentacles and gills are fully evolved, the metamorphosis is complete, and the animal assumes its mature state of existence. The various genera which compose this order may be all arranged in two large groups, according to the situation of the gills or branchiæ.

GROUP I.—PYGOBRANCHIA (*Gray*) = ANTHOBRANCHIATA (*Adams*).

In this group the gills are plumose or branched, and are placed in a circle or semicircle round the vent, on the middle of the hinder part of the back. The skin is tough and coriaceous, of a spongy or cellular structure, and stiffened with numerous imbedded spicula more or less definitely arranged. In some of the families in this group, as in *Onchidoridæ* and *Doridæ*, the body of the animal is of a convex form, the mantle large, reaching to the edge of the foot, and destitute of any appendages. The dorsal tentacles are two in number, retractile; and the mouth tentacles are also two, when present, but are sometimes wanting. These two families are represented on Plate 5 by several species. In all the other families of this group the body of the animal is more or less compressed, the mantle small, exposing the head and foot, or sometimes even obsolete, and often furnished on the margin with beard-like filaments. Such are the families *Goniodoridæ*, *Polyceratidæ*, and *Ceratosomidæ*, as represented in Plates 5 and 6 by several species.

GROUP II.—AIOLOBRANCHIATA.

The second large group of Nudibranchs are all distinguished from the preceding group, by not having the gills arranged round the vent, but on the contrary placed usually in rows along the sides of the body. The exact position and form of these organs vary, however, a good deal. In some (the *Inferobranchia* of Gray) they are placed on the under side of the expanded mouth, and are lamellar. Such are the families *Phyllidiidæ* and *Diphyllidiidæ*. In another series of this group (the *Polybranchia* of Gray) the gills are placed on the upper surface of the mantle, and are either lamellar or plumose. Such are the families *Tritoniidæ*, *Scyllæidæ*, and *Tethyidæ*.

GENUS TRITONIA.—The Tritonias are rather numerous in species, and many of them are found upon corallines or sea-weed, and under stones, in shallow water, in which places they feed upon the Zoophytes that live in their neighbourhood.—See Plate 6, fig. 1 (*Tritonia Hombergii*).

THE TRITONIA ARBORESCENS is remarkable for the sound it produces. When observed in a glass vessel in a room, the sounds are audible at the distance of twelve feet, and resemble very much the clink of a steel wire on the side of the jar; only one stroke is given at a time, and this is repeated at intervals of a minute or two. "The sounds obviously proceed from the mouth of the animal; and at the instant of the stroke we observed the lips suddenly separate, as if to allow the water to rush into a small vacuum formed within."—(*Grant.*)

GENUS SCYLLÆA.—The *Scyllæas* are oceanic, and are found on floating sea-weed, the slender fronds of which they seize by their furrowed or channeled foot, being by this enabled to obtain a firmer grasp and greater security.—See Plate 6, fig. 1 (*Scyllæa pelagica*).

GENUS TETHYS.—The *Tethyses* are oceanic, attaching themselves, like the Scyllæas, to floating sea-weed. Their broadly expanded head-veil, fringed with cirrhi, gives them a peculiar look. One of them is mentioned by Dr. Johnston, on the authority of Rapp, to be remarkable, not more for its singular beauty than by its odour, which is compared to that of roses.—See Plate 6, fig. 1 (*Tethys leporina*).

In a third series of this group (the *Cerabranchia* of Gray) the gills, which are placed, like the last, on the upper surface of the mantle, are fusiform, papillary, simple, or branched. Such are the families *Dendronotidæ*, *Proctonotidæ*, *Hervidæ*, *Dotonidæ*, *Glaucidæ*, *Eolididæ*, *Fionidæ*, and *Hermæidæ*, examples of some of which will be seen in Plate 6.

GENUS GLAUCUS.—The *Glaucuses* have slender, cylindrical gills placed in tufts, proceeding symmetrically from the sides of the body, and supported on broad flattened footstalks. The animals are oceanic in their habits, are predaceous, and are generally of a blue colour.—See Plate 6, fig. 1 (*Glaucus Atlanticus*). Dr. George Bennett informs us, in his "Wanderings," that they feed greedily on the gelatinous Acalephs, Velellæ, and Porpitæ, animals always of a blue colour, and which are in consequence supposed to impart a similar colour to their captors. Dr. Johnston gives a good description of the *Glaucus hexapterygius*, a species from the Mediterranean. "The body," he says, "glows with a fine cerulean blue colour, which deepens in hue towards the ends of the fringes of its ptero-branchiæ; the centre of the back is of a pearly whiteness, bordered with a line of deep blue; and the sides are adorned with an interrupted series of fan-like laciniated gills, by aid of which it swims reversed at the surface of the Mediterranean Sea in numerous swarms."

FAMILY—EOLIDIDÆ.

The *Eolids* are generally elegant and beautifully coloured creatures, and are active, constantly moving their tentacles and extending and contracting their papillæ.—(See Plate 6, figs. 1-4.) They are often to be met with swimming on the surface in an inverted position; but, generally speaking, they frequent rocks at low water. Their chief food consists of Zoophytes, but Alder and Hancock inform us that they have seen the *Flabellina punctata* devour other Nudibranchs, and even make a repast upon its own spawn. The spawn of *Eolis papillosa* "forms an elegant spiral chain of a milk colour, and several inches long, twisted upon itself and constricted at regular intervals, so as to resemble a necklace made of bugles."—(*Johnston.*)

ORDER III.—PNEUMOBRANCHIATA (= PULMONATA OR PULMONIFERA).

THE air-breathing Gasteropods, containing the "Slugs" and "Snails," are for the most part natives either of the land or fresh water, a few only being found in salt marshes or places near the sea. They are, with very few exceptions, provided with a shell, both in their young or larval state, and when fully grown. They have no gills, but breathe the atmosphere or external air by means of a lung which is in the form of an air sac or cavity placed on the front of the back, and lined by a network of vessels. The air is admitted into this cavity by an orifice in the side of the animal, which is small and valve-like, and can be opened and shut at pleasure. The young of the air-breathing Molluscs undergo no metamorphosis, but when first hatched are shaped like the parent, and are not furnished with cephalic fins. They are hermaphrodite animals, the sexes being united in each individual. They are usually active and well organized, having a distinct head furnished with teeth, jaws, well-developed eyes, and tentacles. They have a broad foot upon which they creep, and the great majority of them possess a large, spiral shell. In this latter respect, however, they differ considerably—some genera of slugs having only small, concealed shells, flat, and partially membranous; other slugs having the shells rudimentary and granular, while a few have none at all. The tongue, or lingual membrane, is short and very broad, often nearly as wide as long; and the teeth are very numerous, similar, with broad bases, and invariably arranged in transverse rows, giving the appearance of a tesselated pavement. The greater preportion of these animals are herbivorous, living upon land plants and vegetables; and in these the teeth are all similar in form, with broad bases and dentate crowns. Some, however, are carnivorous, and in these the teeth are slender, and more or less pointed or barbed at the extremity. "The mode in which the tongue is used may be seen by placing a Lymnea or Planorbis in a glass of water, inside which the green conferva has begun to grow; they will be observed incessantly cleaning off this film. The upper lip, with its mandible, is raised; the lower lip, which is horse-shoe shaped, expands, the tongue is protruded and applied to the surface for an instant, and then withdrawn; its teeth glitter like glass paper, and in Lymnea it is so flexible that frequently it will catch against projecting points and be drawn out of shape slightly as it vibrates over the surface."—(*Woodward.*) The shell of the *Pulmonata* is not secreted on the exterior of the mantle, as in other Gasteropods (see p. 185). "Gegenbaur draws attention to the fact that the first rudiment of the shell in *Limax*, *Clausilia*, and probably *Helix*, is not secreted on the exterior of the mantle, as in other *Gasteropoda*, but is deposited, in the form of calcareous granules, within its substance."—(*Huxley.*) The "Slugs" and "Snails" are universally distributed over the globe, but are of a large size, and more numerous individually in warm, moist, intertropical countries, and are especially abundant in large, well wooded

semilunar, or roundish. The margins are distinct, and the peristome is thickened or reflected.

The species of True Snails are very numerous; and as they present a great many variations of form and general appearance, they have been divided into many genera. — See Plates 6 and 7 (several genera and species). Including these, the number of described species exceeds twelve hundred, while some hundreds more have not yet been characterized. They are world-wide in their distribution, being found in all parts of the globe, in Europe, Asia, Africa, both Americas, and Australia. To the north they are found ranging as far as the limit of trees, and to the south they extend to Terra-del-Fuego. They are most abundant, however, in warm countries and moist situations. "M. d'Orbigny observed six species at elevations exceeding eleven thousand feet in South America; and Layard found *H. gardeneri* at the height of eight thousand feet in Ceylon."—(*Woodward.*) They are most active by night, and that is their chief season for seeking their food. This consists of vegetable substances, and, like the Slugs already mentioned, they frequently commit great devastations in our fields and gardens. The most destructive species, perhaps, in this country is the common garden snail, *Helix aspersa;* while in the wine countries of France, the Roman snail, *H. pomatia*, is very destructive to the vine, especially when it is just putting forth its tender buds and first leaves. Snails are truly hermaphrodite, each individual uniting both sexes in itself; they are not self-impregnating, however, the union of two individuals being necessary for the propagation of the species. On the right side of the neck, contained within a small cavity, we find several small bodies of a horny crystalline substance called darts. They are shaped somewhat like a bayonet; and during the love season, according to popular accounts of the snail and its doings, the animals are said to shoot these darts at each other from their quiver, when the two individuals are about two inches apart. "The existence of the darts," says Dr. Johnston, "in some few species of Helix is certain; while the power of the snail to throw them from its reservoir is imaginary!" Their eggs are pretty numerous, and in general are spherical or oval. The outer coat is opaque and hard, consisting of carbonate of lime, the particles of which are gradually and successively deposited over the whole of its inner surface. The Roman snail, *H. pomatia*, deposits only about fifteen eggs, while our common species lay from thirty to fifty. Generally they are deposited one by one, but placed in little heaps, and their colour is usually bluish-white or pure milk-white. Snails are long-lived, and have a wonderful degree of tenacity of life. Many interesting instances are recorded of the resuscitation of snails, after having undergone a long suspension of their vital powers. One of the most wonderful examples of this recovery from a "long slumber" has been related by the writer of this article in the *Annals and Magazine of Natural History* for 1850. The individual alluded to was a species of the snail of the desert, *H. desertorum*, brought from Egypt, and attached to a tablet in the British Museum on the 25th of March, 1846. In this imprisonment it remained for four years, having been discovered on the 7th March, 1850, attempting to escape from "durance vile." The shell being removed from the tablet and placed for a few minutes in tepid water, the animal completely revived and lived for more than twelve months afterwards. In cool or cold climates snails become torpid in winter. They retreat, before the cold has benumbed their powers, into some snug quarters under stones, clods of earth or moss, or in crevices of old walls, &c. Some dig into the ground, forming an excavation or nest in which they bury the shell, and then close the aperture with a sort of temporary operculum of a thick calcareous nature, called an epiphragm. Here they remain till the return of spring calls them forth again from their state of hybernation. In hot climates a similar degree of torpidity takes place; and during this state of estivation, as it is called, they remain perfectly quiescent, and form the same kind of operculum, or epiphragm, to protect them from the drying effects of the external atmosphere. Snails afford food to some kinds of birds, as the missel-thrush, &c., and in their turn are often eaten by omnivorous man. At the present day they are comparatively little used as an article of food; but amongst the ancient Romans, the *H. pomatia* (hence called the Roman snail) was in great request, "not from any peculiar relish for such tasteless food, but from a belief in their aphrodisiacal virtue."—(*Johnston.*) The snails were kept in depots called *Cochlearia*, and fattened carefully with a "certain paste made of cuit and wheat meale."—(*Holland's Pliny.*) The same author states, on the witness of M. Varro, that these snails grew to an enormous size. In Sicily several species of Helix are eaten, and the Brazilians are said also to eat snails. In this country and in France they are used for their supposed virtues in diseases of the chest and lungs.

The GENUS SUCCINEA.—The Amber Snails have a thin, ovate, or oblong shell, with a short spire and a large aperture. It is not umbilicated, and the peristome is simple and sharp. It is generally of a delicate, horny, or amber colour. The animals are of a vesicular structure, are large compared with the size of the shell, and are not quite retractile within it. The species are rather numerous, about seventy having been described, and are found in all the four quarters of the globe, though more especially abounding in temperate climates. They are amphibious in their habits, living amongst plants in damp situations, but rarely entering the water.

GENUS BULIMUS. — See Plate 7, fig. 3 (*Bulimus ovatus*). The Bulimi are animals of a moderate size, inclosed within the shell, which is oblong or turreted, and composed of many whirls. The aperture is longer than wide; the peristome is thin or reflected, rounded in front, and in many species the shell is umbilicated. The species are very numerous, upwards of six hundred and fifty having been described. They are found in all parts of the world, and vary much in shape and appearance. Like the *Helices*, these animals abound most in warm climates, and, like them, pass the dry season in a sort of torpor or deep slumber, buried at the roots of trees, in moss, or in the thick brushwood, and having the mouths of their shells covered with a pretty solid epiphragm. They have the same power also, as the *Helices*, of undergoing long fasts; and instances have

occurred, where they have remained in a state of deep slumber for the space of twenty months. Their eggs are sometimes very large, and are covered externally with a hard calcareous shell. Those of *Bulimus hæmastomus* are almost as large as a pigeon's, and nearly as hard. It appears that the tropical, and more especially the arboreal species, cement leaves of trees together, curling one upon another, so as to form an artificial nest for the reception of these large eggs.

GENUS ACHATINA.—The Agate shells have a shell a good deal resembling the Bulimi; but they are thinner, and the columella is twisted, and more or less abruptly truncated in front. The shell is not umbilicated; the aperture is oval, elongate, and the peristome is thin, acute, and not reflected, the margins united by a diffused callus. The Achatinæ are numerous in species, upwards of one hundred and twenty having been described, and some of the African ones are the largest terrestrial shells known. They attain the length of eight inches, and their eggs, which are calcareous like those of the *Bulimi*, are sometimes more than an inch in length. They are chiefly found about trees near water, and the great majority are natives of Africa. The genus is represented on Plate 7, fig. 8 (*A. virginia*).

GENUS PUPA.—The Pupæ have a solid, cylindrical, or oblong-ovate shell, with many whirls, a conical apex, and a rounded, often toothed aperture. The base is rimate or, rarely, umbilicated, and the surface of the shell is generally very closely ribbed with straight ridges. The species are numerous, amounting to upwards of one hundred and sixty, and are found in all the four quarters of the globe. The genus is represented on Plate 7, fig. 9 (*Pupa mumia*).

GENUS CLAUSILIA.—The Clausilias have a fusiform shell, almost always sinistral, or turned to the left. The aperture is elliptical or pyriform, provided with two plaits or lamellæ which contract the margin, and is closed at the bottom, or in the neck, by a movable shelly plate, called a *clausium*. This peculiar organ is attached to the pillar of the shell by a slender pedicel, and is placed in such a position as to shut the throat of the shell, when the animal is inclosed, while at the same time the animal can push it on one side, when it wishes to come forth in search of food. The species are very numerous, upwards of two hundred having been described, and are distributed over the four quarters of the globe, though most numerous in the temperate countries of Europe. This genus is represented on Plate 7, by fig. 7 (*Clausilia cærulea*).

GENUS CYLINDRELLA.—The Cylinder shells differ from the Clausilias, chiefly in wanting the plaits or lamellæ in the aperture. The shells are generally long and cylindrical, many-whirled, the apex in the adult generally broken off; or truncated while the mouth is round, and the peristome expanded and continuous.

LIMNOPHILA, FRESH-WATER SNAILS.—The animals belonging to the second group have subcylindrical or flattened tentacles, which are simply contractile, and have the eyes placed sessile on their base.

FAMILY—AURICULIDÆ.

The Auriculas have a ringed conical muzzle, and a thin mantle with a thickened edge. The shell is spiral, covered with a horny epidermis, and has the mouth, which is elongate, furnished with strong plaits on the columella. The outer lip is also in many cases toothed, or transversely ribbed. The animals are peculiar in having the power of absorbing progressively the septa, or divisions, which separate the cavities of the whirls from one another. With few exceptions the species, which are numerous (upwards of two hundred having been described by Pfeiffer in the Catalogue of *Auriculidæ* in the collection of the British Museum), are natives of tropical countries, and live in brackish-water marshes, estuaries, and mouths of rivers, clinging to the stems and roots of mangroves; among loose stones above high water mark, but within the influence of the tide; or in damp woods near the sea.

FAMILY—LYMNÆIDÆ.

The Pond Snails have a short dilated muzzle, flattened tentacles, and a flattened, lanceolate, or oval foot. The shell is thin, horn-coloured, rather varied in form, but usually with an oblique fold on the columella, and a simple, acute outer lip. The species are numerous, and are all fresh-water animals, living in the water, but coming to the surface to breathe. They are found in all parts of the world, and inhabit ponds and running streams. They are chiefly found in temperate countries, and are for the most part phytophagous or vegetable feeders. They deposit their ova on the stems and leaves of the weeds which grow around them, enveloped in an oblong gelatinous nidus. The form of the shell, as we have said, is very varied.

GENUS LYMNÆA.—The Lymnææ have a spiral, dextral shell, more or less elongated, thin, horn-coloured, and translucent. The last whirl is large, ventricose, the aperture large, rounded in front, the columella obliquely twisted, and the outer lip simple and acute. The species are upwards of fifty in number, and are found in most temperate countries of the globe. Their food consists of both vegetable and animal matter, one species feeding on the green fresh-water algæ, while others prefer animal food. This peculiarity in their diet has caused them to be denominated "the scavengers of the waters;" and Mr. Jeffreys informs us, that in the absence of other nourishment, "they will even devour each other, piercing the shell near its apex, and eating away the upper folds of its inhabitant." Although generally to be seen creeping on the muddy bottoms of ponds and streams, and on the stones, or on the leaves and stems of submerged plants, they always come to the surface to respire free air, and can, when there, to use Dr. Johnston's words, "make the water a liquid pavement," along which they creep by an undulatory motion of the foot, but with the body and shell in a reversed position. "When thus suspended, they will sometimes relax their hold and drop at once to the bottom, from which in general they emerge by crawling up some solid body; but occasionally I have seen them rise up direct through the water."—(*Johnston.*) When the ponds are dried up, the Pond Snails bury themselves in the mud, strengthen the outer lip by an internal rib, and cover the mouth by means of a membranaceous epiphragm, like the land snails.

GENUS PHYSA.—The Bubble Snails have a sinistral shell, of an ovate form, spiral, thin, and polished. The aperture is oval, rounded in front, the inner lip spread over the last whirl, and the outer lip acute. The species may easily be recognized by their bright polished surface, and their sinistral or left-handed whirls. The Physæ are chiefly found in clear running streams and in fountains, seldom in stagnant water. They appear to be very quick in their movements, and when touched or alarmed, they only arrest their progress for a moment, and then go on again without further hesitation. When floating on the surface of the water, they possess the power of letting themselves down gradually by means of a glutinous thread affixed to the surface (as in the case of *Litiopa*—see p. 204) and when kept in a glass vessel, they have been observed frequently to poise themselves on their foot, and rapidly vibrate their shells. The Physæ are not so numerous in species as the *Lymnææ*, but are widely diffused, being found in Europe, North America, South Africa, India, and the Philippine Islands. This family and genus are represented on Plate 7, fig. 1 (*Physa rivalis*).

THE GENUS PLANORBIS differs very much in appearance from the two preceding genera. The shell is discoidal, instead of spiral, with a depressed spire and numerous whirls, which are visible on both sides. The mouth is crescentic, and the peristome is thin, sharp, incomplete. the upper margin projecting. The species are numerous, upwards of sixty having been described, and are in a great majority of instances natives of temperate climates, as Europe and North America, &c., though a number are found also in India and China. Locomotion in these animals is slow; and it has been observed in the case of a common British species (*P. corneus*) that when irritated, it discharges a purple fluid from under the margins of the mantles, similar to that of the Scalaria (see p. 200), but which is of so fugitive a nature that no means tried yet have been able to preserve it.

THALASSOPHILA—MARINE SNAILS.—In this group the animals have no distinct tentacles, or they are expanded so as to form a frontal disc, upon the front part of which are placed the eyes. They are either marine in their habits, or they live in the vicinity of the sea.

FAMILY—SIPHONARIIDÆ.

The Siphonarias have their frontal disc bilobed anteriorly, and the respiratory orifice covered by a large fleshy lobe of the mantle. The shell is conical, and exactly resembles a patella, except that the horse-shoe-shaped muscular impression is divided on the right side by a deep siphonal groove, which extends in the form of a projection somewhat beyond the margin. In form it is depressly conical, with the apex subcentral, and recurved posteriorly. There is only one genus, *Siphonaria*. The species, upwards of thirty in number, are found adhering to rocks, like limpets, between tide marks, and are widely extended in their geographical distribution. They are most numerous within the tropics, being found in considerable abundance in India, the Philippine Islands, South America, the Cape of Good Hope, Australia, New Zealand, and the islands of the Pacific. The family is represented on Plate 7, figs. 1, 2, 3 (*Siphonaria radiata* and *grandis*).

FAMILY—AMPHIBOLIDÆ.

The Amphibolas have a subglobose, spiral, umbilicated shell, with an oval mouth and a rather expanded outer lip, which is sinuated behind. The surface of the shell is singularly uneven, and battered as it were. The animals possess an operculum, which is horny and subspiral.

Only one genus, AMPHIBOLA, exists.

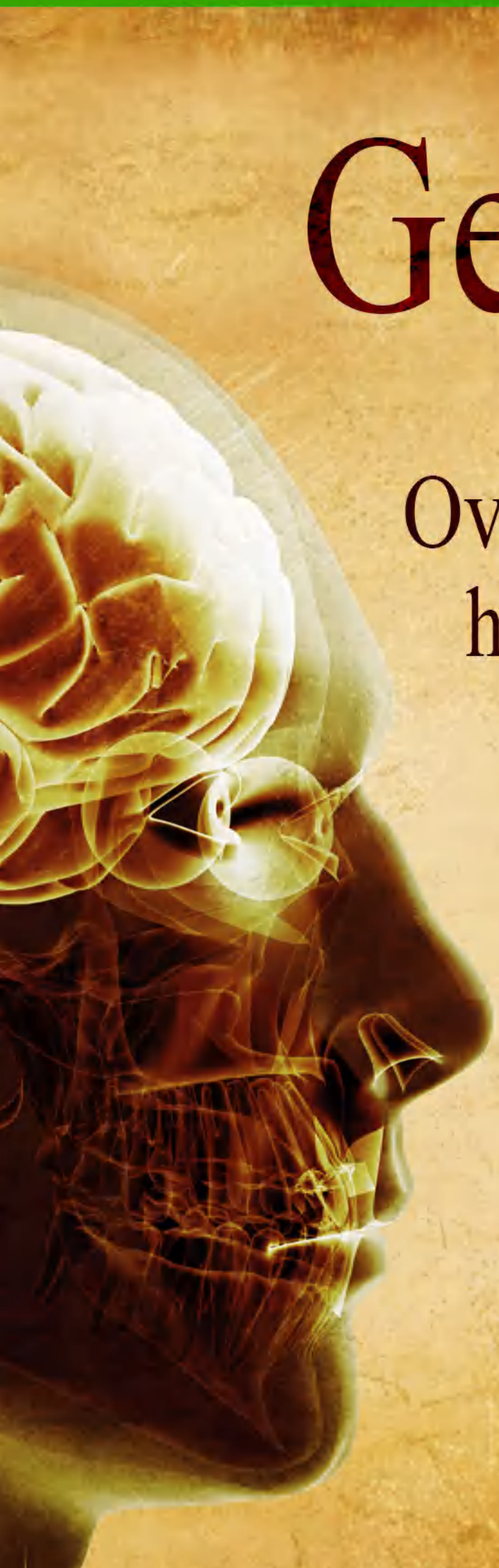
The Amphibolas are found living in salt marshes near the sea. They exist in great abundance in New Zealand and Australia, living in pools of brackish water, and at particular seasons burying themselves in the sandy mud. The natives of New Zealand use them as articles of food.

CLASS III.—PTEROPODA (THE PTEROPODS).

THE true position of the Pteropoda in the natural arrangement of molluscous animals, is still somewhat undefined. Some conchologists place them between the Brachiopods and Cephalopods, others between the Gasteropods and Brachiopods. Lamarck conceived they should be placed between the Gasteropods and Bivalves, and M. Blainville is of opinion that they are in reality only a tribe of Gasteropods, allied to the *Bullidæ*. M. Souleyet supports this view of their position, though the structure of the animal evidently entitles them to rank as a distinct group or class. The animals resemble very much the larval or young state of the Sea-snails; and the shell, when present, is distinctly univalve and analogous to the shell of the Gasteropods. They are, however, much inferior to this class of mollusks, and we place them therefore after the Univalves in our arrangement.

The animal in most of the species is inclosed in a thin shell, which is either conical, cylindrical, or subglobular. It is symmetrical, and consists of a dorsal and a ventral plate united, with an anterior, transverse, contracted opening for the head, and lateral slits for the passage of certain long filiform processes of the mantle. The sexes are united in the same individual.

The Pteropods are amongst the most beautiful of all the Mollusca, but are seldom seen alive except by those "whose business is in the great deep." In consequence of the great fragility of their shells, they avoid the shore, and are generally met with only in the open ocean. They are the most entirely natatory of all the animals of this kingdom. "Created," says Dr. Johnston, "to occupy the high seas, they are organized in evident aptitude to the place assigned them, with a light shell, which affects not their buoyancy, and with



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GENUS LIMACINA.—This is the only genus in the family; the shell is subglobose, with a slightly raised spire, the last whirl obscurely keeled, and the axis umbilicated.

L. ARCTICA is the best known species, and is extremely abundant in the North Sea, where it forms an important article of food for the whale. It was well known to some of our early arctic voyagers, and is often mentioned by them. Peyrêre, in his "Histoire du Groenland," calls it, "a little black spider." Martens, in his "Voyage into Spitzbergen and Greenland," calls it the "snail slime fish," and tells us that they "swim in great numbers in the sea, as numerous as the dust in the sun," whilst Otho Fabricius, in his "Fauna of Greenland," gives us a full and very interesting description of it.

ORDER II.—GYMNOSOMATA (SHELL-LESS PTEROPODS).

THESE naked-bodied or Shell-less Pteropods are distinguished from the preceding order by their body being destitute of a shell. It is composed of three families, none of them containing more than a few species, and very few of these being much known. No doubt many more species will be discovered floating on the seas of warm latitudes; but at present the most interesting are one or two found in our Northern Ocean.

FAMILY—CLIONIDÆ.

The Clios have a fusiform body, furnished with two fins, and a central foot-like appendage. Their head is furnished with a series of conical prominences on each side, which probably represent rudimentary tentacles; they are retractile, and furnished with numerous microscopic suckers.

THE GENUS CLIO (=*Clione*) is the best known of the family, as one of the species belonging to it is a native of our arctic seas, and has been frequently observed in its native haunts by our arctic voyagers.

THE CLIO BOREALIS is a small, gelatinous, pellucid creature of a pale blue colour, with a scarlet mouth and extremity. Dr. Scoresby says that it occurs in vast numbers in some situations near Spitzbergen. Phipps remarks—"Our fishermen call them by the name of 'Whale-food,' and are of the same opinion with Martens, who says they are the chief food of the whalebone-whale." Martens, in his "Voyage into Spitzbergen," tells us that they are called the "Sea May-flie." "I am of opinion," he says, "that the birds feed upon them, because the *lumbs*, *pigeon-divers*, and *parret divers* are plentifully seen in those places where these fish or sea-insects are seen."

FAMILY—PNEUMODERMIDÆ.

The Pneumodermons have a fusiform body, and the head is provided with arms furnished with pedicelled suckers. The wings or fins are rounded, entire, with a central foot-like appendage placed at the base of the head. The gills are placed on the hinder part of the body. There are four genera in this family, each distinguished from the other chiefly by the gills.

THE GENUS PNEUMODERMON has them in the form of a four-lobed leaf at the extremity of the body.

SPONGIOBRANCHIA has them in the form of a prominent spongy ring near the end of the body.

TRICHOCYCLUS has them in the form of a ciliated ring round the middle of the body, one round the base of the head, and another on the hinder end of the body.

FAMILY—CYMODOCEIDÆ.

The Cymodoceas have the body divided into two parts, and are furnished with four wings or fins, the two upper broad and rounded, the lower nearly linear. The family contains one genus, *Cymodocea*, and this genus only one species, *C. diaphana*—a diaphanous, translucent, little creature, with the scarlet viscera shining through it. It is found in the Alantic Ocean.

CLASS IV.—CONCHIFERA (BIVALVES).

THE Bivalves come next to the Univalves in variety and importance; and though in the number of species they are inferior, they exceed them in the number of individuals. They are all aquatic, the greater proportion being marine, and are widely diffused over the globe, ranging from low water mark to a depth of more than two hundred fathoms. The animals have no distinct head—hence called by many naturalists *Acephala*, or headless—no tentacles, and (in by far the greater number at least) no eyes. The mouth is concealed between the folds of their mantle; it is situated near the front of the base of the foot, and is provided laterally with two pairs of elongate fleshy lips, forming lamellar *palpi*. It possesses no teeth, and the creatures thus can only seize upon such particles as the water floats within their reach, or which are brought near the mouth by the currents that are continually circulating within the cavity of the mantle. These currents not only serve, but supply water to the gills for aerating the blood; they are produced by the action of a number of cilia that clothe the gills. The foot of the Bivalves has some analogy with that organ in the Gasteropods, being formed by the under part of the body, but is not so well adapted for locomotion as in these latter mollusks. Instead of forming a flattened disc as in them, it is generally laterally compressed and keeled—(see fig. 228, *Venus verrucosa*)—though indeed there are many exceptions to this rule. In the Oyster and Scallop

(*Pecten*), the foot is either very small or is nearly wanting; in Nucula and some others it is deeply cleft, and is capable of being expanded into a disc, like that of the snails; and in the burrowing species the foot is strong and stout, and adapted for boring vertically into the sand or mud.

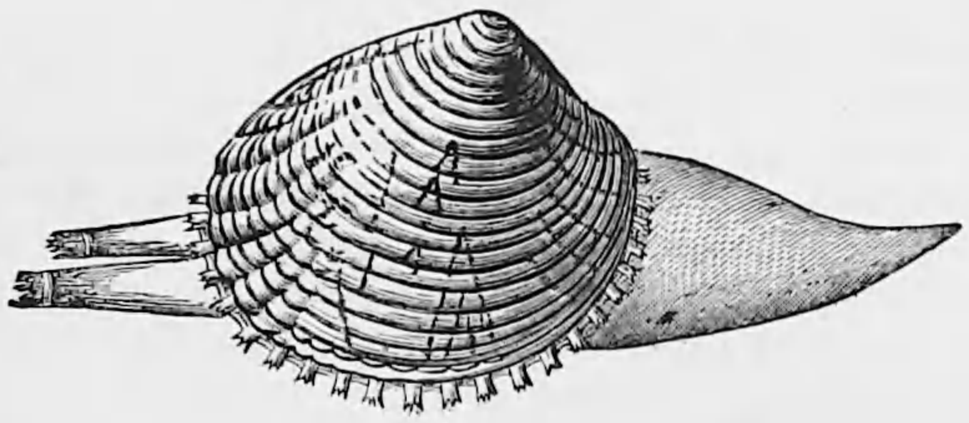
The body of the Conchifers is entirely covered by a two-lobed mantle, which envelopes it as a book is inclosed within its boards, and is protected on each side by a shelly valve. It generally incloses a pair of gills which are placed on the sides of the body, and are each composed of two large membranous laminæ which, when examined by the microscope, appear to be a complete network of bloodvessels fringed with vibratile *cilia*. The water in which they live is filtered through these gills, and thus whatever particles the current brings, are collected on their surface and conveyed to the mouth. The mantle which covers the body of the animal is usually more or less united at its margins; sometimes being produced into long siphons or tubes (fig. 228, *Venus verrucosa*), at others merely having two holes (fig. 229, *Anodon anatinus*) for the passage of the current of water. The various modifications which the end of the mantle assumes, afford some of the best characteristics for dividing the species into orders. The mantle secretes the shell (which, as we have stated, consists of two valves), and lines the interior, to which it is attached by a pair of adductor muscles. The valves are always placed one on each side of the animal, and are united together on their dorsal edges by a ligament of greater or less strength. Within this ligament, in a cavity, there is placed an elastic cartilage; and the two valves are articulated together by a hinge furnished with interlocking teeth. The use of the *ligament* is to keep the two valves together, whilst that of the cartilage is to keep them open without any exertion to the animal while waiting for its prey, or moving from one place to another by means of its foot. The valves are shut, or brought together, by means of two muscles which are attached to their internal surface, and are hence called adductor muscles. In the greater number of species these two muscles are quite distinct, one placed near the anterior, the other near the posterior apertures, whilst in others there is apparently only one; the two being so approximated, as to make it appear as if there were only one. Lamarck and other conchologists adopted this disposition of these muscles as characters for the systematic arrangement of the bivalve shells; but Cuvier and other later authors have preferred to base their systems upon different characters altogether.

The majority of the bivalve mollusca are believed to be monœcious or unisexual; but as Dr. Johnston observes, the exceptions are yearly increasing under the dissections of the comparative anatomist, who has proved several of them to be bisexual, "although the distinction between the male and female does not appear in any external character either of the animal or shell." A few of the genera in this class are viviparous, the ova being carried from the ovary to be deposited in the interstices of the external plates of the gills, where they are retained till the young are hatched and arrive nearly to maturity, the ova remaining there in some of the genera for several months after leaving the ovaria.

SYSTEMATIC ARRANGEMENT OF CONCHIFERA.

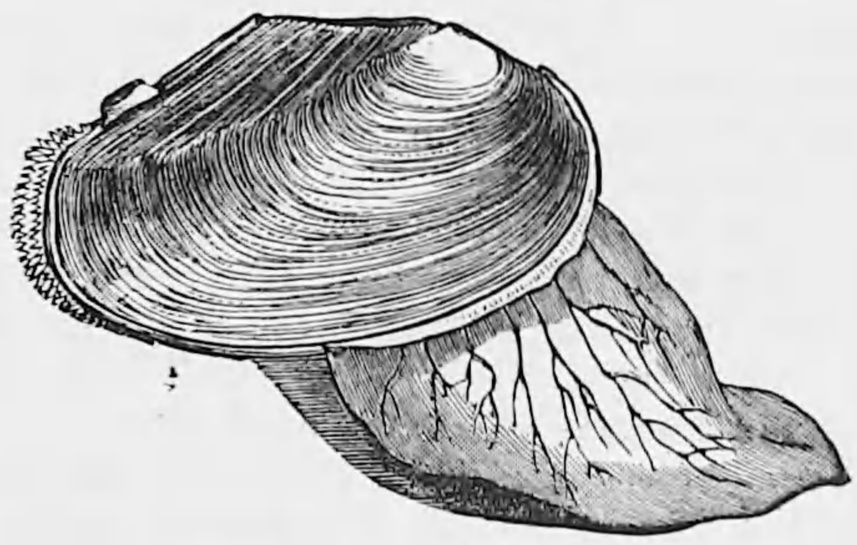
THE principal character adopted in the present arrangement, that of Dr. Gray, is the structure of the mantle. We have stated above that the margins of the mantle are either produced into siphons, or that there are only two holes in it, for the passage of the water to the gills for aerating the blood. The species of this class have in consequence been divided into two large groups or sub-classes—I. *Siphonophora*, in which the mantle leaves or lobes are connected, and produced into two elongated siphons or tubes, through which the water is admitted (fig. 228, *Venus verrucosa*). II. *Asiphonophora*, in which the mantle lobes are mostly free, or when united, are pierced with one or two holes, instead of being produced into siphons, for the admission of water (fig. 229, *Anodon anatinus*).

Fig. 228.



Venus verrucosa.

Fig. 229.



Anodon anatinus.

SUB-CLASS I.—SIPHONOPHORA.

THIS great group is divided into two orders—I. VENERACEA, in which the siphons are in general more or less separate—II. PHOLADACEA, in which the siphons are united.

ORDER I.—VENERACEA.

IN this order the hinder margin of the mantle is furnished with two more or less elongated siphons under the posterior adductor muscle, which are to a greater or less degree separated from each other, and provided with a large fan-shaped muscle on each side, for the purpose of retracting them into the shell when the animal fears external danger. The gills are short, and not produced into the canal of the siphon, and the foot is generally lamellar or elongate.

FAMILY—VENERIDÆ.

This family, with which we begin, is a numerous one, and is remarkable for the elegant forms and varied colours of the shells of many of the species which belong to it. The animals have a large, compressed, tongue-shaped foot, by means of which they crawl; and short unequal siphons, united sometimes for a considerable portion of their length. The shell is regular, closed, or sometimes slightly gaping; generally free, seldom burrowing; suborbicular in shape or oblong. The hinge has usually three diverging cardinal teeth in each valve, and the hinder lateral tooth, when present, is compressed, and forms a part of the margin of the shell; the ligament is external, marginal. The muscular impressions are smooth and polished, and the pallial line is sinuated. The animals of this family are all marine, free, and possess considerable locomotive powers; a few only burrowing in, or perforating rocks. They are found in all parts of the world, though there is not much known of their habits. Some of them, however, are eaten by man in different parts of the world, and are even esteemed a delicacy. Their taste, we are told, is stronger than that of oysters, and one must be habituated to it, to relish it. The *Venus shell* appears to have been held in honour by the ancients, and dedicated to the Goddess of Love. The shells of the *Veneridæ* show little organic structure, and their texture is very hard, approaching the porcellanous univalves in density, and in the absence of almost any trace of animal matter. The species are very numerous, upwards of five hundred and fifty being indicated or described in M. Deshayes' Catalogue of the *Veneridæ* in the British Museum. They differ amongst themselves considerably in form, number, and structure of the teeth, the shape of the pallial impression, &c., so that for convenience sake they have been formed into no fewer than sixteen genera. We will only mention a few.

GENUS ARTEMIS.—This genus has an orbicular, compressed shell, deeply lunulate under the beaks, and the hinge is provided with three teeth in each valve. The sinus of the pallial impression is deep, oblique, triangular, and sharp-pointed. The surface of the valves is usually concentrically grooved, and of a pale, or even white colour.

GENUS CYTHEREA (*Meretrix*).—This genus has a very solid, smooth, ventricose shell, of a more or less transversely oblong, or ovate form, with three cardinal teeth in the hinge in each valve, and a small conical anterior tooth beneath the nearly obsolete lunule. The hinder lateral tooth is always lightly crenulated or striated, and the sinus of the pallial impression is moderate, and angular posteriorly. The surface of the valves is generally smooth and shining, and covered with a fulvous epidermis.

GENUS CUNEUS (*Meroë*).—This genus is remarkable for the compressed, ovate-trigonal shell, having the area of the lunule deeply excavated, and the margins of the shell regularly toothed.

GENUS TRIGONA.—This genus has a triangular, wedge-shaped shell, with very prominent beaks, and an indistinct lunule. The hinge is provided with three and sometimes four cardinal teeth, and a small anterior one. The hinder lateral tooth is torn and divided; the internal margin of the valves is entire, and the pallial sinus rounded, short, and horizontal. The shells are usually thin and gibbous, and are frequently covered with a glassy-looking epidermis.

GENUS DIONE.—This genus, as represented in Plate 10, fig. 1, by DIONE CHIONE, has an ovate, transverse, inequilateral shell, with the interior margins of the valves often thickened. The hinge has three cardinal teeth in each valve, and a small anterior tooth under the lunule. The hinder lateral tooth is simple, neither torn nor striated; and the pallial sinus is wide, deep, and somewhat ovate. The shells are often inflated, and their surface is either smooth, sulcated, striated, or lamellar.

GENUS CIRCE.—This genus has an ovate, somewhat triangular, solid shell, depressed at the beaks. The hinge has three cardinal teeth in each valve, and there is scarcely any trace of a pallial sinus. The external surface of the valves is smooth, or concentrically striated or grooved.

GENUS VENUS.—This genus, as now restricted, has a thick, turgid, ovate shell, with a prominent ligament, a distinct lunule, and a small, often oblique pallial sinus. The hinge is thick, and possesses three teeth in each valve, which are divaricate, and sometimes bifid. The surface of the shell in this genus is either warty, or ornamented with concentric ribs or striæ or lamellæ, or they are decussated by longitudinal furrows.

GENUS MERCENARIA.—This genus has a triangu-

ventricose, smooth, or concentrically striated. The hinge is narrow, and has in most cases two short moderately diverging cardinal teeth in each valve, and two elongate, smooth, compressed, lateral teeth in one valve, and one in the other. The species are all small, and are for the most part natives of cool climates. They inhabit fresh-water lakes, ponds, streams, and ditches, and are generally found buried in the mud. The British species which have been observed are ovoviviparous, the fry being hatched in the internal branchiæ. They breed readily in confinement, and often exhibit when young considerable activity, climbing about submerged plants, and often suspending themselves by byssal threads.

FAMILY—TELLINIDÆ.

The Tellens are numerous, often remarkable for elegance of form, delicacy of sculpture, and beauty of colour. Many of them are thin, fragile, and compressed; and though a strong general resemblance may be observed to exist throughout the family, yet many modifications of form, and considerable differences in the structure of the hinge occur, so as to compel their separation into a number of distinct genera. The animals, however, are strikingly similar, and are particularly noticeable for having the siphons very long and slender, and the foot bent so as to form a sort of elbow. The shell is always free, compressed, and regular; the hinge is never furnished with more than two cardinal teeth; and the lateral teeth are either one in each valve or are obsolete. The ligament in some is external, in others internal, and the pallial sinus is usually very large. Though the shells are often painted with glowing hues, yet the animals are said to be almost always white and colourless. One or two, as *Tellina Gari*, are used as food; and in India this latter species forms a favourite dish called *bacassan*, which old Rumphius extols as "the most grateful of all kinds of food."

GENUS TELLINA.—This genus, as now restricted, has an ovate shell, oblong, or rounded posteriorly, and peculiarly marked with a fold or sinuosity on the binder side. The species vary much, however, in form and appearance; some are elongate transversely (see Plate 10, fig. 2, *Tellina radiata*); others are oval and rough externally; others, again, are nearly orbicular; one or two have one valve flat; while both valves in others are remarkably deep. In sculpture they are equally various; some have one valve striated, the other plain; others have the external surface very rough; others, again, quite smooth. The hinge teeth are compressed; the ligament external, prominent; and the pallial sinus very wide and deep. The Tellens live in sand or sandy mud, buried beneath the surface; the majority at low water-mark, though some occur at considerable depths. "The animals have the power of leaping from the surface by means of their muscular foot" (*Adams*); and no doubt this power is increased by the elbow-shaped bend in that organ.

GENUS PSAMMOBIA.—This genus (some of the species of which are known by the name of the "Setting Suns") have an oblong, compressed shell, slightly gaping at both extremities, and more or less angular at the hinder side. The ligament is external, prominent; the hinge provided with two teeth or a single bifid tooth in one valve, and only one in the other; and the pallial sinus is deep. Externally, they are either smooth or radiately striated, and the internal margin is finely crenulate.

GENUS SANGUINOLARIA.—This genus has an equivalve, oval, compressed shell, attenuated at the hinder end, and gaping a little at both extremities. The ligament, which is external, is very conspicuous on a prominent thickening of the hinge margin, and the pallial sinus is very deep.

GENUS SEMELE (=*Amphidesma*).—This genus has a rounded, subequilateral shell, with the beaks turned forwards. The hinge is provided with a short external ligament, a long, oblique internal cartilage, and the teeth are two cardinal in each valve, and distinct, elongated lateral teeth in the right valve.

GENUS DONAX or *Wedge-shell.*—This genus has a strong, more or less wedge-shaped shell, the hinder side being much shorter than the anterior, or as it were, truncated. The ligament is short, external, the hinge furnished with two cardinal teeth in each valve, and one or two lateral teeth, and the pallial sinus is wide and deep. The external surface is smooth, radiately striated or decussated, and covered with an epidermis. The inner margin is generally crenulated. When the animal moves, it does so by a succession of short leaps, and this peculiar mode of progression has been well described by Dr. Johnston as observed in the common *Donax trunculus* of our own shores. "When it is about to make a spring," says the Doctor, "it firstly, by appropriate motions of the foot, puts the shell on the point or summit, as if aware that this is the position the most favourable of any to avoid the resistance which the sand opposes to the motion. It then stretches out the leg as far as possible, makes it embrace a portion of the shell, and, by a sudden movement similar to that of a spring let loose, it strikes the earth with its foot and effects the leap."

GENUS IPHIGENIA (=*Capsa*).—This genus has a nearly equilateral, transverse, smooth shell, covered with a thin, olivaceous epidermis. The binge is provided with two cardinal teeth in the right valve, and one cardinal and two nearly obsolete lateral teeth in the left valve. There are only a few species known, and these are found in estuaries in Brazil, Central America, and Senegal. They bury themselves at a small depth in the sand, where they are said to lie with the posterior part upwards, to facilitate the influx of the water for respiration.

GENUS GALATHEA.—This genus has a remarkably thick, trigonal, wedge-shaped, smooth shell, covered with a smooth, olive epidermis. The umbo is generally eroded; the short, external ligament is prominent and turned, and the hinge is thick and furnished with two large thick cardinal teeth in one valve and one in the other, and two indistinct lateral teeth. When young, the teeth are like those of the preceding genus, *Iphigenia*, but as the shell enlarges in size and increases in thickness, the teeth increase in size and become subdivided into separate lobes. Two species are known, both inhabitants of the sandy flats of the Nile and the

rivers of Western Africa, as high as twenty miles from the sea.

GENUS SCROBICULARIA.—This genus, forming the type of a small family *Scrobiculariidæ*, has an oval, thin, compressed shell, and the cartilage is internal, and situated in a shallow, triangular pit. The species of shell upon which the genus is founded, is a native of our own shores, and is found living buried vertically five or six inches deep. The most remarkable circumstance in the history of this shell, perhaps, is the number of names by which it has been described.

FAMILY—MACTRIDÆ.

The Mactras have an equivalve, trigonal shell, which in some is close and in others slightly gaping, and in all, covered with a thick epidermis. The hinge is furnished with two diverging cardinal teeth in each valve, the central one being laminar and folded, and usually with an anterior and posterior lateral tooth, those of left valve being single, and those of right double. The cartilage is internal, and is placed in a deep triangular pit behind the cardinal teeth. The pallial sinus is short and rounded.

THE TRUE MACTRAS (*Mactrinæ*) have a more or less trigonal shell, nearly closed behind. The anterior hinge tooth is bifid or triangular, and the lateral teeth are distinct, well developed, and laminar. They inhabit sandy coasts at various depths, though the majority, and especially the larger kinds, are littoral. The animals are active and powerful for their size, and live buried in the sand at a small depth beneath its surface. "The foot can be stretched out considerably, and moved about like a finger; it is also used for leaping."—(*Woodward.*) The British species afford food to the star-fishes and whelks, and Mr. Alder informs us that one species, *Mactra subtruncata*, a common one in the island of Arran, is collected by the natives to feed their pigs with. There are several genera in the *Mactrinæ*, characterized chiefly by the position of the ligament. These genera are *Mactra*, *Schizodesma*, *Spisula*, *Mulinia*, and *Gnathodon*. The family is represented in Plate 10, fig. 3, by a British species, *Mactra stultorum*.

GENUS GNATHODON.—This genus has an oval, ventricose, thick and smooth shell, with eroded beaks and an olive epidermis. The hinge is furnished with two cardinal teeth in one valve, and one in the other, and the lateral teeth are doubled in the right valve, elongated and striated transversely. The ligament is internal and placed in the upper edge of the deep, central cartilage pit.

GNATHODON CUNEATUS—perhaps the only species of the genus—is a native of New Orleans, and was formerly eaten by the Indians. It lives in vast numbers in the extensive flats below Mobile, burrowing three or four inches beneath the surface of the sand, in which numerous depressions indicate where they are to be found. The water there is only brackish, though there is a tide of three feet. Banks of dead shells, three or four feet thick, are found twenty miles inland, and Mobile is built on one of these banks. "A deposit composed entirely of two existing shells in a subfossil state, the *Cyrena Carolinensis*, and more especially the *Rangia cyrenoides* of Des Moulins (=*Gnathodon cuneatus*), extends along the whole shore of the Gulf of Mexico from Pensacola to Franklin in Louisiana, bends round Mobile bay, Lake Pontchartrain, and ranges across the delta of the Mississippi immediately above its marshes, a total distance of nearly three hundred miles, and probably much further! It is remarkable that the shells occur in beds with scarcely any admixture of sand or earth, and they are consequently found extremely useful in repairing roads and paving the streets of the city. They are dug from the surface of the soil, both on the main shore and the islands of the bay. These deposits border the bays of the Gulf of Mexico, between Mobile and New Orleans, and they occur in the vicinity of Franklin, Louisiana. The Ohandeleur Isles, between Mobile bay and the delta of the Mississippi, consist of deposits of these shells covered by a fertile soil." (*Johnston—Report of British Association.*) The road from New Orleans to Lake Pontchartrain (six miles) is made of Gnathodon shells procured from the east end of the lake, where there is a mound of them a mile long, fifteen feet high, and twenty to sixty yards wide. In some places it is twenty feet above the level of the lake.—(*Lyell*, in *Woodward.*)

THE LUTRARIAS or "Otter shells" (*Lutrariinæ*) have oblong or elongate shells, gaping at both ends and covered with an epidermis. The plate on which the cartilage is fixed is prominent, and has one or two small teeth in front of it in each valve. The lateral teeth are very small, rudimentary, often obsolete. The pallial sinus is deep, horizontal. The Otter shells are found in various parts of the world. They live habitually buried in the mud, fixed in a vertical position, and are principally met with in estuaries, at depths varying from low water to twenty fathoms. Several genera have been found in this group.

FAMILY—PAPHIIDÆ.

This family, composed of the genera, *Paphia*, *Mesodesma*, *Donacilla*, and *Anapa*, have an equivalve, closed shell, with the cartilage in an internal pit, and with a simple compressed cardinal tooth and a rudimentary process in the place of the second tooth. The form of the shell is various. The *Paphias* are ovate, somewhat trigonal, truncated behind, and slightly keeled. The *Mesodesmas* are transversely ovate shells, with the hinge in the middle. The *Donacillæ* are wedge-shaped shells, with the hinge at one end. These shells live in sands in New Zealand and other parts of the world, and sometimes are found in estuaries.

GENUS GLOSSUS (= *Isocardia*), the "Heart Cockle."—This genus, forming the type of a small family, *Glossidæ*, has a peculiar heart-shaped shell, whence its English name. It is ventricose, equivalve, smooth or furrowed externally, with prominent contorted beaks, and a hinge consisting of two very oblique cardinal and two lateral teeth in each valve, the anterior being sometimes obsolete. The ligament is external, and there is no pallial sinus. Mr. Bulwer, who had an opportunity of watching our British species, *Glossus cor*, alive, tells us that on being placed in a vessel of sea-water, the valves of the shell gradually opened; the feelers or

ciliated fringe of the upper orifice of the mantle moved slowly, as if in search of animalcula. Having remained in this position about ten minutes, water was ejected with considerable force from the lower orifice, which till now had remained motionless. The expulsion of the water appeared to be effected by a sudden contraction of the muscles, because this was never done without the valves nearly closing at the same time. After a few seconds the valves gradually returned to their open position, and remained quiescent as before, till the water was again ejected with a jerk. The Heart Cockle burrows in sand, forcing its way by means of its sharp pointed, triangular foot, leaving only the siphonal openings exposed. Only five species are known, one of which is an inhabitant of the British seas and the Mediterranean, and the others are natives of China and the Philippine islands.

FAMILY—CHAMIDÆ.

The Chamas have an inequivalve, irregular shell, adhering to other substances, as rocks, shells, and corals, by the outer surface of one of the valves, usually the left one. The beaks are recurved, unequal, and the hinge is composed of two teeth in one valve, and a single large tooth in the other. The valves externally are generally foliaceous, and vary very much in form and colour. Their shape is usually determined by the body to which they are fixed. The species are almost all from tropical seas, and they especially affect coral reefs. The genus is represented in Plate 10, fig. 4, by *Chama lazarus*.

FAMILY—ANATINIDÆ.

The Lantern-shells have usually a thin, brittle, oblong, often inequivalve shell, gaping at the hinder extremity, with a nacreous interior, and generally a granular or spinulose exterior. The hinge is obscurely toothed, the cardinal teeth being rudimentary; the ligament is external, thin, and the cartilage is internal, placed in a pit in each valve, and furnished with a peculiar shelly hinge-piece or ossicle, which is placed before it, or sometimes so as to cover the whole of its surface. The family contains several genera.

GENUS ANATINA or LATERNULA.—This genus, the *Lantern-shell*, has a ventricose, thin and translucent shell, of an oblong form, gaping and attenuated at the hinder extremity. The beaks, which are directed backwards, are fissured or slit externally, and are supported internally by an oblique plate. The cartilage pit in this genus is placed on a projecting spoon-shaped process, which is furnished in front with a transverse, linear ossicle. The external surface of the valves is hispid, or roughened with calcareous points.

GENUS THRACIA.—This genus has the cartilage placed on a thick, not prominent, callous process on the hinge margin, and has a crescentic ossicle. Some of the species are found in crevices of rocks, and in the burrows of *Saxicava*, and have in consequence been sometimes mistaken for boring shells.

GENUS CHAMOSTREA.—This genus has a shell varying considerably in form and appearance from the typical species of *Anatinidæ*, but has the internal cartilage and ossiele peculiar to the family. The shell is inequivalve, like that of the *Chama*, solid, and attached by the anterior side of the deep and strongly-keeled right valve. The left valve is flat, and has a conical tooth in front of the cartilage, which is furnished with an oblong, curved ossicle, not unlike the human clavicle. As yet only one species is known; it is a native of the seas of Australia.

FAMILY—MUTELIDÆ (= *Iridinidæ*).

Notwithstanding the fluviatile habitat, and *Unio*-like general appearance of the shells of this family, they come into this sub-order, as we find the animal having the mantle lobes united and produced into two separate siphons. The shells are solid, oblong, equivalve, pearly within, and externally covered with a hard polished epidermis. The hinge is large, linear, and either toothed or toothless. The species of this family are all natives of fresh water, and are found either in Africa or South America.

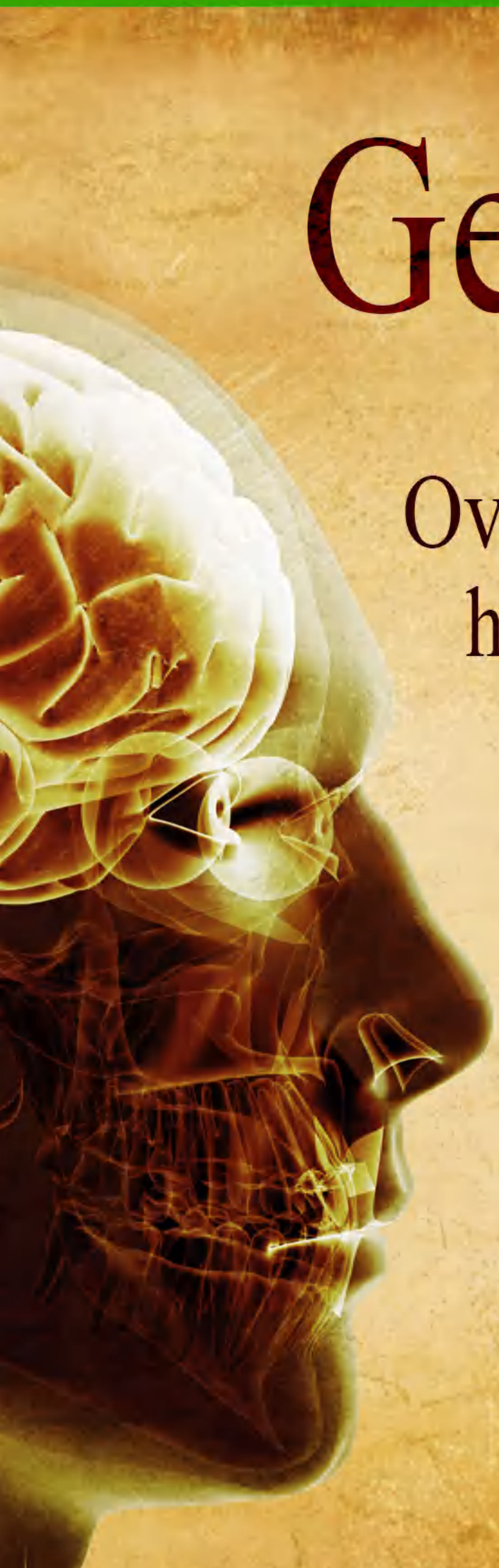
GENUS MUTELA (= *Iridina*).—This genus has an inequilateral, transverse shell, with the hinge margin smooth, without teeth, and attenuated towards the beaks, which are small, recurved, and nearly straight. The species of *Mutela* are natives of the rivers of Africa. One is found in the Nile (*M. exotica*), and the valves are used by the natives of Egypt as spoons in measuring oil, butter, and different kinds of provisions.

GENUS PLEIODON.—This genus (represented in Plate 10, fig. 5, by *Pleiodon ovatum*), has an ovate, strong, and convex shell, with the hinge margin slightly arched, which, becoming broader at its extremities, is furnished with a series of large, irregular teeth, or tubercular crenations. The outer surface of the valves is covered with a dark, olive epidermis, and the interior is brilliantly lighted up with an iridescent silvery nacre generally tinged with pink. The two or three known species are all from Africa.

The other genera are LEILA, CASTALIA, and HYRIA, the species of which are all natives of the fresh waters of South America.

FAMILY—CARDIIDÆ.

The Cockles have a regular, equivalve, usually inflated, and more or less heart-shaped shell, generally ornamented with radiating ribs and furrows. The margins interiorly are crenulated; the ligament is external, short, and prominent, and the hinge is composed of two oblique cardinal teeth, and two elongate, lamellar laterals in each valve. The pallial line is simple, or slightly sinuated behind. The animals have the foot angularly bent behind, enabling them to make leaps, prodigious in proportion to their size—the *Cardium norvegicum* being said to be able to effect such jumps as to spring out of the vessel in which it is held in captivity. The species of this family are very numerous, upwards of two hundred having been described; and are distributed over the whole world, from north to south, from east to west, and range from the sea-



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salt water for a time, it has probably been carried across seas attached to the bottoms of ships, and in this manner it appears to have reached England, and has become so common in our canals as to be much more abundant than many of our indigenous mollusks. James de Carle Sowerby first described it as British. This was in 1824, and he stated that it was found in abundance attached to shells and timber in the Commercial Docks, and that the animal was used as bait for perch. Mr. Stark found it in the Union Canal, near Edinburgh, in 1834; and the Rev. J. Berkely observed it in the river Nen in 1836, though he believed it had been introduced from Wisbeach, on timber, in 1828. Thus it would appear to have found its way into Britain at several points, and is now common in many parts of the country; in London it has been found in large quantities in iron water pipes, encrusted with a ferruginous deposit. On the Continent it is found in the Wolga, Danube, Elbe, and many of the rivers of Germany and Belgium.

Passing over the genus Galeomma, we come to the Clam Shells.

FAMILY—TRIDACNIDÆ.

The Clam Shells are solid, opaque, white shells, regularly equivalve, truncate anteriorly. The valves are strongly ribbed externally, and the margins dentate internally. The ligament is external, and the hinge is furnished with very oblique, interlocking teeth. The Clam Shells are the giants among the Bivalves, and live attached by their byssus to rocks, shells, and corals. "They also have the faculty of forming holes in the surface of the shell or coral to which they may happen to be fixed."—(*Gray.*)

GENUS TRIDACNA.—This genus has a massive trigonal shell, ornamented with radiating ribs and imbricating foliations. The valves have a wide gape close to the beak in front, occupying nearly the whole anterior side, for the passage of the large byssus. The hinge is composed of a single cardinal, compressed, tooth in each valve, two posterior lateral teeth in one, and a single one in the other.

THE GIANT CLAM SHELL (*Tridacna gigas*) is very large, with great imbricated squamous ribs. Its size and weight, combined with the beautiful marble-like appearance of its interior, have always caused it to be sought after as an ornament for grotto work or for garden fountains; and, indeed, as Mr. Broderip remarks, the valve of a large individual forms a very picturesque basin for catching the clear falling water, and transmitting it through the deep interstices of its indented edge to the reservoir below. In Roman Catholic countries, the valves of the huge shell are sometimes used as "benitiers," or vessels for containing holy water. A pair, so used, may be seen in the church of Saint Sulpice, in Paris; they weigh five hundred pounds, are more than two feet across, and were presented to Francis I. by the Republic of Venice. Specimens attain even larger dimensions than these, and indeed are, without exception, the largest shells known. The byssus is so large, and its attachment to the rock so strong, that it is frequently necessary to cut it with a hatchet, in order to remove the shell. The animal is good eating, and some of our earlier voyagers have mentioned it as furnishing their sailors a wholesome meal. Captain Cook states that they sometimes weigh upwards of twenty pounds; and, as Mr. Broderip observes, "a fine well fed Indian giant *Tridacna* would furnish forth a dish for a dozen." The genus is figured in Plate 10, fig. 8, by *Tridacna crocea*.

GENUS HIPPOPUS, Horse-hoof shell, or Bear's-paw Clam.—This genus has a transversely ovate shell of moderate size, ribbed, and squamous externally. It is readily distinguished from the preceding by its valves being closed and flattened in front, and, in consequence, having no aperture for a byssus, and by having only two compressed cardinal teeth in each valve. The only known species, *H. maculatus*, is a handsome shell, white, spotted with red or purple, and is found on the coral reefs of the Indian Ocean. The shells are now much used in the ornamental arts, for making into inkstands and other useful purposes.

ORDER II. PHOLADACEA.

IN this order the animals have in general a closed mantle, with two more or less elongate siphonal tubes, which are almost always united. The gills are produced behind into the inhalent or lower siphon; and the foot is frequently more or less elongated and club-shaped.

FAMILY—PHOLADIDÆ.

The Pholades have a thin, white, brittle, and exceedingly hard shell, with the valves united only by a very thin ligament, gaping at both ends, and armed with rasp-like imbrications in front. The shells are either free or within a shelly tube. The hinge is without any cartilage, and has no teeth, but is often strengthened externally by accessory valves. The hinge plate is reflexed over the beaks, and is furnished with a long, curved muscular process beneath each. The pallial sinus is very deep. The animal is symmetrical, club-shaped, or worm-like; the mantle is closed in front, except the orifice for the passage of the foot, which is club-shaped and truncated; and the siphons are large, elongated, and united nearly to the ends. The Pholades are found in most parts of the globe, and all the members of the tribe are borers into stone, clay, wood, or other substances. The species are numerous, are widely distributed, and they may even be said to be cosmopolitan. The question how the boring mollusca excavate their dwelling-places has been the subject of much discussion, and is still in a great measure undecided amongst Naturalists.

PHOLADINA.—The true Pholades have an elongated cylindrical shell, with the anterior gape either open or, in the adult, closed by a callous plate, and the dorsal margin covered by accessory valves. The

substance of the shell in the Pholades is hard, and, according to the observations of M. Necker, has a small quantity of a very hard mineral in its composition, called arragonite. The front surface is rough, with rasp-like imbrications. It is more than probable then, that with this combination of favourable circumstances, the method of boring of these animals is chiefly, at least, mechanical. The Pholades do not appear to perforate substances harder than themselves. Professor Owen attributes part of the process, to the action of the foot, which is sucker-like, and enables the animal to fix itself to the substance which it wishes to perforate. The softness of this body offers no obstacle, for "it is certain," says the Professor, "that the perpetual renewal of a softer substance will render it capable of wearing away a harder one, subject to the friction of a softer surface, and not like it susceptible of being repaired." There lies the whole mystery, exclaims Mr. Lewis; "the soft muscular disc is perpetually renewed, and the hard limestone has no self-renovating power; and thus, just as falling water wears away granite by the incessant repetition of gentle blows, so do these mollusks excavate rock or wood by the incessant repetition of muscular friction." By many naturalists, however, the rotatory action of the rasping shell, which has been demonstrated, is considered sufficient to produce the excavations; and an experiment, as a sort of test, was made by M. Caillaud, who imitated as nearly as possible the conditions of the mollusk, and produced a perforation in limestone, by carefully rotating the valves of a Pholas under water. The cavities made by the Pholades, if carefully examined, show transverse groovings, or circular striæ, such as could only have been produced by the rotatory action of the valves. The family is represented in Plate 10, fig. 9, by *Pholas dactylus*.

A remarkable property of the animals of the Pholades, and which has long attracted notice, is their phosphorescence or luminousness in the dark. The light is bluish-white, and is stronger as the animal is lively, fresh, and supplied with its fluids; and more powerful in summer, and at the period of propagation, than at other times. Reaumur ascertained that the Pholades secrete a fluid in considerable abundance, a kind of mucus, which is thrown off into the surrounding water, and produces this luminous appearance. Some of the species, especially a West Indian one (*Pholas costata*), are used as an article of food, and regularly sold in the markets of Havannah. In this country none are used by man; but the common piddock, *Pholas dactylus* (Plate 10, fig. 9), is used at Salcomb in Devonshire as a successful bait for fish.

This group consists of several genera, such as *Pholas* (= *Barnia*), *Dactylina*, *Xylophaga*, *Jouannetia*, *Pholadidea*, and *Zirphæa*.

GENUS XYLOPHAGA.—Most of the species of these genera perforate rocks; but those belonging to this genus are found living in floating timber. They bore about an inch deep, and invariably across the grain of the wood, which is always submerged; the burrows are oval, and lined with shell.

TEREDININA.—The Ship-worms differ from the Pholades in their shells being lodged at the inner extremity of a burrow partly or entirely lined with shelly matter. The shell is globular, open in front and behind, and the valves are trilobate, concentrically striated, and divided by a transverse furrow. The hinge margin is reflexed in front, and the cavity under the beaks, internally, is furnished with a long curved muscular process. The animal is worm-like, and the foot is formed like a sucker, and possesses a foliaceous border. As there are no plates or accessory valves to protect the dorsal margin, the animal, which always lives in wood, continues to bore deeper and deeper, and lines the holes as it proceeds with a shelly tube for its protection. The siphons are very long, united nearly to the end, with fringed orifices; and about the place where the two separate, they are provided with small calcareous bodies, called palettes or styles, which close the mouth of the tube. The species are not numerous. They are found in the seas of almost every clime, living in wood, which they perforate, and which, when broken up, may be carried floating about to immense distances. The burrows which they thus form are usually tortuous, and always in the direction of the grain of the wood, unless the animal meets another *Teredo*, or a knot in the timber. The way in which these worms accomplish their perforations is still the subject of dispute. M. Deshayes maintains that the Teredo bores by means of a solvent—a special solvent secreted by the foot. The animal adheres to the wood, he says, by the foot, and by it macerates the surface and renders it friable. Mr. Hancock, on the other hand, says that the excavating instrument of Teredo is formed of the anterior portion of the animal, in the surface of which are imbedded siliceous particles which, penetrating the skin, "give to it much the character of rasping paper." The whole forms a rubbing surface, which being applied closely to the bottom of the cavity by the adhesion of the foot, enables the animal to rub down and penetrate the wood. According to Mr. Osler, however, and some other naturalists, the Teredo, like the Pholas, works its way into and through the wood by mechanical means; the shell in it, as in the other, being the efficient instrument. However this may be, the devastation and destruction produced by this worm is immense. The damage formerly done to ships by its boring powers was so notorious in the days of Linnæus that that celebrated man termed it the "Calamitas navium;" and its English name of "Ship-worm" testifies to the estimation in which it was held by our forefathers. It is equally destructive to piers and bulwarks, and in the years 1731 and 1732 it had made such inroads upon the piles in Holland as to cause the greatest alarm. The piles which support the banks of Zealand and Friesland were threatened with total destruction, so that it was feared this worm would "reclaim from man what he had with unexampled labour wrested from the ocean."—(*Johnston.*) A great many remedies have been tried to prevent the attacks of the Ship-worm, but the most effectual plan hitherto devised is that now adopted of covering the timbers exposed to their assaults, with short, broad-headed nails, "which in salt water soon invests the whole with a strong coating of rust impenetrable by their angers." Notwithstanding the bad character they possess, these little worms are often

of use. They break down and destroy fragments of wrecks and floating timber which might otherwise act as dangerous impediments to navigation; for wood when entirely submerged, is almost indestructible under the mere influence of water. The celebrated engineer, Mr. Brunel, told Sir David Brewster that his plan of tunnelling the Thames was suggested to him by witnessing the boring of a Teredo. The Ship-worms are ovoviviparous animals, and are said to be of separate sexes. At certain seasons it has been observed that the female carries her eggs in the folds of her respiratory organs, and that they are ejected from the siphonal tube, after the milt of the male, floating in the water has fecundated them.* The young swim freely about, and are even able to float on the surface of the water.

FAMILY—GASTROCHÆNIDÆ.

This family is composed of species which are burrowers in mud or stone. The shells are thin, gaping in front, equivalve. The hinge is destitute of teeth, and the valves are united by a narrow ligament; they have no accessory plates on the dorsal margin. The animals live inclosed in calcareous tubes, or imbedded in mud or stone. The valves of the shell are either free or cemented to the shelly tube. The tube itself appears to be formed by the animal to protect its elongated and partly naked body from the roughness of the sand, or the rock, in the holes of which they reside.

GENUS ASPERGILLUM (= *Penicillus*).—This genus, the "Watering-pot," as it has been called, has the two valves of its shell, which are oval and equivalve, imbedded in the lower part of the tube, the beaks alone being visible externally. They are so small, and so completely imbedded in the substance of the tube, that they are generally overlooked, and the tube itself is the part looked upon as the real shell. This shelly tube is elongated, cylindrical, gradually becoming narrower posteriorly, or at the siphonal end, at which extremity it is open and sometimes ornamented with shelly expansions, like ruffles. At the anterior end it is club-shaped, and closed by a convex disc pierced with numerous tubular holes (like the rose of a watering-pot—hence the English name), with a fissure in the centre, and a circular frill of tubes round the periphery. The species, which are not numerous, seven or eight only having been described, are found imbedded in sand and mud at low water, on the shores of tropical countries; the closed disc with the tubular holes being below the surface, and the simple or ruffled siphonal extremity projecting about an inch above it. The genus is represented in Plate 10, fig. 10, by *A. Delessertianum*.

GENUS CLAVAGELLA (= *Bryopa*).—This genus has only one of the valves (the left one) of the shell imbedded in the shelly tube, the other being free. They are oblong, flat, often irregular, and inequivalve. The tube is cylindrical, varying in length, but generally much shorter than that of Aspergillum. It is open posteriorly, the margin of the opening being sometimes furnished with a succession of fringes, and is closed below or at the anterior end by a disc with a minute central fissure, and bordered with branching tubuli.

GENUS FISTULANA (= *Chæna*).—This genus has both the valves of the shell free. They are elongated, irregular, inequivalve, and widely gaping. They are contained within a shelly tube, which is round, tapering, and open at the anterior extremity, straight, transversely striated, closed at the lower end when complete, and thickened or club-shaped. It is furnished with a perforated diaphragm behind the valves.

GENUS GASTROCHÆNA.—This genus has both the valves of the shell free also. The valves are wedge-shaped, regular, widely gaping in front, and close behind. The species perforate shells and limestone, and line the crypts which they make with a layer of shelly matter. The holes made by one of the common species, *Gastrochæna modiolina*, are about two inches deep and half an inch in diameter. The external orifice is flask-shaped, and lined with a thin layer of shell, which projects slightly.

FAMILY—SAXICAVIDÆ.

The Saxicavas, as their name imports, form another family of Borers. They have great affinities with the preceding family, *Gastrochænidæ;* but, though often perforating stones, they never form shelly tubes or proteeting cases. They are borers, says Professor Forbes, "although the habit of boring does not seem necessary to their existence, since we find them very commonly free. If there be a crevice, however, in a rock, shell, coral, or sea-weed, into which they can thrust themselves, they do so; and if near a limestone rock, perforate it, and form crypts in which they live."

GENUS SAXICAVA.—This genus has the shell equivalve, solid, wedge-shaped, and gaping at each end—when young, with two minute teeth in each valve; but when adult, becoming toothless. The cartilage is external, thick, and prominent, and the pallial line sinuated, not continuous. The animals secrete a byssus. The species of *Saxicavæ* are few in number, but are very widely diffused, the same species even being found in many and distant parts of the globe. They are usually found burrowing in limestone rocks, though they have also been observed in sandstone, the animal being fixed by the byssus to the side of the hole it excavates. The question how these animals bore, has been as much discussed, as the Pholades already mentioned. The acid theory has had many supporters; but perhaps, on the whole, the views of Mr. Hancock may be considered as most likely to prove correct. The thickened portion of the mantle of the *Saxicava* is armed, he says, with a rough layer of numerous crystalline particles of various shapes and sizes, which are imbedded in the surface, and consist probably of silex or flint, either pure or in combination with some animal matter. This forms in fact a kind of file, superior, however, to any of our workmen's files in this, that the surface keeps itself always in a proper state of roughness for trituration, the siliceous crystals being constantly shed and as constantly renewed. This thickened portion of the

* NOTE.—M. Quatrefages finds that a weak solution of mercury thrown into the water destroys this milt, and consequently *prevents* the fecundation of the eggs, nipping the young mollusks in the bud.—*Lewes*.

which fits into a pit in the surface of the other. The family, as now restricted, is not numerous in species, about a dozen only having been described. The genera are *Mya*, *Sphœnia*, and *Tugonia*.

GENUS MYA.—This genus contains several species of some utility.

MYA ARENARIA (Plate 10, fig. 12), is used, both in this country and in North America, as food for man and as bait for fishes. On the banks of Newfoundland the fishers bait their lines very successfully with it, and it is said to be peculiarly acceptable to the cod. Dr. Gould, in his account of the Invertebrata of Massachusetts, says, "The Clam (*Mya arenaria*) is still more important in an economical point of view than the oyster. It is extremely prolific; and its exhaustless banks are every day accessible during twelve of the twenty-four hours." It is used for food, as well as for bait. About five thousand bushels of clams are annually brought to market. Immense numbers are salted for the bank fisheries—not less than five thousand barrels every year. "Seven bushels of clams make about one barrel of bait; so that thirty or forty thousand bushels are used in this prepared state, and perhaps as many more are used from the shell. The value of the clam-bait is six or seven dollars per barrel."—*Gould*, and *Johnston*.

MYA TRUNCATA is boiled and eaten by the inhabitants of Zetland, where it is known by the name of "Smurslin." In Greenland, according to O. Fabricius, these shells are much sought after by the walrus, the arctic fox, and various Northern birds.

Passing by the families of Corbulas (*Corbulidæ*) and Pandoras (*Pandoridæ*), we come to the second sub-class:—

SUB-CLASS II.—ASIPHONOPHORA.

THIS sub-class is divided into three orders:—

1. LASIACEA, in which the mantle lobes are united, with an anal siphonal aperture under the hinder adductor muscle, and a large opening for the passage of the foot.

2. UNIONACEA, in which the mantle lobes are free, slightly united behind, forming a separate and siphonal opening placed under the hinder adductor muscle.

3. PECTINACEA, in which the mantles are free all round, without any separate opening for the vent and out-going current.

ORDER I.—LASIACEA.

FAMILY—SOLENOMYIDÆ.

In this family the shell is elongated, cylindrical, obtuse at the extremities, and gaping. The valves are clothed with a dark, horny, shining epidermis, which extends beyond the margins. The hinge has a cardinal tooth in each valve, and a callosity running between them. The family consists of only one genus.

GENUS SOLENOMYA.—This genus contains only four known species. They are usually found burrowing in mud, in about two fathoms water, but at the same time are capable of leaping and swimming about with great freedom. Mr. Stimpson, an American conchologist, has observed them making surprising leaps and swimming about in the water for a considerable space of time without touching the bottom. The leap appears to be performed by the animal suddenly drawing in its large umbrella-shaped foot, at the same time that water is expelled from the hinder opening by the closing of the valves. The genus is represented in Plate 11, fig. 13, by *Solenomya mediterranea*.

The families *Laseidæ* and *Montacutidæ* possess no great interest; we will therefore pass on to the second order:—

ORDER II.—UNIONACEA.

FAMILY—LUCINIDÆ.

The shells of this family are of a more or less orbicular shape, free, and closed. The hinge varies very much; in most cases, however, there are one or two cardinal teeth, and two lateral teeth in each valve, though these are sometimes obsolete. Externally they are variously sculptured, and internally they are always dull and obliquely furrowed. The ligament is external or subinternal. The species are rather numerous; they are chiefly natives of temperate and tropical seas, living upon sandy and muddy bottoms, and ranging from the sea shore to great depths. A good many genera have been formed, their characters being derived from the structure of the hinge, the ligament, &c. These are *Lucina*, *Loripes*, *Corbis*, and *Ungulina*. The family is very well represented in Plate 11, fig. 14, by *Corbis fimbriata*.

FAMILY—ASTARTIDÆ.

In this family the shells are free, of a solid substance, oblong or cordate in shape, smooth or concentrically ribbed on the external surface and covered with a thick brown epidermis. The hinge is furnished with strong teeth—two diverging cardinal teeth in one valve, and one in the other. The ligament is external. Upwards of fourteen species have been described; they are found living in sandy mud, and are almost all found in the Northern seas—ranging geographically from Welling-

ton Channel and Behring's Straits to the Egean Sea, and in depth from thirty to one hundred and twelve fathoms.

FAMILY—CARDITIDÆ.

The species of this family have an ovate or cordate shell, with the surface marked externally with strong radiating ribs. The hinge is furnished with two oblique diverging cardinal teeth directed towards the same side, and no laterals; the ligament is external. The species, which muster upwards of fifty in number, are usually obtained from deep water, on rocky bottoms in tropical seas, though some are found also in shallow water and on the shores of North America.

In the genus *Cardita* the shell is oblong; while in *Venericardia* it is cordate and ventricose.

FAMILY—CRASSATELLIDÆ.

In this family the shell is solid, ventricose, attenuated posteriorly, smooth or concentrically furrowed, and of a porcellaneous texture. The hinge is furnished with two subdiverging, striated, cardinal teeth placed in front of a cartilage pit, and one lateral tooth in each valve. The ligament is internal, inserted in a pit in each valve. The species, which are about thirty in number, are usually dredged from deep water, and are chiefly found in the Australian seas, though some have also been obtained from India, Africa, and South America. None have as yet been discovered inhabiting Europe.

FAMILY—UNIONIDÆ.

The River Mussels secrete a byssus in the very young state. The shell is usually regular, equivalve, and closed. Externally it is covered with a hard, smooth, olivaceous epidermis, beneath which it is beautifully pearly. The ligament is external, large and prominent, and the hinge is variable. The River or Pond Mussels are found in fresh-water lakes, rivers, and ponds throughout the whole world. About three hundred species have been described—the greater number being natives of North America. In Asia and South America a considerable number occur; and though only a few species inhabit Europe, the number of individuals belonging to them is very great. In the *Unionidæ* the sexes are distinct, and the eggs in the females are contained in the outer gills, which in winter and early spring are found to be full of them. "The fry spins a delicate, ravelled byssus, and flaps its triangular valves with the posterior shell-muscle, which is largely developed, whilst the other is yet inconspicuous."—(*Woodward.*) At this season, Lister says that the *Unio pictorum* has the fetid smell of the goat.

GENUS UNIO.—This genus contains about two hundred and fifty species, which, as may be supposed, differ considerably amongst themselves in shape and general appearance. The inside of the valves is generally brilliantly nacreous, and the hinge is furnished with (often strong) cardinal teeth, and very elongated laminar laterals. The *U. pictorum* or Painter's Mussel is extensively used for containing gold and silver paint.

GENUS DAMARIS (=*Margaritana*).—This genus only differs in the posterior or lateral teeth being nearly obsolete. The only species of this genus is the Pearl-mussel, *Damaris margaritifera*. It is found in the rivers and mountain streams of Britain, Lapland, and North America. At the present day the animal is used by the fishermen in Scotland as a bait. Many boat-loads "are taken from the mouth of the Ythen, a river not far from Aberdeen, and employed in the fisheries of cod and ling, established near Peterhead."—(*Johnston.*) In former times, in the same country, these shell-fish were used as an article of food by the natives; "and such is their estimation among the deintiest kinds of food," says Boetius, in his account of Scotland, "that they were not unworthilie called, of old time, widowes' lustes." The pearls found in this shell are bright and of excellent lustre. At Perth there was an extensive fishery in the river Tay, which continued up to the end of last century, and which Pennant tells us had from 1761 to 1764 produced pearls worth £10,000. The fishery, however, we are also told, was exhausted by the avarice of the undertakers, and soon after ceased to be productive. In the river Conway, in North Wales, excellent pearls have been found; and it is said that Sir Richard Wynn of Gwydir, chamberlain to Catherine, queen of Charles II., presented her majesty with one taken from that river, which is to this day honoured with a place in the royal crown. In Ireland also a considerable fishery existed as long ago as 1690. Sir Robert Reading informs us that he had seen a pearl, taken in the county Tyrone, that weighed thirty-six carats, and was valued at £40. He also says "that a miller found a pearl which he sold for £4 10s. to a man that sold it for £10, who disposed of it to the Lady Glenawly for £30, with whom he saw it in a necklace, for which she refused £80 from the old Duchess of Ormond."

GENUS BARBALA.—This genus has a single linear tooth under the dorsal margin, extending the whole length; and the valves are produced at the back into a thin elastic dorsal wing. *Barbala plicata*, perhaps the only species, is the famous Chinese Pearl Mussel. The people of the Celestial Empire produce artificial pearls in this shell, by introducing wire and other foreign bodies under the mantle of the animal. In the British Museum, specimens may be seen where pearls of a fine lustre have been thus produced, as well as a series of little "josses," made of metal, and which, having been introduced under the mantle while the animal was alive, have gradually become quite coated with pearly matter.

GENUS ANODONTA.—This genus has the hinge perfectly toothless. The shell is generally thin, sometimes of large size, oval, smooth, compressed when young, but becoming ventricose by age. The species number about fifty, the greater number of which are natives of the fresh waters of North and South America. They are very prolific; and Mr. I. Lea, who has paid great attention to the study of this family, has computed that the outer gills of a female has contained

six hundred thousand young shells. This genus is represented in Plate 11, fig. 13, by *Anodonta cygnea*.

FAMILY—ETHERIIDÆ.

The Etherias have the shell irregular in shape, inequivalve, covered externally with a thick olive epidermis, and pearly within. The outer surface of the valves is very uneven, and frequently beset with tubular processes, while the internal surface is blistered, as if with air-bubbles, leaving cavities in the form of small vesicles, or very thin bladders between the plates. The hinge is without teeth, and the ligament subinternal. The adult shells are always attached to each other, or to foreign bodies, by the outer surface of one of the valves; but when young is free, like *Anodon*. In this young state the animal, as Dr. Gray observes, may possess a foot, but being adherent when adult, this organ becomes unnecessary. The little cavities in the inner substance of the shell, are believed to be filled with water when the animals are alive.

GENUS ETHERIA.—This genus adheres by the beak. The species are all natives of fresh water, being chiefly found in the river Nile, above the Cataracts, and in the river Senegal. Bruce, in his "Travels," mentions these shells under the name of "fresh-water oysters." They are collected, he informs us, by the natives as articles of food, and the shells are employed by them for ornamenting their tombs. For a representation of the family, see Plate 11, fig. 16—*Etheria caillaudii*.

FAMILY—MYTILIDÆ.

The Mussels secrete a byssus. The shell is equivalve, elongated, closed, with the beaks anterior. The valves are covered externally with a dark thick epidermis, and they are more or less pearly within. The hinge is without teeth, and the ligament is internal, submarginal, and very long.

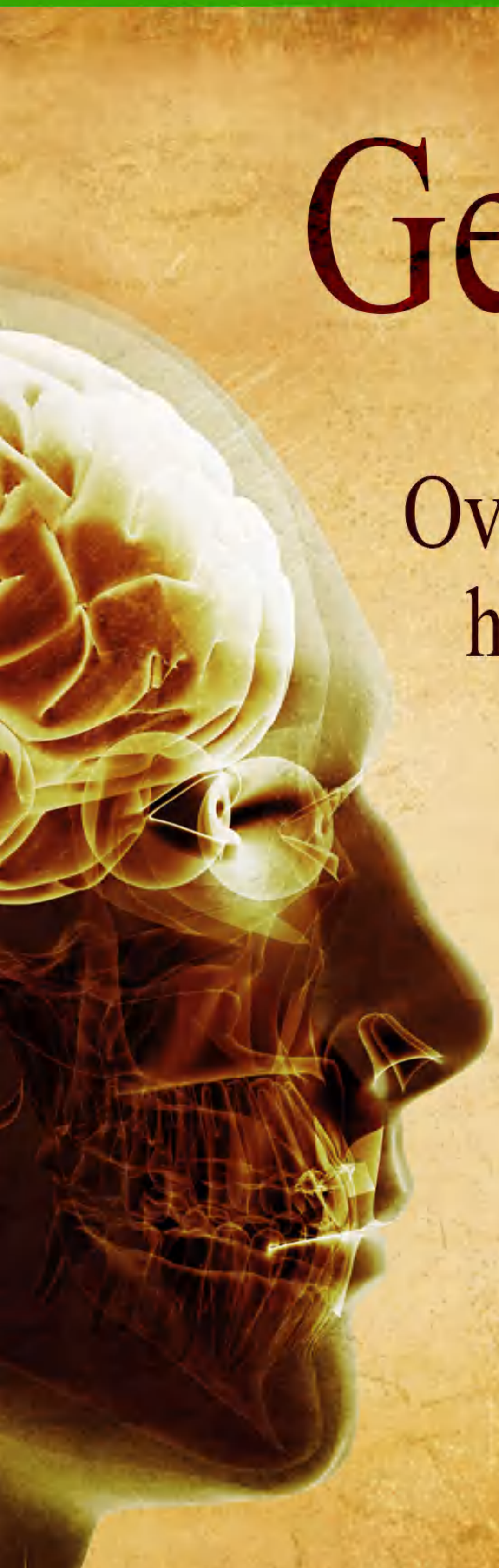
GENUS MYTILUS, the *Sea Mussel*.—This genus has a wedge-shaped shell, rounded behind, and the beaks terminal and pointed. The species of *Mytili* are numerous, and are world-wide in their distribution. The byssus which the animal spins is strong and coarse, and these shells are usually found attached to rocks, stones, floating bodies, &c. It appears, however, from the observations of Dr. Gould of Boston, that mussels are not quite stationary animals, but that they can move from place to place with great facility. The manner in which the common edible mussel, *Mytilus edulis*, forms its connection with the rocks and stones, &c., is explained by Reaumur. By placing some individuals in a vase of sea-water, he was able to watch the process. "Opening their valves, the foot was first protruded, and with various strains and stretches, gradually thrust out, until at length the elongation was carried to the desired extent, sometimes to fully two inches. It was now employed in feeling or testing all the objects within reach, directed to the right or left, or backwards or forwards. After all this prelude, to ascertain apparently the security of the intended holdings, the point of the foot is settled and retained for a short time on the chosen spot, when again, it is suddenly removed, and immediately withdrawn entirely within the shell, leaving behind a thread that reaches from the spot to the base of the foot. By many repetitions of this operation, carried on patiently day after day (for not above four or five threads are spun in the twenty-four hours), and by attaching the disc-like extremities of the threads to different places, the mussel at last completes its cable, and secures a safe anchorage."

Mussels are also used as bait for fishes, and as food for man.

THE EDIBLE MUSSEL (*M. edulis*, Plate 11, fig. 17) frequents mud banks, which are uncovered at low water, are very prolific, and attain their full growth in a single year. They abound in a great many parts of our coasts, and immense quantities are yearly consumed. Their fishery occupies a considerable number of persons, especially where the mussels have obtained a reputation for superior excellence. "This is the case with the mussels of Buddle Bay, on the coast of Northumberland; and those of Isigny, near Bayeux, and of other places on the western coast of France, are held in high estimation. Mussels, however, of inferior delicacy are found in very great abundance on the rocks which border the coast between St. Malo and Cancale, in the department De la Manche, where they are torn from their attachments by means of an iron hook at low water; and the annual profit of this fishery is estimated at from 2000 to 2500 francs."—(*Johnston.*) The consumption of mussels in Edinburgh and Leith is estimated at four hundred bushels (= four hundred thousand mussels) annually; enormous quantities, Mr. Woodward informs us on the authority of Dr. Knapp, are also used for bait, especially in the deep-sea fishery, for which purpose thirty or forty millions are collected yearly in the Firth of Forth alone. It is a curious fact that of all edible mollusks, the common mussel is that which proves most frequently poisonous to those who eat them. Dr. Johnston says that he has known them to produce an itchy eruption and swelling over the whole body, attended with great anxiety and considerable fever. Many instances of their having proved deleterious are mentioned in this author's excellent "Introduction to Conchology," and amongst others one that occurred in 1827 in Leith, which I well remember as having produced a great sensation in that town and in Edinburgh. Two or three deaths took place, and upwards of thirty people were severely affected. The cause of this unwholesomeness of mussels, at certain seasons, is still a matter of conjecture.

GENUS MODIOLA or HORSE-MUSSEL.—This genus has an oblong shell, inflated in front, and the beaks obtuse and placed a little behind the extremity. The species of Modiola are numerous—about seventy having been enumerated. They are chiefly tropical in their distribution, though a few are found in the Mediterranean, Great Britain, and even in the Arctic seas. They differ chiefly from the *Mytili* in the position of the beaks, and in their habit of burrowing or spinning a kind of nest in which they occasionally conceal themselves. They range from low water to an hundred fathoms.

GENUS LITHODOMUS.—The Date shells have a cylindrically oblong shell, rounded and inflated in front,



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The young shells are very thin and brittle, but some of the species, when they reach their full size, are thick and solid, and attain a length of upwards of two feet. The nacreous lining of the interior is thin and scarcely extends half-way from the beak. The colour of this internal pearly coat is usually of a reddish hue, and frequently pearls of a considerable size are found in the shells, partaking of the same tint, or that of amber. Specimens may be seen in the collection of the British Museum. Some of the Pinnas are used as articles of food; while others are valued for the powerful, silky byssus which, it has been mentioned, they possess.

THE SCALY PINNA (*Pinna squamosa*)—Plate 11, fig. 20—has long been known for the silky material which it affords, and which has been woven into various articles of dress. "This silk," says Dr. Johnston, "is the byssus, or rather the cable of the animal, by means of which it is moored to the rocks, in the same manner that our common mussel is. In a crude state the silk is called *lana penna:* the threads are extremely fine, of a perfect equalness in diameter through their whole length, and of great strength. It is cleansed from its impurities by washing in soap and water, drying, and rubbing with the hands. It is then passed through combs of bone, and afterwards, for finer purposes, through iron combs or cords, so that a pound of the coarse filaments is usually reduced to about three ounces of fine thread. When mixed with about one-third of real silk, it is spun on the distaff, and knit into gloves, caps, stockings, vests, &c., forming a stuff of a beautiful brownish-yellow colour (resembling the burnished golden hue on the back of certain flies and beetles), but very liable to be moth-eaten, and requiring to be wrapped in fine linen. A pair of gloves costs on the spot about six shillings, and a pair of stockings eleven; but its sale is not very extensive, and the manufacture is peculiar to Toronto." Specimens of the byssus, and gloves made from it, may be seen in the collection of the British Museum. It has long been known that a little crab infests the mantle or gills of this same Pinna, and indeed the common mussel of our own shores also. The fact was known to the ancient naturalists, who, as Dr. Johnston observes, "never left an observation to stand, like truth, all naked, but ever clothed it with some pretty vestment." They believed that this little crab (belonging to the genus *Pinnotheres*) formed a close alliance with the shell-fish, and acted the part of a guardian to its blind host. The story is told by Pliny, and is thus translated by Dr. Holland:—"The Nacre, also called Pinna, is of the kind of shell-fishes. It is alwaies found and caught in muddie places, but never without a companion, which they call Pinnoter, or Pinnophylax. And it is no other but a little shrimpe, or, in some places, the smallest crab, which beareth the Nacre companie, and waites upon him for to get some victoals. The nature of the Nacre is to gape wide, and sheweth unto the little fishes her seelie body, without any eie at all. They come leaping by and by close unto her; and seeing they have good leave, grow so hardy and bold as to skip into her shel and fill it ful. The shrimp lying in spiall, seeing this good time and opportunitie, giveth token thereof to the Nacre, secretly with a little pinch. She hath no sooner this signall but she shuts her mouth, and whatsoever was within crushes and kills it presently; and then she divides the bootie with the little crab or shrimp, her sentinel and companion." The family *Pinnadæ* is a very natural one, and contains only two genera—*Pinna*, distinguished by having the shell elongated and marked with a longitudinal crack filled with cartilage in the middle of each valve; and *Atrina*, which has a shorter shell and no such crack.

FAMILY—AVICULIDÆ (*The Wing-shells*).

The shells are inequivalve, very oblique in most instances, resting on the right valve, which is the smaller, and which has a notch in the front margin for the passage of the byssus. The ligament is marginal, and the cartilage is contained in one or several grooves, the hinge being without teeth, or obscurely dentated. The beaks are anterior and eared, the posterior ear wing-like. The outer surface of the valves is foliated, with an indistinct epidermis, and the interior is highly nacred or pearly. There are several genera, as *Malleus*, the Hammer-oyster; *Avicula*, the Wing-shell; *Margaritiphora*, the Pearl-oyster; *Perna*, and *Crenatula*—but we have only space for a notice of the Pearl-oyster.

GENUS MARGARITIPHORA (*the Pearl-oyster*).—This genus has a less oblique shell than most of the family, and the valves are flatter and nearly equal. They are somewhat orbicular in shape, and the hinge margin is not produced posteriorly into ears. The hinge is without teeth, and the ligament is external and dilated in the middle. The external surface of the shell is squamose, and the interior is of a pearly lustre. The Pearl-oysters are famed for their production of the beautiful Oriental pearl, and the substance, so much used in the arts and manufactures, called "mother of pearl." The shells are found at Ceylon, the Persian Gulf, Madagasear, the Swan River, Panama, and other parts of the coast of America, and are usually procured from about twelve fathoms water. Pearls, being amongst the most beautiful ornaments for female attire, have for a very long time been highly prized, and the love for their use has often called down stern denunciations, from satirists and moralists, of female vanity. "Pearls of great price" have been eagerly sought after by mankind from the earliest ages. The Romans had an inordinate love for ornamenting themselves with pearls. Pliny tells us that Lollia Paulina ("late wife, and after widow, to Caius Caligula, the emperor,") used to wear such a quantity of pearls and emeralds about her person, that the value was rated, according to her own estimation, at 400,000 sestertii. "I have seen her," he says, "so beset and bedeckt all over with hemeraulds and pearls, disposed in rows, ranks, and courses one by another; round about the attire of her head, her cowle, her borders, her peruk of hair, her bond grace and chaplet; at her eares pendant, about her neck in a carcanet, upon her wrist in bracelets, and on her fingers in rings; that she glittered and shone again like the sun as she went." In those days the most extravagant prices were given for pearls. Julius Cæsar, we are told, presented Servilia, the mother of M. Brutus, with a pearl worth £48,417; and the celebrated Cleopatra,

at a supper with Antony, took from her ear one of two pearls valued at £80,729 3s. 4d., dissolved it in vinegar, and drank it off. The traveller Tavernier, in more modern times, informs us that he saw in Persia a pearl, which had been brought from the fishery at Catifa in Arabia, and then in the possession of the Shah of Persia, which was nearly one and a half inches long, $\frac{63}{100}$ths of an inch in diameter, and was valued at £110,000. The two great fisheries of pearls are those at Bahrein Island, in the Persian Gulf, and in the bay of Condatchy in the Gulf of Manaar, off the island of Ceylon. The fishery of this latter place varies very much in value. In 1798 the revenue derived from it to Government reached the large sum of £192,000, but in 1828 it only brought £30,612. The Bahrein fishery, which includes the whole trade of the Persian Gulf, is estimated as worth from £300,000 to £310,000! The worst and most valueless kinds of pearls taken at Ceylon are "carried to China, to be burned into lime, which the rich Chinese use, instead of lime, with the betel leaf and areca nut."—(*Bertolacci.*) The small pearls called seed pearls, from the Persian Gulf fishery, find their way in large quantities into various parts of India, where they are used in the composition of the majoons or electuaries, so much valued by the natives for their supposed stimulating and restorative qualities.

THE PEARL-OYSTER (*Margaritiphora fimbriata*), represented in Plate 11, fig. 21, *Margarita margaritifera*, when adult, is of a solid thick substance, and of a highly polished nature internally. This forms the article called in commerce "mother of pearl," a substance now used in so many ways in ornamental work —as inlaying cabinet work, forming knife handles, paper cutters, buttons, and constructing toys and fancy articles. Immense quantities of these shells are annually imported into Great Britain. "There are three principal kinds, which are worth from £2 to £4 per cwt.—1st, The Silver-lipped, from the Society Islands, of which about twenty tons are annually imported to Liverpool; 2nd, The Black-lipped, from Manilla, of which thirty tons were imported in 1851; 3rd, A smaller sort from Panama, two hundred tons of which are annually imported — in 1851 a single vessel brought three hundred and forty tons."—(*Woodward.*) The animals of these shells are sometimes used as food. Morier says that those in the Persian Gulf are considered excellent, and that there is no difference to be perceived in respect of taste between them and the common oyster. Most authors, however, describe them as unfit for the table. Dampier, in one of his voyages, found them in abundance at Gorgonia, coast of Peru. "The fish," he says, "is not sweet nor very wholesome; it is as slimy as a shell-snail; they taste very copperish if eaten raw, and are best boyl'd. The Indians, who gather them for the Spaniards, hang the meat of them on strings like Jews-ears, and dry them before they eat them." In another part of the coast of South America, he says that they were "so large, that one stewed is a meal for five men." "The crew," he adds, "ate them for want of better food." When stewed with pepper and vinegar, they were "very tolerable food."

FAMILY—SPONDYLIDÆ.

The Thorny oysters have the margins of the mantle thickened and furnished with bright eye-spots or oc*elli*. The shell is irregular, attached by the right valve, radiately ribbed, spiny or foliaceous. The hinge has two large interlocking teeth in each valve.

GENUS SPONDYLUS, or THORNY OYSTER.—This genus (the only one) has in general a strong thick shell, variously ornamented with spines or plates. The beaks are apart from each other, and eared. The lower valve has a peculiar triangular hinge area, divided by a groove and enlarging as it grows older; and the cartilage is placed in a pit which communicates at its base with the external groove. These shells adhere to foreign bodies, such as stones, coral, &c., by the right valve, being cemented to these bodies without the medium of any connecting membrane or ligament, and becoming modelled to the foreign substance on which it lies. In the inner layer of shell there are left in some of the species, as in *Spondylus varians*—hence called the "Water-clam"—spaces or cavities which are filled with water. Similar cavities are found in the *Etheriæ;* but these are generally like blisters or air bubbles, whilst in *Spondylus* the quantity of water contained is often considerable and remains for a length of time, perhaps years, after the shell is dry. These cavities are produced by the border of the mantle depositing shell more rapidly than the umbonal portion. There are a good many species, and some of them are beautiful shells and adorned with bright and lively colours. The genus is represented in Plate 11, fig 22, by *Spondylus regius*.

FAMILY—PECTENIDÆ (*The Scallops*).

The Scallops have a long foot, which secretes a byssus. The margins of the mantle are double, the inner hanging down somewhat like a curtain and finely fringed; and having at its base a row of conspicuous round black spots, like eyes, called oc*elli*, surrounded by tentacular filaments. The shell of the Scallops is free, not cemented, and is closed. The beaks are placed near each other, and the dorsal edges are produced into ears. The ligament is internal, in a central pit. The species are numerous; they generally attach themselves by a byssus to rocks and other marine bodies, and sometimes cover extensive banks with their shells. Their long and angulated foot is not at all adapted for crawling, but it is used "chiefly as an exploring organ and to anchor them when required." —(*Adams.*) The animals are said to possess the power of vision; and the bright spots on the edge of the mouth are believed by many conchologists to be the eyes. Poli so considers them, and he named the animal, "after Juno's watchman, the Argus, to whose mantle you may suppose the hundred eyes of the fabled son of Ariston had been transferred."—(*Johnston.*) When young the Scallops are free and extremely active. The fry of the common "Quin," as it is called, *Pecten operculatis*, has been particularly noticed by Dr. Landsborough. At the time he observed them they were about the size of a fourpenny piece, and were seen in

a pool of sea-water left by the ebbing tide. He thought from their motions that they were small fishes. "On close investigation, however," he says, "we found that it was the fry of *P. opercularis* skipping quite nimbly through the pool. Their motion was rapid and zig-zag, very like that of ducks in a sunny blink, rejoicing in the prospect of rain. They seemed, by the sudden opening and closing of their valves, to have the power of darting like an arrow through the water. One jerk carried them some yards, and then, by another sudden jerk, they were off in a moment in a different tack. We doubt not that when full grown they engage in similar amusements, though as *Pectens* of greater gravity they choose to romp unseen, and play their gambols in the deep." The ancients believed that by flapping their valves, by a very quick motion, they could "rise up from their beds in the deep and navigate the surface, having one valve raised and exposed with its concavity to the breeze, while the other remained under the water, and answered the purpose of a keel, by steadying the animal and preventing its being overset."—(*Johnston.*) The sailing part of this account, as Dr. Johnston observes, is no doubt an embellishment thrown in by way of effect; but there is no doubt these animals do possess the power of leaping to a considerable distance, and M. Lesson tells us that he has seen them leap out of the water by striking their valves rapidly together. When deserted, too, by the tide on any occasion, they will tumble forward by the same kind of movement, until they have regained the water. Fabricius, in the Fauna of Greenland, tells us that the northern species, *Pecten islandicus*, which is used as food by the natives, is often cooked with difficulty, for if the shell is put into the pot alive it leaps out of it again. Several species are used as food. The *Pecten* (*Janira*) *maximus* is often, in England, pickled and barreled for sale, and *P. opercularis* is a common article of food in Scotland. The shells, too, of some of the species are employed as useful articles. They are used as spoons; and "in the days when Ossian sang, the flat valves of the Scallop (*P. maximus*) were the plates, and the hollow ones the drinking cups, of Fingal and his heroes; hence the term *shell* became expressive of the greatest hospitality."—(*Johnston.*) The shell of *Pecten* (*Janira*) *Jacobæus*, St. James' shell (Plate 11, fig. 23), was worn as the emblem of the pilgrim journeying to the Holy Land. It was worn fixed to the hat in front, and became the badge of several orders of knighthood; for, as Moule in his "Heraldry of Fish" remarks, "when the monks of the ninth century converted the fisherman of Gennesaret into a Spanish warrior, they assigned him the scallop shell for his 'cognizance.'" The family contains several genera—*Pecten*, *Janira*, *Amusium*, and *Pedum*.

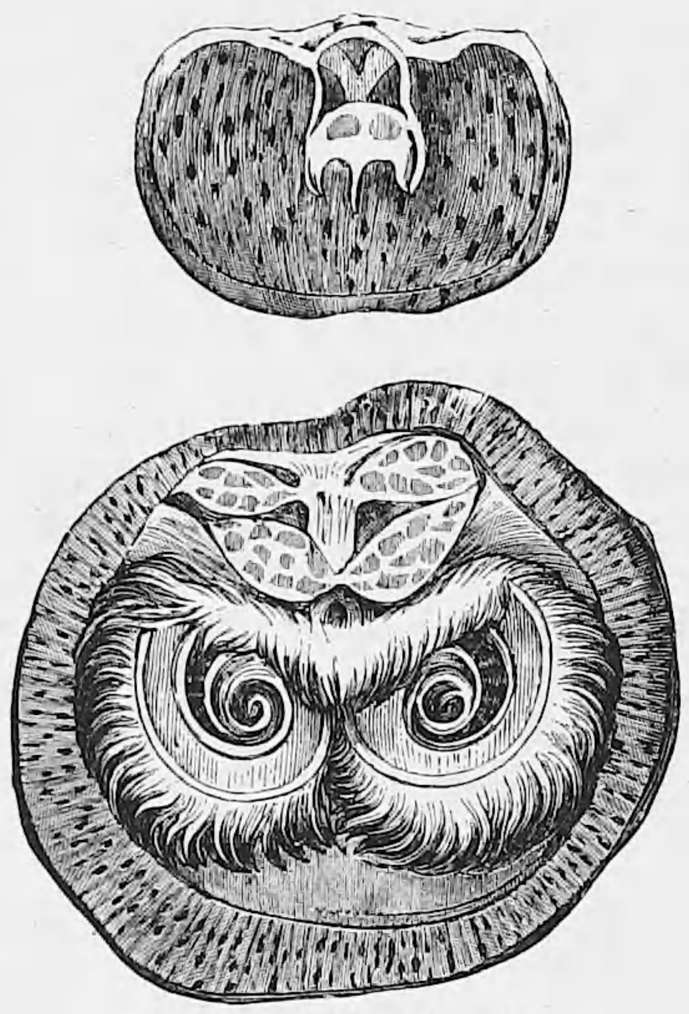
FAMILY—LIMADÆ (*The File-shells*).

The File-shells have their shells always white and gaping at the sides. The valves are equal, obliquely oval, and the beaks are apart and eared. The hinge is without teeth, the area triangular, and the cartilage pit central. The surface externally is usually grooved in a radiating manner, and some of the species are covered with a thin brown epidermis. The species are not very numerous. They are active creatures, and possessed of such locomotive power that Messrs. Quoy and Gaimard tell us they were obliged to run after them in order to catch them. Mr. A. Adams, in describing the habits of some foreign species which he had watched amongst the Philippine Islands, says —"The Limæ usually live quietly at the bottom with the valves widely extended and thrown flat back, like the wings of certain butterflies when basking in the sun; but when disturbed they start up, flap their light valves, and move rapidly through the water by a continued succession of sudden jerks. The cause of alarm over, they bring themselves to an anchor by means of their provisional byssus, which they seem to fix with much care and attention, previously exploring every part of the surface with their singular leech-like foot. When many hundreds of these curious bivalves are seen at the bottom of clear pools, surrounded by living branches of party-coloured coral, their crimson-spotted mantles and delicate spiral appendages that fringe the edges cause them to exhibit a very rich and beautiful appearance." Our British species are described as equally beautiful. Dr. Landsborough, in his delightful little book, "Excursions to Arran," tells us that he had an opportunity of watching the movements of the common *Lima hians* (or *tenera*) in Lamlash Bay. When put into a jar of sea-water, he says, this Lima "is one of the most beautiful marine animals you can look upon. The shell is beautiful; the body of the animal within the shell is beautiful; and the orange fringe-work outside of the shell is highly ornamental. Instead of being sluggish, it swims about with great vigour. Its mode of swimming is the same as that of the Scallop. It opens its valves, and suddenly shutting them expels the water, so that it is impelled onwards or upwards; and when the impulse thus given is spent it repeats the operation, and thus moves on by a succession of jumps. When moving through the water in this way, the reddish fringe is like the tail of a fiery comet. The filaments of the fringe are probably useful in catching its prey. They are easily broken off, and it is remarkable they seem to live many hours after they are detached from the body, twisting themselves like so many worms." These very interesting little mollusks also spin for themselves a nest or artificial burrow in which they live gregariously. This kind of nest is composed of sand and fragments of coral and shells united together by means of their temporary byssus. "The coral nest," says Dr. Landsborough, "is curiously constructed, and remarkably well fitted to be a safe residence for this beautiful animal (*Lima hians*). The fragile shell does not nearly cover the mollusk—the most delicate part of it, a beautiful orange fringe-work, being altogether outside of the shell. Had it no extra protection the half-exposed animal would be a tempting mouthful, quite a *bonne bouche* to some prowling haddock or whiting; but He who tempers the wind to the shorn lamb teaches this little creature, which he has so elegantly formed, curious arts of self-preservation. It is not contented with hiding itself among the loose coral, for the first rude wave might lay it naked and bare. It becomes a marine mason and

CLASS V.—BRACHIOPODA (BRACHIOPODS.)

THE Brachiopods are so closely allied to the conchiferous mollusks, that they have been considered by many naturalists as forming only a simple division of that extensive class. "In all essential points," says Professor Owen, "the *Brachiopoda* closely correspond with the acephalous *Mollusca*, and we consider them as being intermediate to the Lamellibranchiate and Tunicate orders; not, however, possessing, as far as they are at present known, a distinctive character of sufficient importance to justify their being regarded as a distinct class of mollusks, but forming a separate group of equal value with the *Lamellibranchiata*." In accordance, however, with the more modern systems of classification, as propounded by Dr. Gray, Mr. Woodward, and the Messrs. Adams, we treat them as a separate class, the peculiar structure of the animal entitling them to such distinction. Though this structure shows them to be comparatively low in the scale, yet they are exceedingly interesting both to the physiologist and the geologist. The number of recent or living species is small, but in former periods of the earth's surface it was very great, and the Brachiopods at those times occupied the position now taken by the *Conchifera*. The shell of the Brachiopodous mollusca is essentially bivalve. It is symmetrical but inequivalve, and is generally attached to submarine bodies by a muscular peduncle which passes through a hole in the beak. This in all probability is a byssus when the animal is young, but becomes consolidated as it increases in age, and forms at length a permanent organ of attachment. The valves, instead of being right and left as in the *Conchifera*, are superior and inferior. As the animal lies upon its back, the lower valve covers the back of the animal, and therefore is, with reference to the body, correctly called the *dorsal* valve; the upper, covering the ventral surface, receives the name of *ventral* valve. The dorsal valve is the smaller of the two in general, and is always free; the ventral valve, on the contrary, is usually the larger, and has its umbo produced and perforated for the passage of its attaching peduncle. These valves are united by a hinge without a ligament, and are articulated by two curved teeth, which are developed from the margin of the ventral valve and fit corresponding sockets in the other. Internally the dorsal valve is furnished with a peculiar shelly apparatus, called by some authors the "apophysary system," and by others the "internal skeleton, and by collectors the "carriage-spring." "The principal part of the internal skeleton," says Professor Owen, "consists of a slender, flattened, calcareous loop, the extremities of which are attached to the lateral elevated ridges of the hinge. The crura of the loop diverge, but again approximate to each other, as they advance for a greater or less distance towards the opposite margin of the valve. The loop then suddenly turns towards the perforate valve, and is bent back upon itself for a greater or less extent in different species. . . . . The arches of the loop are so slender that, notwithstanding their calcareous nature they possess a slight degree of elasticity and yield a little to pressure, but for the same reason they readily break off if the experiment be not made with due caution." (See cut annexed—fig. 230—upper figure.) This extraordinary apparatus is intended for the support of the "fringed

Fig. 230.



Structure of Brachiopods.

arms" of the animal, a structure which is peculiar to this class of mollusks, and which has obtained for them their name.* (See lower figure.) The mouth of the Brachiopods is placed on the under part of the cavity between the lobes of the mantle. Developed from the sides of this mouth we see two long appendages, which appear to be lateral prolongations of the lips, and correspond with the lips and labial tentacles of the ordinary bivalves. These have usually been called arms —they are free or united by membrane, and are so long that they require to be folded up. In most of the species they are twisted in a spiral form, and their outer margins are fringed with long cirrhi or filaments, by means of which the animal creates a current in the water that brings objects of food within reach of the mouth. Some conchologists imagine that the animal has the power of protruding these oral arms beyond the shell in search of food; but this does not appear to be the case, as from the fact of their being united by a membrane, and supported by the internal skeleton described above, they must evidently be confined to one position. In some of the genera, however, we are told that the ends of their arms are "endowed with a degree of voluntary motion, the movement being effected by the injection of a fluid into the hollow spiral tube, by means of which the coils are separated."

* From βραχιον, arm, and πους, foot, these arms having been supposed to take the place of the feet in the preceding classes.

Another peculiarity in the structure of the Brachiopodous Mollusca is their respiratory system. True gills are altogether wanting, and accordingly, by some of the earlier conchologists, these oral or fringed arms were considered as subsidiary to respiration and the aeration of the blood; but Professor Owen, in his masterly paper in the *Zoological Journal*, from which we have already given an extract or two, shows that these processes are carried on by the mantle. The true branchial vessels, he says, are ramified in rich profusion upon the inner surface of the lobes of this part of the body, and consequently it forms the chief, if not the sole respiratory organ. "In this profuse distribution of vessels over a plain membraneous expansion," says the Professor, "we perceive the simplest construction of the water-breathing organ, or *branchia*." In some of the Brachiopods the ova are developed in these large branchial veins, and in others they are developed in vascular sinuses on each side of the body. Nothing accurate is known respecting the development of the young, but they are believed to be, in their first stage, free and able to swim about until they meet with a suitable position. Some of them appear to attain their full growth in a single season, and all, probably, live many years after they have become adult. The species are all marine, and are found attached to branches of coral, hanging from the under side of shelving rocks, or abiding in the cavities of other shells. They are seldom found on clay beds; but where the bottom consists of calcareous mud they appear to be very abundant, mooring themselves to every hard substance on the sea bed, and clustering one upon the other.—(*Woodward.*) The Brachiopods enjoy a greater range both of climate and depth, as well as time, than any other Mollusca known. They are found in tropical, temperate, and arctic seas; in shallow pools left by the retiring tide, and at the greatest depths explored by the dredges; whilst, in time, they are found fossil in the miocene tertiary, and in the oldest Devonian strata. Indeed the oldest form of organic life at present known, both in the Old and New world, is a *Lingula*. At present there are only between seventy and eighty recent species known, whilst of extinct forms upwards of one thousand have been described.

The class BRACHIOPODA is divided into two sub-classes—I. ANCYLOPODA, and II. HELICTOPODA. In the *Ancylopoda*, the oral arms are recurved; not extensile, or only at the tip; and are affixed to shelly appendages on the disc of the dorsal valve. The mantle is adherent to the shell, the substance of which is pierced by numerous minute perforations. In the *Helictopoda* the oral arms are elongate and regularly spirally twisted when in repose. The mantle lobes are merely applied to the inner surface of the shell, the surface of which is not punctured.

The sub-class *Ancylopoda* is divided again into two orders—I. ANCYLOBRACHIA, and II. CRYPTOBRACHIA.

The *Ancylobrachia* have the oral arms affixed to calcareous lamellæ, forming a loop attached to the hinge margin of the dorsal valve, and more or less prominent in its cavity. The animal is generally attached to marine bodies by a tendinous peduncle. The *Cryptobrachia* have the oral arms sunk into grooves in the convex centre of the inner surface of the ventral valve. The shells are generally attached by the outer surface of the larger valve.

SUB-CLASS I.—ANCYLOPODA.

ORDER I.—ANCYLOBRACHIA.

THIS order contains only two families:—

FAMILY—TEREBRATULIDÆ (*The Lamp-shells*).

The shells in this family (see Plate 11, fig. 26, *Terebratula australis*) are inequivalve, and usually oral or subcircular. They are somewhat like a Grecian lamp in form, and have therefore received the general appellation of *Lamp-shells*. The valves are minutely punctate, sometimes smooth, sometimes striated. The ventral valve is the larger, and its beak is produced and truncated at the apex, which is perforated. The foramen or hole is sometimes perfect, at other times it is a deep sinus, unconneeted at its lower margin. It is usually separated from the hinge line by a triangular plate, called the *deltidium*, which is composed of two pieces. The two teeth are placed in this valve, situated one on each side of the deltidium. The dorsal, and smaller valve, has a depressed beak, two sockets for the reception of the teeth of the ventral valve, and a prominent cardinal process between them. It is also furnished with a hinge plate provided with four cavities, and a central ridge or *septum*. The internal skeleton (see fig. 204) is attached to this valve, and consists of a slender shelly loop attached in some genera at its origin to the hinge plate, and furnished with oral processes; in others to the septum in the middle of the dorsal valve. The animal is always attached by a peduncle, which passes through the hole or deep sinus in the apex of the beak; and the strongly cirrhated, looped, or contorted oral arms (described above) are united throughout by membrane, are folded upon themselves, and are only spiral at their extremities. The valves are opened and closed by adductor and retractor muscles, and the peduncle is provided with two additional ones. The species, though not numerous, have been distributed throughout a number of genera, whose characters have been taken chiefly from the structure of the internal skeleton. They may all be arranged in two tribes.

TRIBE I.—TEREBRATULANINA.

The species belonging to this tribe have the shelly loop attached to the hinge plate, and is composed of three genera, *Terebratula*, *Terebratulina*, and *Waldheimia*.

TRIBE II.—MAGASINA.

In this tribe the species have the shelly loop attached to the septum, in the middle of the dorsal valve, and is composed of six recent genera—*Terebratella*, *Magas*, *Bouchardia*, *Megerlia*, *Morrisia*, and *Kraussia*.

ORDER II.—CRYPTOBRACHIA.

FAMILY—THECIDEIDÆ.

This is the only family of recent shells contained in the order. The animals have the oral arms folded upon themselves, united by membrane, fringed with long cirrhi on their outer margins, and supported by a shelly loop. The mantle extends to the margin of the valves, and adheres closely.

GENUS ARGIOPE.—This genus has the loop folded into two or four lobes, and adhering to the prominent septa with which the dorsal valve is furnished interiorly.

GENUS THECIDEA.—This genus has an unsymmetrical loop divided into two or more lobes which are united more or less intimately with grooves formed in the disc for their reception.

SUB-CLASS II.—HELICTOPODA.

THIS sub-class consists, like the preceding, of two orders—the SCLEROBRACHIA and the SARCOBRACHIA, the first having the oral arms, supported by a shelly band arising from the hinder or cardinal edge of the ventral valve; the second, having the oral arms fleshy to the base, and without any shelly support.

ORDER I.—SCLEROBRACHIA.

IN this order there is only one family of recent shells, and this consists of a single genus.

FAMILY—RHYNCHONELLIDÆ.

The Rhynchonellas have elongate, fleshy, spiral, oral arms, supported at the base by two short, hard, diverging shell-laminæ arising from the hinge margin of the ventral valve.

GENUS RHYNCHONELLA.—This genus has a trigonal shell, usually plaited, and acutely beaked. Externally it is not punctate, and internally it has no testaceous skeleton or apophysary system. The dorsal valve is elevated in front, and depressed at the sides, whilst the ventral valve is hollowed along the centre. The foramen is triangular and open, situate under the beak. Only two recent species are known; one from the northern seas, and the other from New Zealand.

ORDER II.—SARCOBRACHIA.

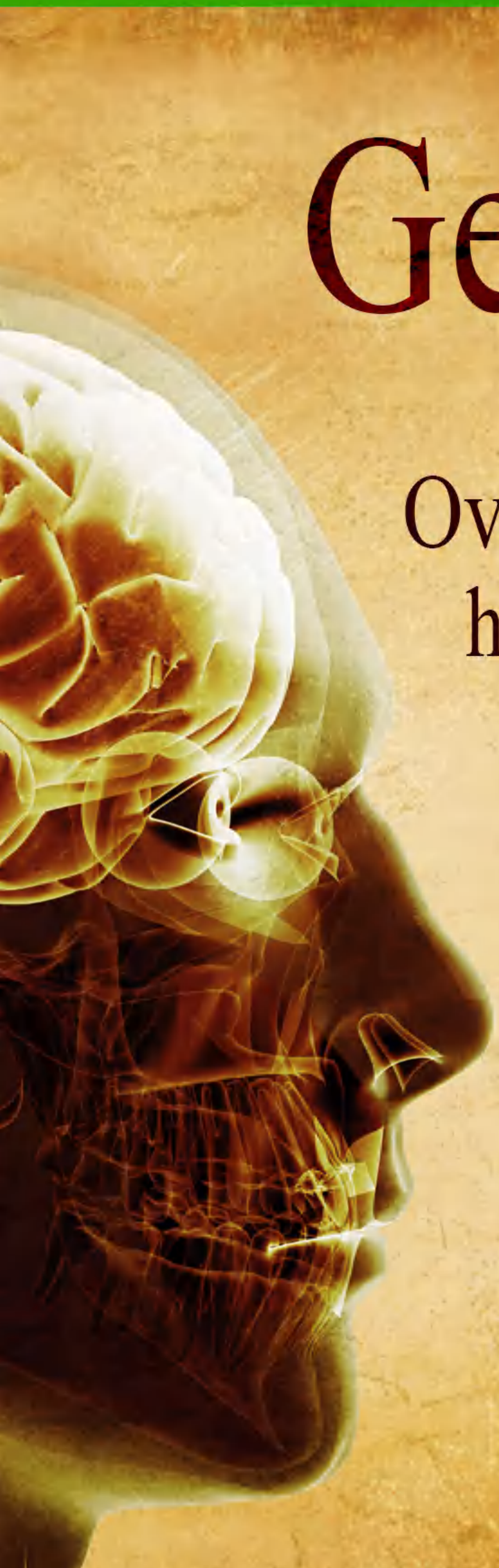
THIS order is composed of three families of recent shells, all distinguished by there being no processes on the hinge-margin or disc in the lower valve, though in some of them there is a slight medial longitudinal elongation.

FAMILY—CRANIIDÆ.

The Cranias have the oral arms fixed to a process of the ventral valve. The shell of *Crania* is orbicular, calcareous; the dorsal or upper valve of a conical form, and the lower or ventral valve entire, flat, and attached by its outer surface to marine bodies. Five recent and twenty-eight fossil species are known. The recent ones are natives of the north seas, the coasts of Great Britain, the Mediterranean, India, and New South Wales.

FAMILY—DISCINIDÆ.

The Discinas, like the preceding family, have the oral arms fixed to a process of the ventral valve; but the shell is horny, and when fresh and moist, is quite flexible, and is attached to marine bodies by a short tendinous peduncle, which passes through a small slit in the disc of the lower valve. The upper valve of *Discina* is conical, and resembles the shell of a limpet or *patella*, the lower is orbicular and flat; they are not united together by a hinge, and the external surface is minutely punctate. Seven recent species are known, chiefly from South America.



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morphoses. The larvæ are like tadpoles in shape, are solitary and free, swimming rapidly by the aid of the undulatory movements of a long tail. They attach themselves occasionally; they then change their form, lose their tail, and after a few days' free and locomotive life, finally fix themselves. In addition to reproduction by ova the compound Tunicaries have been ascertained to possess a second mode, viz.—by gemmation. This process is superinduced upon the young Ascidian after its development from the ovum. "The individuals formed by the gemmation of the primary bud of the young Ascidian are, instead of being detached, retained; the process of gemmation being regulated so as to produce the characteristic pattern in which the different individuals are grouped in the mature compound animal."—(*Owen.*) The greater number of the Tunicaries are fixed in their adult state; but there are others that are always free, and only found in the open ocean. They thus form two natural groups. Of the first or fixed group, some of the individuals become entirely distinct, in others they remain connected by a vascular canal, and in a third set all the individuals become blended into a common mass. These groups form the *Solitary*, the *Social*, and the *Compound* ascidians of authors. The animals belonging to the class *Tunicata* are all marine, and are numerous in all seas, being found from low water to a considerable depth. "Adhering to rocks and sea-weeds," says Mr. Adams, "these strange, bag-shaped, leathery bodies may be seen along the strand at low water, ejecting when touched the sea-water to some distance; and on the ocean their lengthened sinuous chains, or pellucid phosphorescent tubes, cannot fail to arrest the eye of the voyager. The compound forms exhibit, in the varied arrangement of the individuals composing the general mass, a number of elegant stems and flowers of curious and complicated design. Towards the northern shores they are sombre in their colours, but in the sunny regions of the south their hues assume the brightest dyes, and vie with those of the corallines and actiniæ that people the bed of the ocean. It was in the Ascidian Tunicaries that MM. Audouin and Milne Edwards first discovered the metamorphoses of the Mollusca, and their discoveries have since been extended by the laborious researches of Sars and Lovén. It was among these singular beings that Van Hasselt discovered "a heart of such extraordinary character, changing incessantly its auricle to ventricle, and its ventricle to auricle—its arteries to veins, and its veins to arteries." Among the Salpian Tunicaries it was, moreover, that Chamisso made the no less extraordinary discovery that a 'Salpa mother is not like its daughter or its own mother, but resembles its sister, its granddaughter, and its grandmother.' The Pyrosomes afford a spectacle to the naturalist of unexampled beauty when, seen by myriads from the vessel in the night, they gleam with phosphorescent radiance, forming vast shoals of mimic pillars of fire, illuminating all around with a green unearthly glare. The most curious feature in the history of these soft-shelled mollusks is the fact that many among them form communities of beings, like the corals, a commonwealth of beings bound together by common and vital ties. Each star is a family, each group of stars a community—individuals are linked together in systems, systems combined into masses."

The Class *Tunicata* has been divided into two orders or divisions by Dr. Fleming, according as the inner or muscular tunic or sac is more or less detached, or is adherent to the external tunic. Those individuals which have this inner sac more or less detached from the external sac are termed *Dichitonida;* and those which have it adhering throughout to the external tunic are termed *Monochitonida.*

ORDER—DICHITONIDA.

INNER sac more or less detached from the external tunic; united to it at the two orifices. Branchiæ large, equal, spread on the inner surface of this sac. Branchial orifice with an inner membranaceous ring and circle of tentacles.

This order contains four families, three of which are fixed, and the fourth floating.

FAMILY I.—ASCIDIIDÆ (*Simple Ascidians*).

This family has been thus characterized:—Animal simple, fixed, solitary or gregarious; not united into groups by a common integument; oviparous; not gemmiparous; sexes united; branchial sac simple or disposed in (eight to eighteen) deep and regular folds.

The species of Ascidians are very abundant in the northern seas, on the British coasts, the northern shores of Europe, and in the Mediterranean. "Barely is the dredge drawn up from any sea-bed at all prolific in submarine creatures," says Professor Forbes, "without containing few or many irregularly-shaped leathery bodies, fixed to sea-weed, rock, or shell by one extremity or by one side, free at the other, and presenting two more or less prominent orifices, from which on the slightest pressure the sea-water is ejected with great force. On the sea-shore, when the tide is out, we find similar bodies attached to the under surface of rough stones. They are variously, often splendidly coloured, but otherwise they are unattractive or even repulsive in aspect. These creatures are *Ascidiæ*, properly so called. Numbers of them are found clustering among tangles, like branches of some strange semitransparent fruit. They are very apathetic and inactive, living upon microscopic creatures drawn in with currents of water by means of their ciliated respiratory organs. The leathery case is often incrusted with stones and shells, decorated with parasitical though ornamental plumes of corallines, and not seldom perforated by bivalves which lodge themselves snugly in the tough but smooth skin." Some of the Ascidians appear to have been well known to Aristotle; and his description

is extremely accurate. On the coasts of the Mediterranean and in China (where species of Ascidiæ occur), several of them are esteemed as articles of food. Van Beneden informs us that at Cette Ascidiæ are taken regularly to market, and that a particular species (*Cynthia microcosmus*), "although so repulsive externally, furnishes a very delicate morsel, much sought after by some."

GENUS ASCIDIA or *Sea Squirt*.—This genus is known by its sessile body being covered with a coriaceous or gelatinous tunic; the branchial orifice being eight-lobed, and furnished inside with a circle of simple tentacular filaments; the anal orifice is six-lobed, and the branchial sac is not plaited. The species vary in length from one to five or six inches, and range from low water to twenty fathoms. In some of the Ascidiæ the external tunic is pale and semitransparent, and the inner coat is orange or crimson, or sometimes marbled with orange and white. Most of them, however, as Sir John Dalyell says, "are coarse, unsightly, deformed-looking animals, utterly void of that external symmetry and beauty rendering many of the tenants of the waters so interesting. Nor is it in this only that they should fail to attract the spectator's notice. They testify neither instinct, action, nor motion, nor even the symptoms of life, farther than slight enlargement and reduction of size, together with contraction and expansion of the two tubular orifices of the body. No sensible attraction follows abstinence or repletion; the external form undergoes scarcely any modification from health or disease; even the lapse of time, that universal consumer, seems hardly to make any impression on the shapeless mass, which is rooted immovably from the first moment on the same spot to vegetate, live, or die."

GENUS CYNTHIA.—This genus is sessile as well as *Ascidia*, and its test or tunic is coriaceous; both branchial and anal orifices are four-lobed, and the branchial sac is plaited longitudinally and surmounted by a circle of tentacular filaments. About fourteen species are described as inhabiting the coasts of Great Britain, and they are found ranging from low water to thirty fathoms. Individuals are often seen unattached as well as fixed, though, as Mr. Rupert Jones observes, these animals "cannot be said to have an entirely free existence, their tests being usually more or less imbedded in sand or mud, and frequently held to their anchorage by the agglutination of the surrounding sand-grains to their outer surface. But from such a position they are easily disturbed." The species of Cynthia are also frequently found associated in groups of numerous individuals, forming large bunches in consequence of the interlacing of their root-fibres. The genus is represented by two species, *C. momus* and *C. Canopus* (Plate 9, figs. 7 and 9).

GENUS BOLTENIA.—This genus instead of being sessile, as in the two preceding genera, has its coriaceous body fixed by a peduncle to stones, often in deep water. Sometimes young Bolteniæ fix themselves on to the stem of their parent. In this genus the orifices are lateral, and both of them are cleft into four lobes or rays; the branchial sac is longitudinally plaited and surmounted by a circle of compound tentacles.

Two other genera belong to this family, *Molgula* and *Chelysoma*—the one (Molgula) having a membraneous tunic or test, but usually invested with sand or other extraneous matters; the other having its coriaceous test resembling the carapace of a tortoise.

FAMILY II.—CLAVELLINIDÆ (*Social Ascidians*).

The "Social Ascidians" are very small animals found on stones, shells, and sea-weed, adhering by numerous root-like projections of their outer tunic. As their name indicates, these animals occur in groups of several individuals, each having its own heart, respiration, and system of nutrition, but fixed on peduncles or stalks that branch from a common stem, through which the blood circulates in opposite directions. They are such transparent and colourless animals, that their internal structure can be seen without dissecting them. Reproduction takes place in these Social Ascidians by gemmation or by the process of budding, as well as by eggs. The new individuals so formed may continue united to the parent, or may become completely free by the rupture of the connecting tube.

GENUS CLAVELLINA.—In this genus the individuals composing the compound body are connected by creeping tubular prolongations of their common tunic. They are elongate, erect, more or less pedunculated; the outer tunic is smooth and transparent, and the thoracic portion of the body is usually marked with coloured lines. The branchial and anal orifices are both simple, without lobes or rays. The species which have been observed are found in the northern seas and in the Mediterranean. This genus is represented by *C. borealis* in Plate 9, figs. 5 and 6.

GENUS PEROPHORA.—This genus differs from the preceding in the individuals being suborbicular and compressed, and the thoracic portion of the body being destitute of coloured lines. There is only one species known. It is beautifully transparent, according to Professor Forbes, who has dredged it adhering to sea-weed on the coast of Anglesea, and appears like little specks of jelly dotted with orange and brown. When dried, these bodies appear like the minute ova of some mollusk.

FAMILY III.—BOTRYLLIDÆ (*Compound Ascidians*).

The *Botryllidæ* are compound animals, and fixed. The animals are associated with each other, their tests being fused together so as to form a common mass in which they are imbedded in one or more groups. Each individual, however, has a distinct branchial and anal orifice, and they are not connected with one another by any internal union. "If, when walking on the sea-shore about low water mark, we turn over large stones, or look under projecting eaves of rock, we are almost sure to see translucent jelly-like masses of various hues of orange, purple, yellow, blue, grey, and green, sometimes nearly uniform in tint, sometimes beautifully variegated, and very frequently pencilled as if with stars of gorgeous device; now encrusting the surface of the rock, now depending from it in icicle-like pro-

jections. These are Compound Ascidians. A tangle or broad-leaved fucus, torn from its rocky bed, or gathered on the sands where the waves have cast it after storms, will show us similar bodies, mostly those star-figured, investing its stalks, winding among the intricacies of its roots, or clothing with a glairy coat the expanse of its foliated extremities. If we keep some of these bodies in a vessel of sea-water we find they lie as apathetic as sponges, giving few symptoms of vitality beyond the slight pouting out of tube-like membranes around apertures which become visible on their surfaces, though a closer and microscopic examination will show us currents in active motion in the water around these apertures, streams rejected and whirlpools rushing in; indicating that however torpid the creature may externally appear, all the machinery of life, the respiratory wheels and circulatory pumps, are hard at work in its inmost recesses. In the course of our examination, especially if we cut up the mass, we find that it is not a single animal which lies before us, but a commonwealth of beings bound together by common and social ties. . . . Each member of the commonwealth has its own peculiar duties, but shares also in operations which relate to the interest and well-being of the mass. Anatomical investigation shows us the details of these curious structures and arrangements beautiful as wise. Indeed few bodies among the lower forms of animal life exhibit such exquisite and kaleidoscopic figures as those which we see displayed in the combinations of the Compound Ascidians."—(*Forbes.*) The Compound Ascidians form rather a large family, comprising within it at least thirteen distinct genera. These may be arranged, however, in three groups or sub-families.

SUB-FAMILY I.—BOTRYLLINA.

In the animals of this group the individuals are united in systems around common excretory cavities or *cloacæ;* and their bodies are not divided into a distinct thorax and abdomen.

GENUS BOTRYLLUS.—This genus may be taken as the type of this group. The external tunic is gelatinous or cartilaginous, sessile, and incrusting. The animals are grouped in simple prominent stars, and the individuals—from six to twenty in each system—lie horizontally, with the vent far from the branchial orifice, which is simple. The branchial orifices are arranged round a common *cloaca*. "The tests of the animals are fixed together, forming a common mass, in which the animals are imbedded in one or more groups or systems, but the individuals are not connected by any internal union."—(*Adams.*) There have been as many as ten distinct species described, six of which are found on the shores of Great Britain. They vary considerably in form and colour, some of them being purple, and others yellow, blue, grey, or green. They are fixed on stones or sea-weed, near low-water mark. The genus is represented by *B. polycyclus* (Plate 9, figs. 7 and 8).

SUB-FAMILY II.—POLYCLININA.

This group is distinguished from the preceding by the body being divided into three distinct portions, viz.—a thorax, with the branchial apparatus; a superior abdomen, with the digestive organs; and a post-abdomen, with the heart and reproductive organs.

GENUS POLYCLYNUM.—This genus has a gelatinous or cartilaginous test, sessile or slightly pedunculated, and varying very much in form. The systems are numerous, convex, somewhat star-shaped, each with a central cloacal cavity. The individuals, varying from ten to an hundred and fifty, are placed at unequal distances from their common centre. The abdomen is much smaller than the thorax, and the post-abdomen is pedunculate. The branchial orifices are six-angled and six-rayed, and the anal aperture is prolonged horizontally and irregularly cut. Six species are known, one of which, *P. constellatum*, is figured in Plate 9, figs. 12-14.

GENUS SYNOICUM.—This genus has the test semi-cartilaginous, cylindrical, and pedunculate, and the animals are either isolated or attached gregariously to similar cylindrical bodies. The systems are single, circular, terminal, and comprise six to nine animals. The branchial orifices are six rayed, and the anal aperture has the same number; but they are unequal, the three largest forming the exterior margin of the central star. Only one species is known, *S. turgens*, figured in Plate 9, figs. 15–17.

GENUS SIGILLINA.—This genus has a solid, gelatinous test, in form of an elongated, erect cone. It is pedunculated, and occurs either isolated or gregarious. Each cone consists of a single system of many individuals disposed one above another in irregular circles. The branchial and anal orifices have each six rays; the abdomen is larger than the thorax; and the post-abdomen is long and slender. The genus derives its name from a fancied resemblance of the common mass to a seal (*sigillum*), and contains as yet only one species, *S. australis*, from the tropical seas, which is represented in Plate 9, figs. 10 and 11 (*magnified*).

SUB-FAMILY III.—DIDEMNINÆ.

This group embraces all the compound Ascidians whose body is distinctly divided into two parts, the thorax and abdomen.

GENUS DIDEMNIUM.—This genus has a coriaceous test which is sessile and encrusting, and diversified in form and appearance. The systems are numerous, compressed, without central cavities, and the individuals are scattered over the common body without any appreciable order of arrangement. The abdomen is pedunculate. The branchial orifice only is rayed.

GENUS DISTOMUS.—This genus differs from the preceding in having both the branchial and anal orifices rayed. The test is semicartilaginous, sessile, and assumes various forms. The systems are numerous, usually circular, and the individuals are placed in one or two rows at unequal distances from a common centre. The rays at the margin of both apertures are six in number. There are several species of this genus, one of which, *D. ruber*, is represented in Plate 9, figs. 1–3.

were very indefinite, presenting much of the appearance of great masses of fire, or rather of enormous red-hot cannon balls; whilst those more distinctly seen near the surface perfectly resembled incandescent cylinders of iron." The genus is represented by fig. 232 (*Pyrosoma giganteum*)

ORDER—MONOCHITONIDA.

INNER sac adhering throughout to the external tunic. Orifices without tentacular fringes.

This order contains two families—one of which is always free and floating; the other free also, but living buried in mud.

FAMILY I.—SALPIDÆ.

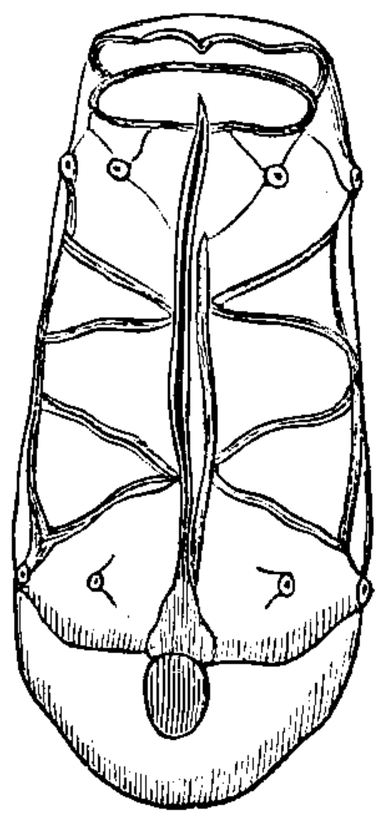
The *Salpæ* are distinguished by their outer tunic being thin, elastic, elongated, compressed, and open at both extremities, the two orifices being opposite each other. They are free, and habitually swim on the waters of the ocean, and are alternately solitary and aggregated. The solitary individuals resemble short but rather wide tubes, which are often of considerable size, and so transparent that, as Professor Forbes says, they look as if carved in crystal.

The history of these Tunicaries is replete with interest, especially on account of their singular mode of reproduction. These occur under two conditions; at one time appearing, as described above, in solitary individuals, floating freely on the surface; at others, associated into lengthened groups, or chains, composed of numerous individuals of similar form, and swimming with regular serpentine movements through the tranquil waters. The individuals which compose these chains contract and expand simultaneously, "keeping time, as it were, like a regiment of soldiers on parade," each chain thus appearing to be a single being, acting through the influence of a unique will. After floating for a certain time under this form the society is broken up, and each individual, so separated from the chain, propagates a young one like itself. This individual grows to the size of its grand parent, and then brings forth, in its turn, a social chain of young *Salpæ*, which, again, give origin to the solitary individuals; thus, as Chamisso discovered, for it is to him we owe the knowledge of this curious fact, chained *Salpæ* do not produce chained *Salpæ*, but solitary *Salpæ*, and these do not reproduce solitary, but chained *Salpæ;* or, as this naturalist expresses it, "a *Salpa* mother is not like its daughter or its own mother, but resembles its sister, its granddaughter, and its grandmother!" the *alternate generations* only resembling each other. As the members of one generation are very dissimilar from those of the other, the species described previously to this discovery of Chamisso's, were accordingly very much multiplied. The only conspicuous vital action in these *Salpæ*, says Professor Owen, are the rhythmical contraction and expansion of the mantle, in which the elasticity of the outer tunic antagonizes the contraction of the inner one. During expansion the sea-water enters by the posterior aperture, and is expelled, in contraction, by the anterior one; its exit by the opposite end being prevented by a valve. The reaction of the jet, which is commonly forced out of a contracted tube, occasions a retrograde movement of the animal. The currents which successively traverse the interior of the animal, renew the oxygenated medium upon the surface of the respiratory organ, bring the nutrient molecules within reach of the prehensile, subspiral, labial membrane of the mouth, and expel the excrements and generative products. Thus a single act of muscular contraction is made subservient, by the admirable co-adjustment of the different organs, to the performance of the functions of locomotion, nutrition, respiration, excretion, and generation. The *Salpæ* are found in some of our northern seas, but they are more abundant in the Mediterranean, and in the warmer parts of the ocean. In these localities they are remarkable for the brilliant phosphorescent light they give out at night, especially when the water is agitated. The long chains of these animals swimming near the surface, have been described as occasionally producing the effect of long ribands of fire drawn along by the currents.

Three genera have been enumerated.

GENUS SALPA.—This genus is the typical and most important one, and may be defined in the solitary form, as oblong, subcylindrical, truncated in front by the oral orifice, pointed posteriorly, anal orifice subterminal, each orifice furnished with a valve; *test* thin, transparent; muscular mantle incomplete, forming a set of transverse or oblique bands; mantle cavity lined by a system of vascular sinuses; gill rudimentary, consisting of two narrow, oblique, unequal laminæ, forming an oblique band across the interior; visceral mass or *nucleus* situate near the posterior extremity, and very conspicuous, owing to the brilliant orange, brown, or reddish hues of the liver. The sexes are combined, and all the species yet observed are Viviparous; the young being produced by gemmation in chains consisting of individuals unlike the parent, and becoming oviparous. The individual *Salpæ* vary in length from half an inch to ten inches, and the chains are found extending from a few inches to many feet. A good many species have been described. The genus is represented by fig. 233 (*Salpa octofora*).

Fig. 233.



Salpa octofora

GENUS DOLIOLUM.—This genus was established for some little animals nearly allied to the *Salpa*, which are described as round, or in the form of a little cask, transparent, open at the ends, and from two to ten lines in length. The method of progression in these

small creatures is by contracting the whole body, and forcing the water out at one or the other extremity. Some other little Tunicaries have been found floating on the surface of the ocean, in various parts of the world, consisting of an ovoid-shaped body, terminated by a long curved tail or swimming organ. They are minute in size, from one-sixth to one-fourth of an inch, and are rapidly propelled through the water by powerful vibrations of the long, curved, lanceolate, caudal appendage. These form the genus APPENDICULARIA. Professor Forbes describes them as very numerous at times, and appearing at a little distance, "as cloudy patches of red colouring matter in the water."

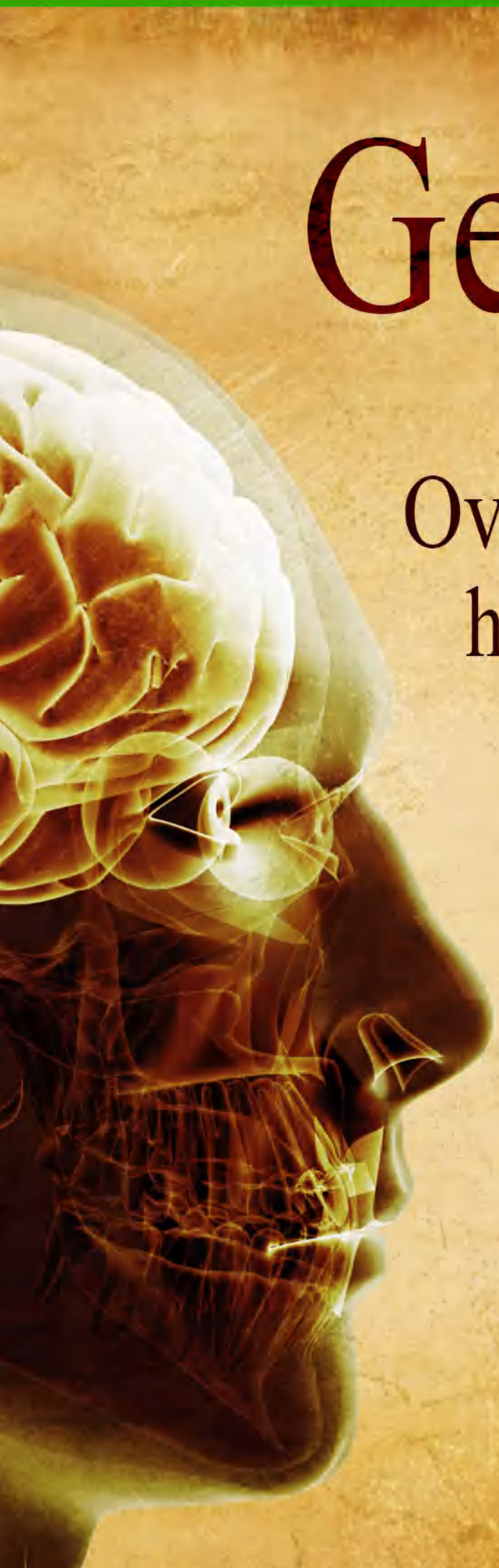
FAMILY II.—PELONAIADÆ.

This family is composed of only one genus, PELONAIA, which contains two species, both of them very rare. The animals are simple and unattached. The test is more or less cartilaginous, smooth, or wrinkled, elongated and cylindrical. The two orifices are not opposite each other, but are both placed on the same plane on two eminences on the anterior extremity. The creatures live buried in mud, quite unattached to any other body, and are extremely apathetic, presenting scarcely any appearance of motion.

BRYOZOA.

Before drawing our history of the sub-kingdom *Mollusca* to a conclusion, we ought to mention the fact that the large group of animals formerly arranged amongst the Zoophytes, and known as the *Bryozoa*, are now included within it; and that their proper place in the zoological system ought to be immediately following the class *Tunicata*. The structure of the animals belonging to the *Bryozoa* is decidedly more molluscan than zoophytic; and indeed were we only to imagine the minute tentacula which fringe the oral orifice of many of the Ascidian tunicaries to be greatly prolonged and clothed with cilia, and the respiratory cavity to be contracted, we should see the great resemblance which a Bryozoon, such as *Flustra*, has to a mollusk of the Asceidian type. The nervous system of these little creatures is not formed on the radiated type, but consists of a single ganglion placed between the two orifices, as in the *Tunicata*. They have also a separate intestine, which possesses an anal orifice; and there exist a gizzard-like organ and a rudimental liver. Still, as in almost all systems these animals continue to form part of the class *Zoophyta*, we will postpone their further consideration till we come to treat of that class.

INDEX TO MOLLUSCA.



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Sub-kingdom IV.—RADIATA (Rayed or Radiated Animals).

This sub-kingdom of animals contains a great variety of creatures, differing from each other in form and outward appearance. Some are highly organized, while others have a very simple structure, and appear to form the connecting link between the animal and vegetable kingdoms. Generally speaking, however, they may be distinguished from the three sub-kingdoms already treated of in this work, by the animals having all the parts of their body and members disposed in a rayed or radiated form round the digestive cavity. The organs of digestion consist of a single sac, or short alimentary canal. The nervous system is obscure, and in some cannot even be traced. In those in which it exists it is without ganglia, and is composed of single filaments which are disposed in a circular form around the orifice of the mouth. They have no true circulating system, and as they are all aquatic, they breathe by branchiæ or gills, and the greater portion of them are free. Their organs of motion, when they are present, are movable spines attached to the skin, or flexible papillæ capable of inflation. The rayed arrangement of the organs and different parts of their body in the greater number, is what has obtained for the class to which these animals belong the name of Radiata; and in many of them this is so distinct as to give them the shape of the flowers of plants.

This sub-kingdom is divined into five classes—

I. The Echinoderms or Spiny Skins (*Echinodermata*).
II. The Acalephs or Sea-nettles (*Acalephæ*).
III. The Zoophytes or Polyps (*Zoophyta* or *Polypi*).
IV. The Infusory and Foraminiferous Animals (*Protozoa.*)
V. The Sponges (*Spongia* or *Porifera.*)

Class I.—ECHINODERMS, or SPINY SKINS (Echinodermata).*

The Spiny Skins are radiated animals which have the body covered with a hard coriaceous skin, under which or attached to it are frequently found plates of solid or calcareous matter, forming a sort of skeleton, and which in some species is covered with sharp spines or prickles, like those of a hedgehog. They possess a distinct alimentary canal, distinct organs of circulation, and a nervous system forming a ring, generally surrounding the mouth, and giving off radiate branches. The principal character of the class, however, is, that the animals have, fixed to the skin, a more or less considerable number of tentacular-shaped cirrhi, at once serving the purpose of locomotive organs, organs of respiration, and organs of touch. In some, as in the Echinidæ, in addition to the tentacular-formed organs of motion and touch, there exist organs, called *pedicellariæ*, which serve as organs of prehension. The animals belonging to this class are all marine, and live on animal food. The greater number are free, living unattached, and moving about in the water with their mouths beneath; but some are attached, being affixed by their backs, and have their mouths above, so as to enable the limbs to bring the food within their reach. The sexes are distinct, and the young are produced from ova.

Such is a general description of the class Echinodermata; but in it we find animals of extremely dissimilar appearance associated together.

The class has been divided into five orders—

I. Crinoidea—Feather-stars.
II. Asteroidea—Star-fishes.
III. Echinoidea—Sea-urchins or Sea-eggs.
IV. Holothurioidea—Holothurias or Sea-cucumbers.
V. Sipunculoidea—Sipunculi.

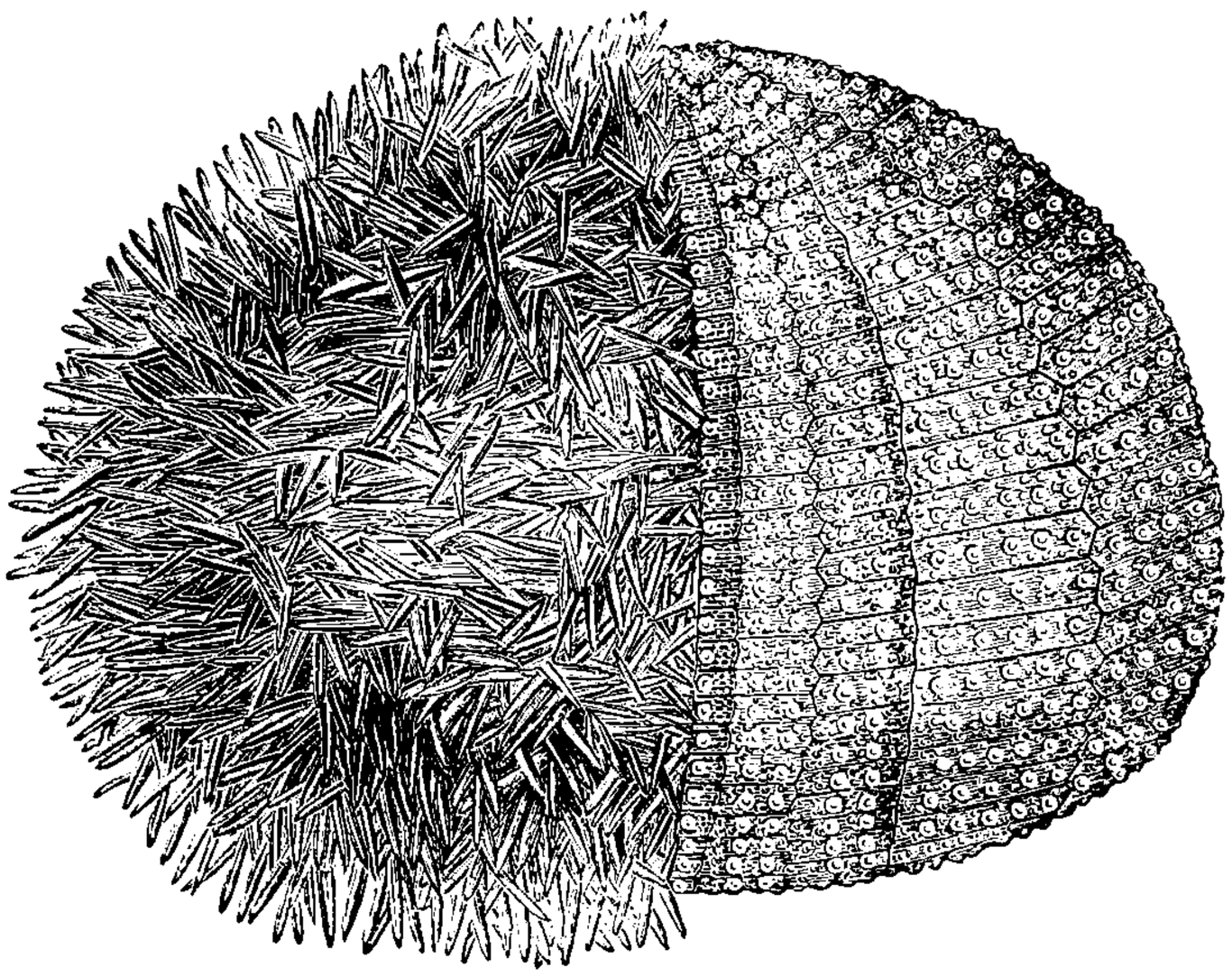
As those occupying the centre of this group may be looked upon as the types or models of the radiated class, we will begin with them.

* Derived from the two Greek words *echinos* (ἐχῖνος), a spine, and *derma* (δέρμα), skin.

ORDER I.—ECHINOIDEA (*Sea-eggs, or Sea-urchins.*)

The animals belonging to this order (see Plates 1-4, *Echinodermata*) are covered with a round or oval hard case, composed of perpendicular bands of square or six-sided pieces sunk in the substance of the skin. Externally this case is studded all over with numerous spines which are affixed on hemispherical tubercles by particular muscles, and easily fall off when the animal is dead (see fig. annexed). These spines are various in shape and size, move in all directions; and—judging on the principle that Nature does nothing in vain, and that even the apparently insignificant peculiarities of form which she has given to creatures are designed to serve some important end connected with their wellbeing—appear to be useful in protecting the animals from their enemies, and enabling them also to bury themselves in the sand on the shores when they are left by the retiring tide. Half the number of the perpendicular bands of which the case is composed, alternating with the others, are pierced with minute double pores through which are sent out small filaments with dilated ends, that enable the animals to anchor themselves to marine bodies. These pierced bands, from a fancied resemblance to the walks in a garden, are called *ambulacra;* while the alternate ones which have the tubercles have been compared to the beds of the garden, and have in consequence been sometimes called *areæ pulvilli* (see Plate 1, fig. 4). These animals have two separate openings to their digestive canal, and in some of the species the vent is placed in the centre of the lower surface, whilst in others it is situated on the side of the body. The mouth is armed with very complicated jaws, and furnished with five projecting teeth (see Plate 1, fig. 3; Plate 3, figs. 5, 6). These jaws were well described by the ancient naturalists, and are known by the name of the "lanterns of Aristotle," that author having represented them as resembling a lantern. The animals belonging to this order are carnivorous, living chiefly upon small mollusks and crustacea. The recent species are numerous, and are found in most parts of the world; while the fossil remains of their shells or external cases are abundant in many of the formations, but especially in the chalk.

Fig. 234.



Echinus.

The numerous species of which the order is composed, may be divided into six families:—1, *Echinidæ;* 2, *Cidaridæ;* 3, *Scutellidæ;* 4, *Galeritidæ;* 5, *Echinolampasidæ;* and 6, *Spatangidæ.*

FAMILY I.—ECHINIDÆ (*True Sea-eggs*).

This family is perhaps the most numerous in species, contains some of the best known and most commonly distributed, and may be taken as the most typical of all. The shell or case is generally rounded and composed of twenty perpendicular bands of square or six-sided pieces. The tubercles upon which the spines are placed are simple, rounded, imperforate prominences. The spines vary a good deal in shape. Generally, as in *Echinus*, they are equal-sized, conical and striated. In others, as in *Colobocentrus*, they are large and club-shaped; while in a third set, as in *Heterocentrus*, they are very short and truncated, forming in the mass a smooth surface—somewhat resembling a tesselated pavement. The *ambulacra* are constantly of the number of five pairs (see Plate 2, fig. 3), and are complete, extending from the upper to the lower surface. In addition to the spines on the tubercles and the filaments which are sent out from the ambulacral pores, and which serve as organs of progression, the Echini possess other movable organs scattered over the surface of the body, and known by the name of *Pedicellariæ.* These organs though small, are very curious, and perform a very important part in the economy of these animals. They are prehensile, and are used by the animal to seize hold of objects, which can thus be passed from one to another, and possibly may even be conveyed from the dorsal surface to the mouth. They are very numerous, crowded irregularly on most parts of the skin, but especially round the oral aperture. They are of various forms, but in general they may be described as having a thick head, cleft into three divisions, and set on a long, slender, flexible stalk. The whole body and head are invested with a glutinous flesh, in which are imbedded minute red glands, that are common to the integument of the whole class,

power of reproducing lost parts when accidentally destroyed. If an entire arm be torn off, provided a small portion of the body remains attached to it, other arms are reproduced, and a fresh, perfect animal is formed. In each ray we find two ovaries, and it is supposed that the animals can reproduce their species without the aid of a second individual. The spawn is said to be venomous to the touch, and poisonous to the animals which eat them. The larvæ, or young, are very different in appearance from the adult animal. They are ciliated, and move with great quickness by means of their vibratile cilia, and swim rapidly, rotating round their axis. The order *Asteroidea* is rather an extensive one, comprising numerous species and many genera, which may be arranged in five Families:—I. *Asteriidæ;* II. *Astropectenidæ;* III. *Pentacerotidæ;* IV. *Asterinidæ;* and V. *Ophiuridæ.*

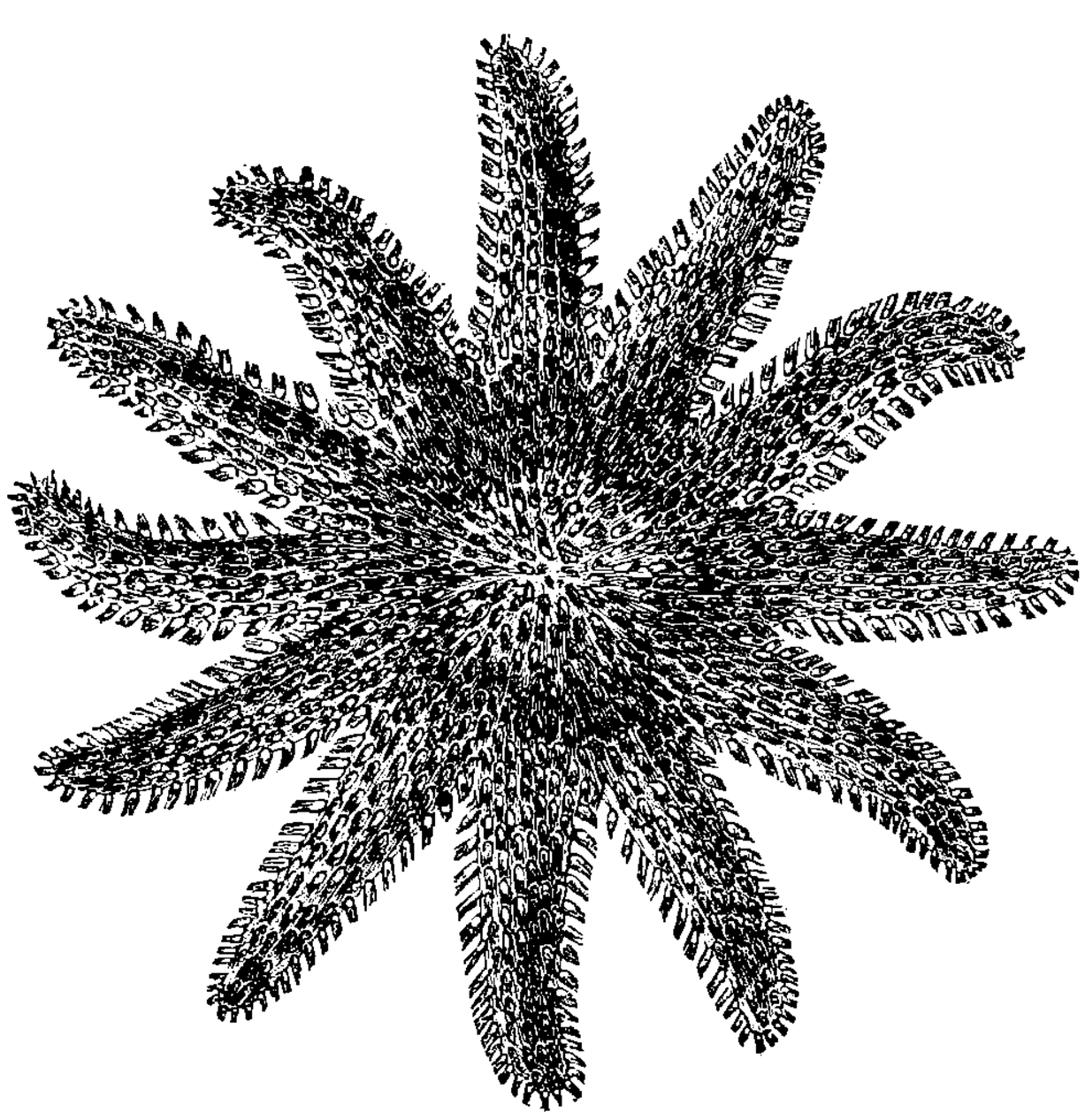
FAMILY I.—ASTERIIDÆ (*True Sea-stars*).

In this family, the typical Star-fishes, the rays are five in number, and they much exceed in length the diameter of their disc. The family is represented on Plate 6, fig. 2., by *A. cylindrica.*

FAMILY II.—ASTROPECTENIDÆ (*Astropectens*).

In this family the back of the rays or arms, which are various in number, are thin and netted, and have

Fig. 235.



Solaster papposus.

numerous tubercles at the junction of each of the little bones, which are covered at their tips with many small movable spines. They are very beautiful creatures. The family is well represented by a species found on the coast of England, *Astropecten irregularis*, the "Asterias aurantiaca" of Muller, and by the *Solaster papposus*, the Rosy Sun-star or Ten-fingers—see fig. 235—which, as this latter name indicates, possesses ten rays, that nearly equal in length the diameter of the disc.

FAMILY III.—PENTACEROTIDÆ.

This family is characterized by the body being formed of large roundish tubercles, the skin between which is pierced with small holes. The genera into which the members of this family have been divided, are rather numerous. Many of the species have their backs studded with conical tubercles, which enlarge in size as the part on which they are placed increases. These tubercles sometimes fall off as the animal becomes larger, and are easily separated, leaving a flat scar when the animal is dead.—(*Gray.*)

This family is represented in Plate 6, fig. 3, by *Pentagonaster pulchellus*, a species which is found in the Indian seas.

FAMILY IV.—ASTERINIDÆ (*The Birds'-foot Stars*).

This, the last family of the *Asteroidea*, have the body formed of compressed pieces, placed one over the other like the tiles on a house. They are generally thin, flat, and pentangular, have always a thin margin, and are covered above and beneath with fasciculated spines. Some of the species have the back convex, and a few are possessed of many rays.

FAMILY V.—OPHIURIDÆ (*Lizard-tailed Star-fishes*).

This family of Echinoderms is characterized by the species having a more or less orbicular, depressed body, with five cylindrical, jointed, very flexible arms, which are sometimes very long, and repeatedly divided into branches. Their arms are furnished with a series of small pores along each side of the under surface, and they have a lunate hole on each side of the base of their arms. They are scaly, like the tails of serpents or lizards, and are very fragile; hence their common English name. They are destitute of grooves or gutters underneath, and have in consequence no tentacles. Their motion, therefore, is different from that of the true Star-fishes. When they move, the animals employ the two arms nearest the point to which they wish to go, and the one farthest from it. The two first, curving at the extremities, form two hooks directed outwardly, which applying themselves to the sand, draw the body forwards; whilst the posterior arm is curved vertically, and pushes the animal along. The species of Lizard-tails live exclu-

sively in sandy shores, and hide themselves in the mud at the least appearance of danger. Like the true Star-fishes, if these animals lose their arms, they are able quickly to renew them; and during summer a few days suffice to replace their loss.

THE TRUE LIZARD-TAILS (*Ophiura*) have the body covered with spines or scales; and the arms, which are always simple, are furnished with cross series of spines on the sides, which in some of the species are short and appressed, in others long and expanded. These arms, or rays, are almost always five in number, and extremely flexible, though composed of rigid and fragile plates. The family is represented on Plate 6, fig. 1, by *Ophiura mutica;* fig. 3, *O. squamosa*; fig. 4, *O. Lamarckii;* and fig. 2, *Euryale simplex*; and on Plate 6, fig. 1, by *Ophiothrix lineolata.*

THE GORGON-HEADS, or MEDUSA-HEADS (*Astrophyton*), have the arms repeatedly branched, so as to end in very small flexible filaments, by means of which the animal attaches itself to marine bodies, and strains its food from the surrounding water. It is from this extraordinary branched disposition of the arms that the species have derived their name.

THE COMMON MEDUSA'S HEAD (*Astrophyton arborescens*) is a native of the North Sea, and has been particularly noticed by some of our early arctic voyagers.

ORDER III.—CRINOIDEA (*Feather-stars*).

The order *Crinoidea* is characterized by the species composing it being furnished with five arms, which bifurcate so close to their origin as to appear like ten. These arms are long, slender, jointed, the joints being composed of calcareous matter, and furnished with a series of processes on each side like a feather; hence their English name. In most of the species these arms, besides being divided at their base, are repeatedly subdivided as they approach their termination. The body of the animal is surrounded with hard shelly plates. This order of Echinoderms contains several families and an immense number of species; but with few exceptions these are fossil. To geologists they are particularly interesting, as their remains are found in vast abundance in the limestone formations, forming whole beds of great extent, and composing immense strata of what is known as "entrochal marble," which are found extending over large tracts of country in Northern Europe and North America. Almost all these fossil Crinoideans had an elongate peduncle or stem, and the joints which composed this stem are called *entrochi*, or wheel-stones. Being perforated in the centre, they are well formed for being strung as beads; and in Roman Catholic times, and in Roman Catholic countries, they have been used as rosaries. In several parts of the north of England these detached beads are very common on the sea-shore, and are called "St. Cuthbert's beads." One of the Fern islands, on the coast of Northumberland, was particularly celebrated as the place where the holy Saint Cuthbert manufactured these beads for the use of the faithful. The body of the animal is known by the general name of "Encrinite," or the "Stone-lily," and a fine collection of these remains, from the mountain limestone of Yorkshire, exists in the British Museum.

Of this very numerous order of Echinoderms only two genera exist, which contain species that are still found in the recent form at the present day. The species are few in number, and some of them are exceedingly rare.

FAMILY—PENTACRINITIDÆ.

The animals of this family are composed of two kinds—the one having an elongated peduncle furnished with claspers, and being fixed by a root to the bottom of the sea; the other existing (in the adult state) as a free animal, swimming at will through the water.

GENUS PENTACRINUS.—This genus contains the first kind. The peduncle, to the top of which the star or body is attached, and by the base of which it is fixed as by a root, is a long column, formed of numerous pentangular joints, and has five auxiliary side arms, formed of round joints, proceeding from it at intervals. At the upper extremity of this column is what is called the pelvis, composed of five plates, from which ten arms proceed, each subdividing into three fingers.

THE PENTACRINUS CAPUT-MEDUSÆ is the only recent species known, and individuals appear to be exceedingly rare in collections. It is a native of the West Indian seas, and three fine specimens may be seen in the British Museum. In none of the four or five individuals, which are all that are known to exist in museums, is the base of the stem perfect. We have thus no positive knowledge as to whether it adhered by a fixed base or had a locomotive power. Some authors indeed assert that this Pentacrinus is an animal that crawls along the bottom of the sea; but from the appearance of the peduncles and the analogy the species bears to some of the fossil ones, it is much more probable that it adheres by its base to some extraneous matter, and that it stands more or less erect in the sea, bending down so as to yield to the force of the waves, and rising again when the storm is over.

GENUS COMATULA, or FEATHER-STAR.—This genus is the second kind of animal belonging to the family *Pentacrinitidæ*. The body in this genus is orbicular, depressed, and very small. It is protected above by an assemblage of calcareous pieces, and provided with five great rays, deeply bifid and pinnate, and one or two rows of short, accessory, articulated, simple rays, by means of which the animal attaches itself to foreign bodies. The buccal or labial channel is continued throughout the whole length of the axis and pinnacles of the great rays, is fleshy, and is provided with cirrhi, which serve the animal to seize its prey.

THE ROSY FEATHER-STAR (*Comatula rosea*) has been long known as a native of the British seas. Its history is exceedingly interesting, but we must refer to the writings of Mr. J. V. Thompson, Professor E. Forbes, &c., for further information.

ORDER IV.—HOLOTHUROIDEA (*Sea-cucumbers*).

The animals belonging to this order of Echinoderms have many characters in common with the *Echinidæ;*

but instead of being inclosed in a shelly case, their skin is only hardened with irregular scale-like or oblong calcareous plates. The body is more or less elongated and cylindrical, sometimes vermiform, soft or flexible in all its parts, very extensile and contractile, and furnished with numerous suckers, by means of which their movements are effected. They have a large orifice at each extremity, at the anterior end of which is situated the mouth, placed at the bottom of a kind of funnel, which is surrounded, or supported throughout its whole circumference, by a circle of small calcareous fibres, and crowned with a circle of from five to ten branchial appendages more or less plumose. These the animal can at pleasure retract entirely. The reproductive organs are situated near the mouth, and each animal is bisexual. At the extremity opposite to the mouth there is situated the respiratory organ or gill, which is in the shape of a hollow tree very much branched, and the animal can receive or expel water by means of this apparatus, which possibly thus assists it in its locomotion, as well as supplies air from the inhaled water. These animals are, like the leeches amongst the Annelides, exceedingly sensitive, and when disturbed will sometimes contract so violently that the integuments are ruptured and the intestines protrude. The Holothurioids are generally distributed through the seas of the globe, but are congregated in the greatest numbers in the Eastern seas. "On our shores," says Professor Forbes, "they are rare and unattractive animals, but abroad they are very abundant." Those of the European seas are never highly coloured, but in more tropical ones, where coral reefs rise within a moderate distance of the surface, as in the Red Sea and the seas to the north and east of Australia, they are many of them splendidly coloured. The general form of the Holothuriæ is that of a cucumber, and many of the species are of a gelatinous nature and esculent.

The species belonging to this order are numerous, and are arranged in several groups or families.

The True Holothurians (Sea-cucumbers or Sea-slugs) have a rather soft, somewhat elongated, subcylindrical body, covered throughout with tentaculiform suckers, which in the genus Holothuria form regular lines from the mouth to the vent.

THE NIGGER OR COTTON SPINNER (*Holothuria nigra*) is the only species of the genus Holothuria that is found in Great Britain. It is taken in the Cornish seas in deep water, and is held in great detestation by the fishermen on that coast.

GENUS TREPANG.—The genus Trepang, containing several edible species, belongs to this family. There are a great many species and varieties now known, though formerly they were all described under one, viz., *Holothuria edulis*. These animals are all natives of the Indian and Australian seas, and are well known under the general name of Trepang, Tripang, *Biche-de-mer*, or *Beche-de-mar*. They are generally found adhering to rocks near the shore. Some of them attain a considerable size, reaching to nearly the length of two feet, and the circumference of seven or eight inches. These animals are much esteemed by the Chinese as a nutritious article of food, and are particularly used for flavouring their soup. They form an important article of commerce amongst the natives of the islands of the Indian archipelago, Cochin China, the islands belonging to Australia, &c. Thousands of Malay proas are annually engaged in this fishery, and the produce taken to Canton is sold at an average for about forty-five Spanish dollars per picul (= 133⅓ lbs). Macassar is the head quarters for this fishery, and about 8,333 cwt. are annually exported from thence to Canton. There are two principal kinds of Trepang sold in Canton. "The black, called *coatoo*, is sold to the Chinese for forty dollars the picul; the white or grey, called *koro*, is worth no more than twenty." Though the natives of the Celestial Empire are very partial to the Trepang as an article of food, Europeans do not share in their taste.

ORDER V.—SIPUNCULOIDEA (*Siphon-worms*).

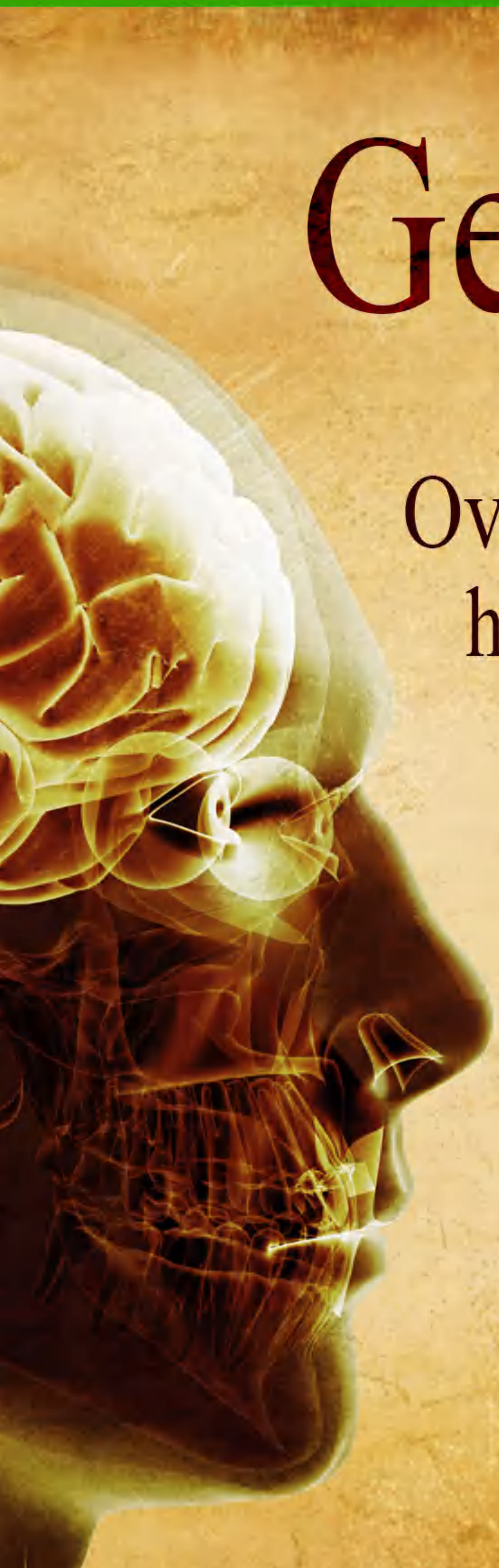
The order *Sipunculoidea* is characterized by the animals having a coriaceous covering, free from any calcareous bodies. The mouth, or commencement of the œsophagus, is not surrounded by calcareous fibres, and the form of the body is cylindrical.

The family *Sipunculidæ* is represented by the genus *Sipunculus*, which has the anterior part of the body or neck retractile and exsertile. At the extremity of this retractile neck is placed the mouth, which is of an orbicular form, and from which is protruded a retractile proboscis surrounded with linear tentacles. The vent is situated at the side near the anterior third of the length of the most swollen part of the body.

The *Sipunculi* live in the sand of the sea-shore near high water mark, or amongst the debris of broken shells. Their food appears to consist of the mud of the shore, mixed up with organic particles. A considerable number of species have been described, and not fewer than ten have been found on the British coasts. Some of the species perforate submarine rocks and lodge in the cavities so made, or take possession of old shells, like the hermit crabs.

CLASS II.—THE SEA NETTLES OR ACALEPHS (ACALEPHÆ).

THE Sea-nettles, or Acalephs, form a class of interesting creatures of beautiful structure and appearance, which, however, to be fully understood, must be studied on the spot where they are found. As Cuvier defines them, they are animals which are found swimming in the sea, and in whose organization may be perceived vessels, which in truth are most frequently nothing but productions of the intestines, hollowed in the substance of the body. This body is composed of a transparent gelatinous substance formed of polyhedral cells, and there is only in a few to be seen any calcareous or cartilaginous nucleus that can be compared to a rudimentary skeleton. The quantity, indeed, of solid matter in them is so small, that if we take a *Medusa* (for



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known by the name of the Girdle of Venus (*Cestum Veneris*) a native of the Mediterranean.

ORDER III.—CIRRHIGRADA.

This order of Acalephs contains a number of animals the body of which is almost membranous, oval, or circular in shape, and supported by an internal sub-cartilaginous part. Their organs of locomotion consist of numerous extensile, tentacular cirrhi, pendent from the whole of the under surface; and it is by the action of these organs that their motion through the water is effected. The order is well represented by the *Velellæ* and *Porpitæ*.

GENUS VELELLA (the *Sallee-man*).—This genus, forming the type of the family *Velellidæ*, is represented in Plate 1, fig. 8, by the species *V. cyanea*.

GENUS PORPITA.—This genus, forming the type of another family, is represented by *Porpita gigantea* in Plate 1, fig. 7.

ORDER—IV.—PHYSOGRADA.

The animals belonging to this order are characterized by their possessing one or more vessels filled with air, by means of which they keep themselves suspended in the water; and by their being furnished with more or less numerous cirrhiform tentacula attached to these air vessels. The species are numerous, and are distributed throughout several families.

The family *Physophoridæ* contain several genera composed of animals found floating on the surface of the sea, and is represented in Plate 2, fig. 2, by *Physalia pelagica* (or *megalista*), the common "Portuguese man of war," as it is called; and in Plate 1, fig. 5, by *Physophora disticha*.*

The family *Diphydæ* consists of gelatinous transparent little creatures, which appear, when closely examined, to consist of two crystalline-looking pieces like bits of glass. These two portions are always found the one included within the cavity of the other, but capable of being separated without injury to each other. The family is represented in Plate 1, fig. 4, by the beautifully delicate *Diphyes Boryi* or *Campanulifera*, an exotic species, but which is sometimes thrown up on our own coasts, particularly the flat sandy beaches of Norfolk and Suffolk.

CLASS III.—ZOOPHYTA* OR POLYPI (ZOOPHYTES OR POLYPS).

THIS class of radiated animals is thus characterized by Milne Edwards:—Animals organized for a sedentary mode of life, having no locomotive organs, and being provided with a circle of retractile tentacula round the mouth, and a central gastric cavity not communicating with a vent, and containing the reproductive organs when they exist; in general fissiparous or multiplying by buds as well as by ovules. They received the name Zoophytes (animal plants) because the animals are often crowded together in societies or families in such a manner as to assume the form of trees—a form assumed so as to allow each of the individuals of which the society is composed to procure a fair and equal share of nourishment from the water which surrounds them and on which they live, as the leaves of trees extract nourishment from the air in which the plant grows. The union which they form with each other is sometimes so intimate, that one individual cannot be injured without its becoming felt by the whole society. The permanent fabric formed by these animals is called *Polypidom* (the house of the Polyps). The Zoophytes, taken as a class by themselves, have been divided into two sub-classes or divisions, according as the animals assume the *radiated* or the *molluscan* type. These are termed the *Anthozoa*, or Radiated zoophytes; and the *Bryozoa*, or Molluscan zoophytes, which are now considered by many naturalists to form a class of Mollusca, following and nearly related to the *Tunicata*. Many of the more transparent Zoophytes are highly luminous. See page 381, *Mollusca*.

SUB-CLASS I.—ANTHOZOA.†

THOUGH we retain here this sub-class of Anthozoa, or "animal flowers," as part of the class *Zoophyta*, we are aware that from late observations made as to their structure, the animals of the *Anthozoa* appear to be closely related to the *Medusæ*, and form indeed, according to these observations, a sub-order of the *Pulmograda* or *Discophoræ*.

The animals forming the *Anthozoa* may be thus characterized:—Body tending to globular, contractile in every part, symmetrical; mouth and vent one; gemmiparous and oviparous; mouth surrounded with a circle of retractile non-ciliated tentacles. They are divided into three orders, which contain numerous interesting species—I. *Hydroida;* II. *Asteroida;* III. *Helianthoida*.

ORDER I.—ANTHOZOA HYDROIDA (*Hydroid Polyps*).

In this order of Zoophytes, the permanent fabric, the "House of the Polyps," the *Polypidom*, is horny, fistular, external, and plant-like. The Polyps themselves are generally compound, and have the body for the most part of a somewhat globular figure, and of a nearly homogeneous composition, consisting of an aggregation

* From *zoon* (ζωον) an animal, and *phyton* (φυτον) a plant.

† From *anthos* (ανθος) a flower, and *zoon* (ζωον) an animal.

* The figure is reversed or turned upside down in the Plate.

of vesicular granules held together by a semi-transparent, glairy gelatine. They are very contractile, and can change their form at pleasure. The tentacula surrounding the mouth are generally numerous, and are always simple and filiform, or tapering a little towards the extremity, and have their surface roughened more or less with granules arranged in an imperfectly verticillate fashion. These granules are possessed of a peculiar apparatus adapted for paralyzing and killing the animalcules the Polype feeds upon. They are similar in form and function to what in the *Acalephæ* are called the nettling organs. In the centre of these tentacula is placed the mouth, which is very dilatable, and leads by a short passage into the stomach.

The Anthozoa are propagated by buds or gemmules, and by eggs; the former extending their individual life, and the latter multiplying and continuing the species. The bud is a shoot from the body, and is identical in structure with the part of the parent whence it pullulates. The eggs are of several kinds. One sort produces young, which, when first born, are very unlike their parents, and resemble minute Medusæ. They are free and unattached, swimming at large in the water, and possess a higher organization than the adult animal. They have senses to guide, and muscles to move the body to and fro; and it is not until they have undergone a series of changes or metamorphoses, that they become staid, their muscles and nerves disappear, and they fall down into an inferior order. Another sort produces young which undergo no change in their development amounting to a metamorphosis. As soon as they are extruded from the ovisac they settle, root, and glide insensibly into the resemblance of the parent species. A third set are in the form of ciliated animalcules, which have freedom of motion, and swim in the water as if guided by volition and sense, whirling on their axis, and stopping occasionally as if in search of a situation on which to fix themselves. After a short life of this sort they obtain a proper site for their permanent stay and future growth, and begin to shoot up into those beautiful forms peculiar to the species. Many, if not all of the marine Hydroid polyps, are luminous in the dark.

The Hydroid anthozoa are composed of numerous species, arranged in several families.

The family *Tubulariidæ*, the species of which have a distinct polypidom, is represented in our plate of Zoophytes, fig. 5, by the exotic species *Tubularia clytoidea*.

The family *Sertulariidæ*, in which the polypidom is plant-like, horny, variously branched, and tubular, is represented in our Plate 2, fig. 2, by the British species *Sertularia* (Dynamena) *pumila*, the Sea-oak coralline of Ellis, and fig. 14 by the exotic species *Plumularia secundaria*.

In the family *Campanulariidæ*, the polypidom is also plant-like and horny, as in the preceding family. It is illustrated in Plate 2, fig. 1, by the "Sea-thread coralline" of Ellis, *Laomedia dichotoma*, a species found in various parts of Great Britain and Ireland.

The family *Hydroidæ*, containing the fresh-water polypes, so well and popularly known under the name of *Hydra*, though placed amongst the Anthozoa by most naturalists, is considered by some others as equivalent to an order by themselves.

In the animals belonging to this family, and which consists of a single genus (*Hydra*), the Polypes are locomotive, single, naked, gelatinous, sub-cylindrical, but very contractile and mutable in form, the mouth encircled with a single series of granulons filiform tentacula. The Hydræ are all natives of fresh water alone. Though usually found attached, they can nevertheless move from place to place, either by gliding with imperceptible slowness on the base, or by stretching out the body and tentacula to the utmost, fixing the latter and then contracting the body towards the point of fixture, loosening at the same time its hold with the base. Their usual motion is very slow; but when seizing their prey, they are nimble and active. They are exceedingly voracious, and their long tentacula are spread out in all directions to entrap their victims. Worms and other annelids are killed almost immediately they are seized, though Entomostracous crustaceans, which are provided with a shell, frequently escape from their grasp unharmed. This has lately been explained by the investigations into the nettling organs which are found in these tentacula, and which have been already mentioned in treating of the *Acalephæ*.

ORDER II.—ANTHOZOA ASTEROIDA (*Asteroid Polypes*).

The Asteroid polypes have the polypidom variable in form, either free or attached, of a fleshy consistence, strengthened with a horny or calcareous axis, enveloped in a gelatinous crust in which the Polypes are immersed. These are compound, living in societies closely united in a single mass by their outer skin; and the mouth is surrounded with only eight fringed tentacula. The stomach ends in six or eight elongated processes, which are considered as the oviducts. The polype mass is propagated by gemmation; and as each species emits its buds in a peculiar form, the shape and size of the mass depends upon the manner or preordained fashion in which the buds are evolved. The species, again, are propagated or increased by eggs. These are expelled from the ovisacs into the stomach, and from thence ejected into the sea. They are ciliated, and possess motion, as if apparently actuated by volition. Some of the species are phosphorescent. By far the greater number have a thick, spongy outer skin, which is often strengthened by having variously-shaped calcareous grains or rugose, and more or less fusiform calcareous spicula, imbedded in its surface. In general the common mass has an expanded base, by which it is attached to some marine body, and when the mass assumes an erect or branched tree-like form, the animals secrete in the centre of their body a more or less rigid support, which has been called their axis, and which has sometimes, though erroneously (from its being commonly seen in collections without the remains of the investing animal), been considered the entire coral. This axis is thickened by depositions of fresh layers of horny matter on its surface, as the mass increases in size and requires more support; the increase of the thickness and length of the axis being always simultaneous with

the growth of the mass—such are the *Gorgonias*. When the common mass is of a low, rounded shape, the spicula in the substance of the skin are strong enough to support the mass—such we see to be the case in the *Alcyonians*, or Sea-fingers (*Alcyonidæ*).

FAMILY—CORNULARIA.

The family *Cornulariidæ*, which has a horny external skin like that possessed by the genus *Tubularia*, is represented in Plate 1, fig. 1, by the pretty species, *Cornularia* (rugosa) *rosea*.

FAMILY—GORGONIIDÆ (*Gorgonias*).

In the *Gorgonias* or *Bark-bearing Corals*, the polype mass is attached by a root, and is formed like a small tree or shrub. Some of the Gorgoniæ are very handsome, much branched and reticulated. These species are commonly called "Venus' fans." In others the mass is not much branched; but the species are peculiar for having the axis quite black and very hard, and are well known by the common name of "Black Coral" (*Antipathes*). These were formerly much esteemed for their supposed magical and medicinal qualities, but are now only used for making riding whips and whisks, &c. The family is represented in Plate 1, fig. 9, by the exotic species *Gorgonia patula*.

FAMILY—TUBIPORIDÆ (or *Organ Corals*).

The animals belonging to this family have at first a tough skin similar to those of the last, which, however, becomes in time so hardened by the continued deposition of calcareous matter within its substance, as to assume the consistence of a hard coral. The animals live in groups side by side, and the shelly tubes formed by them give the appearance of the pipes of an organ; hence the English name for the family. These tubes are of a vivid red, and the animals being bright green, the mass forms a beautiful object when alive. The family is represented in Plate 1, figs. 2–4, by the species *Tubipora musica*.

FAMILY—CORALLIIDÆ (*The Calcareous Corals*).

In this family a larger quantity of calcareous matter is deposited along with the horny matter, and this forms a stone-like axis, instead of a horny one, as in Gorgonia.

GENUS CORALLIUM.—This genus is the type of the family. To it belongs the celebrated red coral of commerce, *Corallium rubrum*, a native of the Mediterranean, and represented in Plate 1, fig. 6—*Isis nobilis*. This coral, so much admired for its fine red colour, and the high polish of which it is susceptible, is the article so much used for making beads and other trinkets. It forms a very profitable trade in the Mediterranean, and is procured by dredging and diving, the fishery thus giving employment to numbers of people.

FAMILY—HYALONEMIDÆ (*The Glass-rope Corals*).

In this family (consisting of only one genus and a single species) the axis is composed of a bundle of thin transparent fibres, looking exactly like a rope of spun glass. These fibres are formed of nearly pure flint, and are hard enough to scratch glass. This axis is covered with a polypiferous crust as in Gorgonia. The end of the axis is lodged in a species of sponge. Fine specimens of the *Hyalonema* (*mirabile?*) from Japan may be seen in the British Museum.

FAMILY—PENNATULIDÆ (or *Sea-pens*).

This family contains species which have the polype mass free, floating in the sea, or having the naked part of the stem sunk into the sand or mud on the coast.

GENUS PENNATULA.—This genus contains those species which float free, and which are well known from their resemblance to a pen, by the name of "Sea-pens." They have only a single axis, which pervades their central stem, and this, which is called the shaft, is subcylindrical. The animals come out from the upper part of the side branches which emanate from this shaft, and which correspond with the plume of the pen. These branches or plumes are twice pinnate. This family is represented in Plate 1, fig. 12, by a species belonging to the genus Renilla (*R. americana*), the polype mass of which is fleshy, with a kidney-shaped expanded head, the animals coming out on the broad flat sides.

GENUS VIRGULARIA.—This genus contains some of the species which have the base of the stem sunk in the sand. A beautiful species, the *V. mirabilis*, occurs on our own coasts, the stem or polype mass being linear, elongate, like a rod or a quill deprived of its feathers, the side branches being very small.

ORDER III.—ANTHOZOA HELIANTHOIDA (*Zoanthoid Polypes*).

The Zoanthoid polypes have the Polypes single, free, or permanently fixed. They are fleshy, either naked or encrusted with a calcareous polypidom, the upper surface being crossed with radiating lamellæ. The mouth of these Polypes is encircled with tubulous tentacula, which, being disposed in regular circles and tinged with various colours, represent not unaptly the petals of some flowers. Their stomach is membranous and furnished with more or less numerous longitudinal folds. They have no intestine, and no visible exit from the stomach, except the mouth, by which the undigested remains of the food are ejected, always enveloped in a large quantity of a clear glairy fluid. They are oviparous, the ovaries being internal.

This order contains an immense number of species, some of which are well known to our readers by the familiar name of *Actiniæ*, and others by the not less well known term of *Madrepores* and *Corals*.

that throughout these vast areas, wherever there is now an "Atoll," a foundation must have originally existed within a depth of from twenty to thirty fathoms from the surface." Taking this as a certainty, he solves all difficulty as to the origin of these immense structures, by saying that wherever these "Atolls" occur there must have been a gradual subsidence of land, which served as a basis for the polypiferous corals to erect their wonderful structures upon. The Polypes never build their corals above low-water mark; hence the coral islands and reefs never rise many feet above the surface. The elevation of the land upon them is principally owing to the action of the sea. Large masses are detached by the waves and washed upon the reef; shells, coral, and other debris are likewise washed up on to it, and accumulate till a surface is formed with a layer of soil upon it capable of supporting various forms of vegetable life.

There are numerous genera and species of coral, the variations of form depending upon the manner in which the animal emits from the whole surface, or from a particular part of the sides of its body, the bud by which the new individuals of the general mass or society are produced. The specimens usually shown in collections are small individuals which grow in sheltered places among the rocks, where they are not exposed to the action of the waves, and collected before they have reached their proper magnitude. The illustrations in Plate 2 of the various genera of corals, give a very poor idea of the beauty of these formations. In the family Madrephylliidæ the genus *Caryophyllia* is represented on Plate 2, figs. 6–7, by the *Caryophyllia solitaria*. The genus Astræa is represented at figs. 4–5, by *Astræa ananas;* the genus *Meandrina*, or Brain Coral, at figs. 10–11 by *Meandrina limosa;* and at fig. 3 by *M. cerebriformis;* and the genus *Oculina* is represented at figs. 8–9 by *Oculina varicosa*.

FAMILY—MADREPORITIDÆ.

In this family the animals live crowded together in societies, forming a branched coral; and the cellular substance of the animal is in general not so perfectly filled with calcareous matter as in the preceding family. In consequence of this, we find the species to be of a more spongy or a lighter texture. It is, however, of these that the coral reefs are chiefly formed. Mr. Darwin found on the edges or outer margins of the reefs of the Lagoon islands, that a species of the genus *Porites* was the most abundant, and that it formed great irregularly rounded masses from four to eight feet broad, and about the same in thickness. The fringing reefs, again, of the Mauritius had their outer edges formed of great shapeless masses of branching Madrepores, belonging chiefly to two species, the *Madrepora corymbosa* and *M. pocillifera*.

FAMILY—MILLEPORIDÆ.

According to Mr. Nelson, the animals forming the corals belonging to this family are very different from those of any other coral, being quadrangular, expanded at intervals into four rays, and destitute of any true tentacles.—(*Gray.*) The greater bulk of the described species of millepores are fossil. A few, however, are recent; and one of these (*Millepora complanata*) is said by Mr. Darwin to be next to *Porites* in abundance, as forming the reefs of the Lagoon islands. This species appears to possess the stinging or nettling power possessed by the Actiniæ. Lieut. Burnaby, R.N., informed the writer of this, that at the Cocos or Keeling islands he had often experienced this fact. Mr. Darwin, at the same locality, says that he found both this species and *Millepora alcicornis* to possess this power. The family is represented in Plate 1, fig. 10, by the species *Millepora spongites*.

SUB-CLASS II.—POLYZOA OR BRYOZOA (MOLLUSCAN ZOOPHYTES).

By many naturalists this sub-class of Zoophytes is placed in the sub-kingdom *Mollusca*. In some respects, as we have observed already at the conclusion of our article MOLLUSCA, the species are closely allied to those of the class Tunicata, more especially the family *Botryllidæ* or Compound Ascidians; and in others they approach the *Terebratulæ* amongst the Brachiopoda. The Polyzoa are compound animals, and the growth formed by the associated animals or colony, is termed "polyzoary," corresponding with the "polypidom" of the Anthozoa. This is formed of a number of little chambers, or cells, organically united, each of which contains a polypide. They possess organs of digestion, respiration, and circulation, have a muscular and nervous system, and in an embryonic state are furnished with organs of motion. Their reproduction is effected in three different modes; by gemmation, by ova, and by what have been called free locomotive embryos.

The numerous species of animals belonging to the class *Polyzoa* have been arranged in two orders, according to the disposition of the tentacles which surround the mouth—1st, Those which have the tentacles disposed in a ring surrounding the unarmed mouth—all natives of the sea, the *Infundibulata;* and 2nd, Those in which the tentacles are disposed in a crescent, or horse-shoe shape—all natives of fresh water, the *Hippocrepia*.

ORDER I.—INFUNDIBULATA.

This order is by far the most extensive in number. The animals have the tentacles disposed in an uninterrupted series round the annular disc surrounding the unarmed mouth. This order is represented in Plate 1, fig. 8; by *Bicellaria fastigiata;* in fig. 7, by *Cellepora hyalina;* and in fig 11, by *Serialaria lendigera*.

ORDER II.—HIPPOCREPIA.

This order contains only, comparatively speaking,

few species, and these are all natives of fresh water. The animals have their tentacles disposed in a crescentic or horse-shoe series round the disc surrounding the mouth. The order is well represented by the "Bell-flower Animals" of some of the earlier writers on the microscope, the genus *Plumatella*. Another genus, *Cristatella*, is remarkable from the only species belonging to it possessing, when adult, a locomotive faculty. This creature is a native of the fresh waters of Great Britain, and is found floating on the surface. Though it does possess motion, its progression is very slow, seldom exceeding an inch in twelve or twenty-four hours. This beautiful species forms a fine object for microscopic inspection.

CLASS IV.—PROTOZOA.

THE Class *Protozoa* contains an immense number of creatures, very minute in size, and very low in organization. They all belong to two large orders—1. *Infusoria*; 2. *Rhizopoda*.

ORDER I.—INFUSORIA (*Infusory Animalcules*).

The animals belonging to this order of animals are for the most part extremely minute, and have been made known to us by the aid of the microscope. They inhabit stagnant water, fresh or salt, in which plants are growing, or in which an abundance of decayed vegetable or animal matter is contained. Most of them are invisible to the naked eye, and species have been described from 1-1500th to 1-2000th of a line in length. So exceedingly minute, indeed, are they, that it is calculated a moderate-sized drop of water may contain five hundred millions of these minims of creation! They are of very simple organization, as they are furnished with neither vessels nor nerves, are not symmetrical, have not distinct sexes, have no visible eggs, and are without determined or permanent digestive cavity. The chief organs of which they are composed appear to be internal spherical cavities, which frequently contain foreign particles supposed to serve as food, and which are derived from the surrounding water, entering into the substance of the body, and moving through it by the general contraction of the mass, and being expelled through the opposite side. Some have no visible locomotive organs, others have; and these are either cilia, or changeable processes, as they are called—expansions of the substance of the body. The substance itself which forms the body is called *Sarcode*, and in perhaps the greater number is a glutinous, homogeneous, or slightly granular diaphanous mass. In some Infusoria red specks are visible, which resemble eyes, and by some zoologists are really considered as such; though, from a want of all traces of a nervous system, and possessing no distinguishable cornea or lens, others deny them to be true eyes, and compare them to the red specks often seen in Algæ. The food of the Infusoria consists partly of vegetables, and partly of animal decomposing matter, and they not unfrequently prey upon each other. They are the prey, again, of other aquatic animals; and as they occur in immense quantities in the water of the ocean, as well as in that of our fresh-water pools and slow running streams, they contribute much to the nourishment of animals of a higher order which are useful to man. This has been particularly observed in the ocean, in high latitudes, where vegetable life ceases to be represented, but where animal life is still in abundance. Infusoria are there found to exist in inconceivable numbers, and form the principal food of the fishes inhabiting these regions. They frequently occur in such immense numbers as to colour large tracts of water with very remarkable hues. Some species impart a blood-red tint to the water, and Ehrenberg has thrown out the conjecture that these little creatures were the agents employed in the miracle worked by Moses in turning the waters of Egypt into blood! Others give a blue colour, while a third set tinge the whole surface with green. At sea, though singly invisible, they produce one kind of the phosphorescent light so often observed in the ocean. Formerly, before their history was well understood, they were erroneously considered to derive their being, directly and spontaneously, from the decomposition of animal or vegetable matter in water, and were, from their sudden appearance in such situations, and in such immense numbers, held to prove the truth of what is called "spontaneous generation." Infusoria can resist a degree of cold equal to 8° of Fahrenheit, and a degree of heat equal to 260° Fahrenheit. According to Ehrenberg, who has studied these creatures with great care, they are divided into two large groups, which he denominates *Polygastrica* and *Rotifera*.

This latter group, however, has now been proved to be of a much higher organization than the former, and has accordingly been removed from the class Infusoria into a separate class by itself, allied to the Crustacea.

The *Polygastrica* have also been proved to contain whole families and sections which are not true Infusoria. Thus the *Diatomaceæ* and *Desmidiaceæ* have been proved to be forms of *Algæ*. The *Vibrionina* are now included amongst the *Oscillatoreæ*, a family of compound *Algæ*; whilst the *Volvocina* and *Monadina* are ascertained to be other forms of plants. On the other hand, many others are apparently only the larva state of *Annelides*. The genus *Paramecium*, for example, has been ascertained to be the embryo state of *Planaria*, and the genus *Cercaria* to be the undeveloped young of an intestinal worm; and lastly, two whole families containing the genera *Amiba*, *Arcellina*, &c., have been removed to form part of the following order, *Rhizopoda*.

The greater portion of the fossil Infusoria described by naturalists as so abundant in the marine and fresh-water deposits, are in like manner removed from this class and placed amongst the *Diatomaccæ*. Though

these various removals leave this order of animals now, comparatively speaking, a small one, yet it contains a great number of genera, and the individuals of most of the species are immensely numerous.

We must content ourselves with indicating some of the leading forms of this interesting order of Protozoa as represented in Plate 1., figs. 1 to 7, including the genera *Kolpoda*, *Ophryoglena*, *Oxytricha*, *Stylonichia*, *Discocephalus*, *Chlamidodon*, and *Euplotes*.

ORDER II.—RHIZOPODA OR FORAMINIFERA.

THE species belonging to this order of Protozoa were formerly known to us only by their external coverings or shells, and before the animals were discovered were always considered to belong to the sub-kingdom *Mollusca*. They were indeed, from the structure of the shell, generally arranged in the class Cephalopoda, under the name of *Polythalamia*. Dujardin, however, has lately shown, from his investigations and discovery of the living animal, that they are nearly allied to the Infusoria. The animals are of a very simple organization, appearing to be merely a gelatinous mass, or sarcode, with no apparent organs or viscera. They creep slowly by means of a series of filaments or filiform processes of considerable length, which they protrude through the small holes observable in the shells (see Plates 1 and 2.), and which, when watched in motion, appear like a drop of gum flowing along the surface of the substance they move upon. The coverings of these animals are small shells, and consist chiefly of carbonate of lime. The texture, however, varies considerably; in some being opaque, of a close texture like porcelain, and without any external indication of pores; in others being porous, and perforated, especially in the last segments, with a great many small apertures; and in a third class being transparent as glass.

The recent species occur in various parts of the surface of the globe in immense numbers. The sand of the sea-shore in many places is so completely filled with them, that it appears half composed of these elegant little shells. In the Adriatic Sea four thousand or six thousand have been found in an ounce of sand, and in the West Indies three million eight hundred and forty thousand have been found in the same quantity. If we calculate larger quantities, as for example a cubic yard, the amount surpasses all human conception, and we have difficulty in expressing the resulting number in figures. When we regard in this point of view the whole enormous mass of the sea-coasts of the earth, we must conclude that no other series of beings can, in regard to number, be compared with them. The part they play in creation at the present day is truly wonderful. Banks of sand which impede navigation, obstruct gulfs and straits, and fill up harbours, are their work; and along with corals they assist in forming those islands which are every day making their appearance in the warm regions of the great ocean. In former eras of the earth's surface, the part they played seems still more striking. In the carboniferous period enormous masses of limestone in Russia have been found composed almost entirely of a single species of *Fusolina;* and immense quantities occur in the cretaceous formations in France. They were still more abundant in the tertiary period. The stones of which the largest pyramids of Egypt are built are so full of a species of *Nummulites*, that these extraordinary erections appear to be almost entirely composed of them. The stone of which the houses and buildings of Paris are constructed is so full of a species of *Miliola*, that Paris and the villages in the neighbourhood may be said to be built of them. A cubic inch of the stone from the quarries of Gentilly contains upwards of fifty-eight thousand of these fossil shells, and the beds of which these quarries are composed are of great thickness and of vast extent. The actual number of such shells is thus inconceivable.

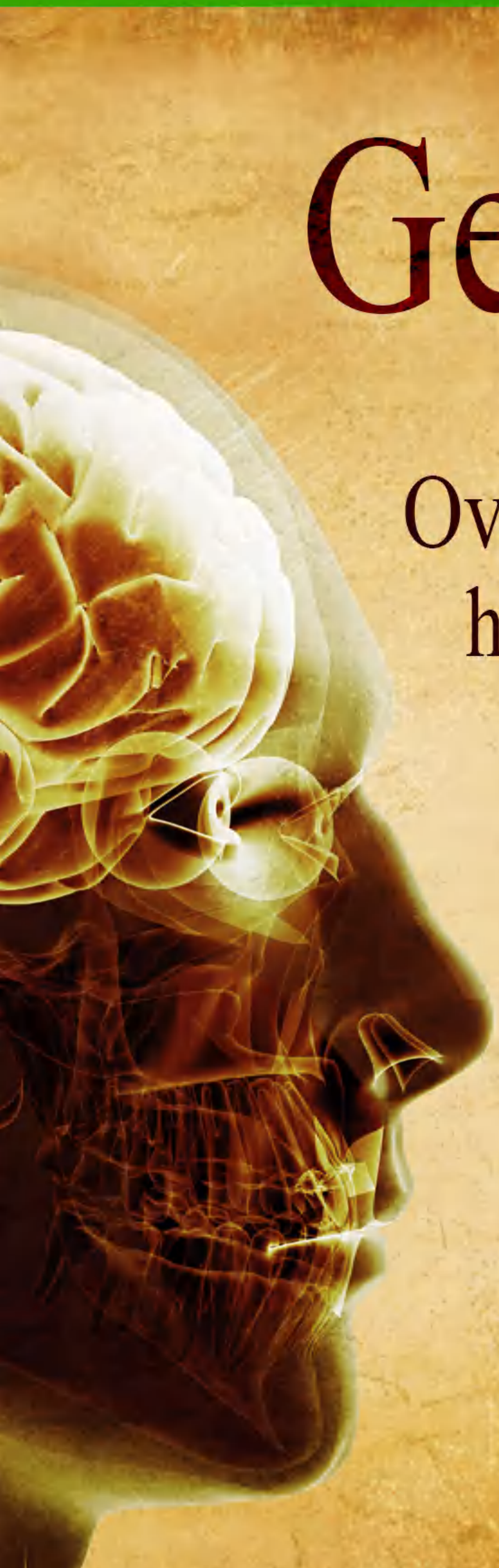
A great many species of Foraminifera or *Rhizopoda*, both recent and fossil, have been described; but the researches of the latest authors upon this class tend to throw great doubts upon their value, and give reason to believe that, though individually the Foraminifera are amazingly numerous and abundant, the number of distinct genera and species has been very much exaggerated. This order has been divided into several families, which are characterized by the arrangement of the chambers constituting the shell. For illustrations of these curious creatures we must refer to the magnified figures of the families and genera in Plates (*Rhizopoda*) 1 and 2.

CLASS V.—PORIFERA (THE SPONGES).

THE class *Porifera*, the last in the zoological series, and the lowest as regards their organization, is composed of those substances called Sponges, and to which, amongst many others, the well-known Sponge of commerce belongs.

For a long time it was a disputed point whether sponges belonged to the animal or vegetable kingdom, and it is only of late years that the evidence has preponderated in favour of their animal nature.

Sponge, in the state in which we usually see it, consists of a congeries of horny filaments, interlaced in every direction so as to form a most intricate net-work of intercommunicating cells. Imbedded in these filaments, in the majority of sponges, are a number of very minute needle-shaped, siliceous, or calcareous substances called *spicula*. These bodies vary much in form. In some sponges they are simply of a needle-like form, slender and cylindrical, and pointed at both ends. In other instances they have a small knob at one end, whilst the opposite extremity is pointed, giving them exactly the appearance of small pins. In others, again, we find one end transformed into a fork with two or even three prongs; or the whole spiculum consists of three or four spines of equal length. These spicula appear to be hollow tubes, closed at both ends. This framework with its inclosed spicula, is, however,



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THE MUSEUM

OF

NATURAL HISTORY.

APPENDIX.

PRINTED BY WILLIAM MACKENZIE, 43 & 45 HOWARD STREET, GLASGOW.

place between the months of March and July, and a second, again, from July to October. At other parts of the Mediterranean coast of France they arrive simultaneously from very different directions, but only in the winter months.

The mode of fishing for this valuable fish pursued on the sunny Provençal shore, is sufficiently interesting to merit a detailed description:—

It is carried on by the tunny-net, and the fish are driven into an inclosure called the Madrague. The tunny-net is, in truth, a combination of nets, which is quickly cast into the sea in order to *head* the tunnies at the moment of their passage. Sentinels are posted at suitable points to signal the approach of the wished-for legions, and as soon as their warning has been given the fishing-boats, as if moved suddenly by one uniform impulse, pull towards the designated spot, where they range themselves in curved lines, and form with the light floating net a semicircular inclosure directed towards the shore, whose interior is called the Garden. The fish pent up within this garden, between the net and the coast, become stricken with a panic. As they unwillingly move towards the shore they press upon the inclosure, or, rather, a new interior inclosure is quickly formed with nets held in reserve. In this second inclosure a narrow opening is left, which affords the tunnies their only chance of egress. Ever moving towards the shore, the fishermen continue to diminish the size of the garden by successive inclosures, each smaller than the preceding, until the tunnies are banked up in about nine feet of water. When this has been effected, a kind of semi-net is flung into the garden, and hauled into shallow water *vi et armis*, when the small fish are taken by the hand, the larger by hooks. The boats receive their cargo, and pull ashore. The result of a single day's battue will sometimes be sixteen thousand tunnies, but these mostly of small size, and averaging from twenty to five and twenty pounds in weight.

When the park, instead of being established for a single fishing, becomes a permanent construction, it is called, as we have already stated, a Madrague. The Madrague is a vast inclosure. The netting which divides it into compartments is sustained on the surface by buoys of corks, and kept down by heavy stones and other weights on the lower edge. In this position it is secured by stout ropes, one extremity being fastened to the net, and the other to an anchor. The object of the Madrague is to arrest the course of the tunny-shoals at the moment they abandon the shore to return again to the deep waters. For this purpose a long alley, or run, is formed between the shore and the Madrague, and the fish, necessarily following it up, pass from chamber to chamber, until inclosed in the narrow area of the park. In order to drive them into this receptacle they are pressed towards the shore by means of a long net, supported by and extended between two boats, which slowly and carefully pursue them in their movements. As soon as the prey has reached the best compartments, the fishermen raise a horizontal net, which forms a sort of floor to the park, and gradually lift its contents to the surface of the water. This operation occupies the whole night.

In the morning the tunnies are found gathered within a very limited area, at various distances from the shore, and thereupon the massacre begins! With long poles, with boat-hooks, and with any similar weapon, the fishermen lustily lay about them, until the sea is literally "incarnadined." It is said, and we can well believe, that the spectacle of the struggling fish—some of them slightly wounded, others half dead, vainly endeavouring to escape the murderous blows of the assailants—is a very painful one, and not easily endured by any person of sensibility. (See Plate.)

The flesh of the Tunny is valued on account of its firmness, wholesomeness, and nutritious properties. It is called "the salmon of Provence," but M. Figuier tells us he prefers it to the salmon. Nothing, he exclaims, can be comparable to the fresh Tunny thrown into a hot frying-pan, and besprinkled with salt and vinegar. When properly cooked, it is peculiarly firm and savoury. In short, he adds, nothing of this kind can rival the Tunny, as it may be procured at Cette and Marseilles.

The Tunny is also in high repute among the Greeks, and generally among all the populations which inhabit the shores of the Mediterranean, the Propontis, and the Black Sea. From numerous passages in the Latin authors we know that it was much esteemed by the ancient Romans, who, however, eat only the head and lower part of the belly. They cut the fish into pieces, and preserved them in vessels filled with salt. They are now cured with oil and salt, after being cooked; and in this condition are in great demand at Cette, Montpelier, and Marseilles.

Closely allied to the Mackerel, and other Scombridæ, is the Bonito (*Thynnus pelamis*), which has been also called the Striped Tunny. It is noted for its activity and voracity, and pursues the flying-fish with unrelenting hostility. Externally, it is a handsome fish; about three feet long, with a sharp head, small mouth, full silvery eyes, large gills, and a crescent-shaped tail. Except on the middle of its sides it is wholly without scales, but a band of golden colour stretches from the head to the tail. Its back and sides are of a greenish colour, but its under parts of a silvery white. It is a native of the Mediterranean, and very rarely visits the British coasts.

Fishing for Electrical Eel (Gymnotus) on the Orinoco.

The Gymnotus belongs to the order *Apoda*. It has a long, nearly cylindrical, and serpent-like body, with a tail of considerable extent. Its sole locomotive organ is a long swimming fin placed beneath the tail, and it is owing to the wideness of its back that it has received the designation of Gymnotus—from γυμνος, naked, and νῶτος, back.

The Gymnotus is a fresh-water fish, and in the South American rivers attains to a great size. There are several species, of which the most remarkable is the *Gymnotus electricus*, or Electrical Eel, so called, of

course, in reference to its curious physical properties. When touched with the hand or an electric conductor, it communicates a pungent sensation, similar to an electrical shock. The organs which produce this effect consist of four groups of parallel membranaceous laminæ, situated very near each other and almost horizontally extending from the skin to the central medial plane of the body, and connected by numerous transverse vertical laminæ. The prismatic canals or cellules intercepted by these laminæ are charged with a peculiar gelatinous substance, while an abundance of nerves permeates the whole apparatus; which is said, when fully vigorous, to be able to knock down a man, and benumb the stricken limb for several hours. It has been conjectured that it is by this means the eel obtains its prey, stupifying the smaller fishes, and other animals, which come within its reach.

Though *externally* allied to the eel, says an able writer, yet if that part of the body was cut off which contains the nutrient, the respiratory, and generative organs—all the parts, in fact, which are essential to the existence of the Gymnotus as a mere fish—it would present a very different appearance to the slender eel in its short and thick-bodied form. Its long electric organs are, so to speak, an extraneous appendage to the true fish, and its eel-like form is therefore accidental. The back-bone and muscles are of necessity coextended with the electric organs for their support and motion; and the air-bladder stretches along the produced electrophorous trunk to secure a suitable specific levity. Two dorsal nerves are prolonged from the fifth and eighth cerebral nerves, for ordinary sensation and motion. The spinal cord is produced along the vertebral column, for the exclusive supply of the electrical organs. The electricity which they discharge decomposes chemical compounds, produces the spark, and magnetizes iron, as does that of the Torpedo. But the magnetizing power seems to be relatively weaker, while the benumbing shock communicated to other animals is stronger than in any other electric fish.

It gives this shock with the greatest force when touched under the belly, or in the pectoral fin, and always acts without the least muscular exertion in the fins, head, or body. It acts, too, of its own will, and the discharge is more or less powerful according to the animal's pleasure.

Those electrical properties were first discovered by Van Berkal. As far as the American fish was concerned, little was known of them by the scientific world until described by the astronomer Richer, who visited Cayenne in 1671. "I was much astonished," he writes, "to see a fish some three or four feet in length, and resembling an eel, deprive of all motion for a quarter of an hour the arm and neighbouring parts which touched it. I was not only an ocular witness of the effect produced by its touch, but I have myself felt it, on touching one of these fishes while still living, though wounded by the hook the Indians had employed in drawing it from the water."

For the first precise and philosophical account of it we are indebted to Humboldt, who drew it up from Bonpland's observations.

In crossing the wide grassy llanos of the province of Caracas, in order to embark at San Fernando del Apure on his voyaye up the Orinoco, M. Bonpland stopped at Calabozo. His object was to investigate with care and completeness the history of the Gymnotus, which is abundant in the neighbourhood; and some Indians conducted him to the Cano de Bera, a muddy and stagnant lake, surrounded by luxuriant vegetation, among which the Clusia rosea, the Hymenæa courbaril, the Indian fig, and some fragrant flowering mimosas shone pre-eminent. The Indians then collected a troop of half-wild horses, and surrounding the marsh, as hunters surround the forest where some wild animal lies concealed, drove them into the miry waters, shouting and screaming vociferously. The horses rushed into the water, when the eels, stunned and alarmed by the noise, the tumult, and the agitation, defended themselves by repeated discharges of their batteries, which seriously wounded their involuntary enemies.

"I wish, says Humboldt," that a clever artist could have depicted the most animated period of the attack," which has been done, as the reader will see, on turning to the Illustration. "The groups of Indians surrounding the pond; the horses with their manes erect and eyeballs wild with pain and fright, striving to escape from the electric storm which they had roused, and driven back by the shouts and long whips of the excited Indians; the livid yellow eels, like great water-snakes, swimming near the surface and pursuing their enemy—all these objects presented a picturesque and exciting *ensemble*.

"In less than five minutes two horses were killed. The eel, being more than five feet in length, glides beneath the body of the horse, and discharges the whole extent of its electric organ, attacking simultaneously the heart, the digestive viscera, and, above all, the gastric plexus of nerves. I thought the scene would have a tragic termination, and expected to see most of the quadrupeds killed; but the Indians assured me the fishing would soon be finished, and that only the first attack of the Gymnotus was really formidable."

After the combat had endured for about fifteen minutes, the alarm of the mules and horses gradually decreased; they no longer erected their manes, and their eyes expressed less pain and terror. They were no longer struck down in the water, as if seized by an invisible hand; and the eels, instead of swimming to the attack, retreated from their assailants, and made for the marshy bank.

The Indians then easily captured them with barpoons attached to long cords, and they were landed without having any opportunity of communicating a shock.

THE HIPPOCAMPUS

The *Hippocampus* is a genus of highly curious aspect, known in English nautical parlance as the Sea-horse Pipe-pot. The best-known species is the *Syngnathus hippocampus* of Linnæus, or the *Hippocampus* brevirostris* of Cuvier. Its average length is

* From ἵππος, horse, and κάμπος, fish.

from six to ten inches; the body is much compressed, short, and deep; the whole length of the body and tail is divided into ring-like segments, separated by longitudinal and transverse ridges, with the angles of intersection marked by tubercular points—the *ensemble* having a striking resemblance to a caterpillar's body. The snout is slender; the neck suddenly contracts beyond the head, which presents a sufficiently remarkable likeness to that of the horse, to justify the name popularly bestowed on this bizarre animal. The tail is long, of a quadrangular form, and terminates in a naked or finless tip. When swimming about, the *Hippocampus* preserves a vertical position; but its tail is ever ready to seize any object it encounters in the water, and when once attacked, the animal darts upon its prey with surprising dexterity.

The *Hippocampus* is a native of the Mediterranean, the Atlantic, and the Indian oceans. It is frequently met with on the eastern coast of Spain, and the south coast of France. Mr. Lukis, who had two female *Hippocampi* in captivity, thus describes their habits:—"When they swim, they preserve [as already stated] a vertical position; but their tail seems on the alert to seize whatever it meets with in the water, clasping the stem of the rushes. Once fixed, the animal seems to watch attentively all the surrounding objects, and darts on any prey presenting itself with great dexterity. When one of them approaches the other, they interlace their two tails, and it is only after a struggle that they can separate again, attaching themselves by the lower part of the chin to some rush in order to release themselves. They have recourse to the same manœuvre when they wish to raise the body, or when they wish to wind their tail to some new object. Their two eyes seem to move independently of each other, like those of the chameleon. The iris is bright and edged with blue."

The pectoral fins of the *Hippocampus* are so formed that they can easily sustain the body, not only in the water, but also in the air; they are, in fact, winged fishes; and it is probable that they suggested the old fable of Pegasus, or the winged horse.

THE FLYING FISHES.

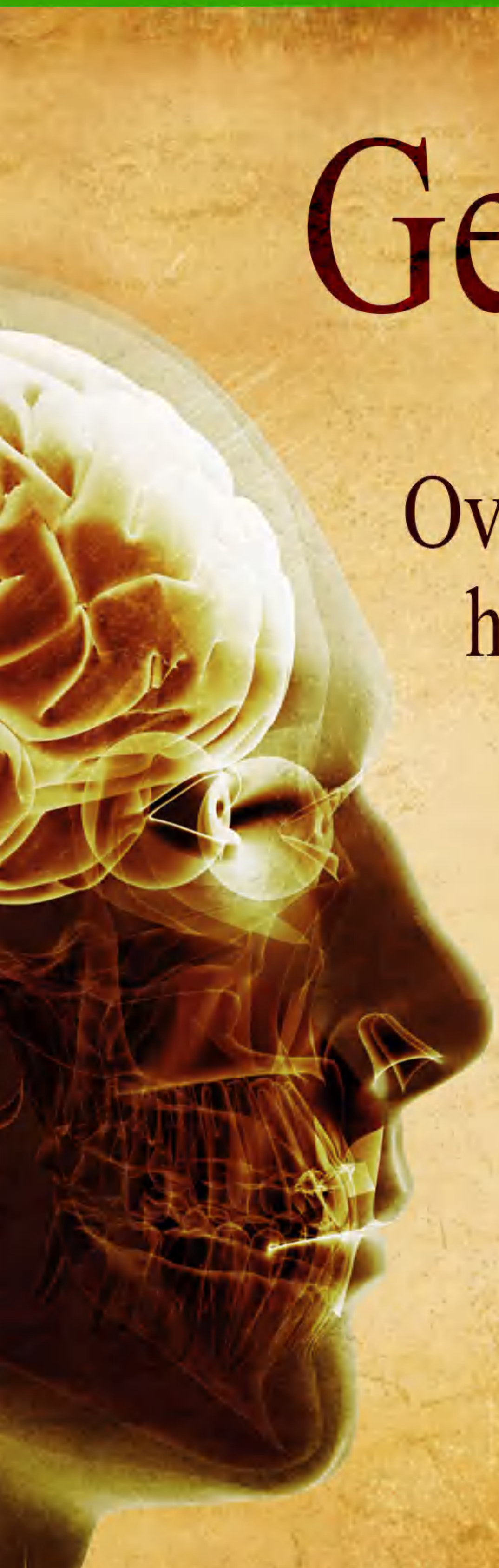
The so-called flights of the Flying-fish are really short springs or leaps through the air, not made voluntarily, but for the purpose of escaping from the pursuit of the dolphin and other enemies. Mr. Bennett, in reference to this *vexata quæstio*, observes:—"I have never been able to see any percussion of the pectoral fins during flight; and the greatest length of time I have seen this volatile fish on the fly has been thirty seconds by the watch, and the longest flight mentioned by Captain Basil Hall has been two hundred yards; but he thinks that subsequent observation has extended the space. The most usual height of flight," continues Mr. Bennet, "as seen above the surface of the water, is from two to three feet; but I have known them come on board at a height of fourteen feet and upwards; and they have been well ascertained to come into the chains of a line-of-battle ship, which is considered as high as twenty feet and upwards. But it must not be supposed they have the power of elevating themselves in the air after having left their native element; for on watching them, I have often seen them fall much below the elevation at which they first rose from the water, but never in any one instance could I observe them rise from the height at which they first sprang; for I regard the elevation they first take to depend on the power of the first spring, or leap, they make on leaving their native element."

Mr. Gosse, however, asserts that they are fully able to direct and change their flight in the air; and Mr. Gardner confirms Humboldt's declaration, that they use their pectoral fins as wings during the time they remain above water.

Of the manner in which the dolphin pursues and attacks the flying fish, Captain Basil Hall furnishes a very graphic sketch:—

"Two or three dolphins," he says, "had ranged past the ship in all their beauty. The ship in her progress through the water had put up a shoal of flying fish, which took their flight to windward. A large dolphin which had been keeping company with us abreast of the weather gangway, at the depth of two or three fathoms, and as usual glistening most beautifully in the sun, no sooner detected our poor dear friends take wing, than he turned his head towards them, darted to the surface, and leaped from the water with a velocity little short, as it seemed to me, of a cannon-ball. But though the impetus with which he shot himself into the air gave him an initial velocity greatly exceeding that of the flying fish, the start which his fated prey had got enabled them to keep ahead of him for a considerable time. The length of the dolphin's first spring could not be less than ten yards; and after he fell we could see him gliding like lightning through the water for a moment, when he again rose, and shot upwards with considerably greater velocity than at first, and of course to a still greater distance. In this manner the merciless pursuer seemed to stride along the sea with fearful rapidity, while his brilliant coat sparkled and flashed in the sun quite splendidly. As he fell headlong in the water at the end of each leap, a series of circles were sent far over the surface; for the breeze, just enough to keep the royals and top-gallant studding-sails extended, was hardly felt as yet below.

"The group of wretched flying fishes thus hotly pursued, at length dropped into the sea; but we were rejoiced to observe that they merely touched the top of the swell, and instantly set off again in a fresh and even more vigorous flight. It was particularly interesting to observe that the direction they took now was quite different from the one in which they had set out; implying but too obviously that they had detected their fierce enemy, who was following them with giant steps along the waves, and was gaining rapidly upon them. His pace, indeed, was two or three times as swift as theirs, poor little things! and the greedy dolphin was fully as quick-sighted; for whenever they varied their flight in the smallest degree, he lost not the tenth part of a second in shaping his course so as



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dorsal fin small, thin, and narrow; the pectorals are also small, but slightly rounded; and the tail corresponds to the latter both in size and shape.

The most remarkable species, however, is the Foliated Pipe-fish (*Syngnathus foliatus*), closely resembling the Dog-fish in general appearance, but exceeding it considerably in length. Its characteristic feature is, the large leaf-shaped appendages attached to the back, tail, and abdomen, on very strong, rough, square spines, or processes. These, but for the regularity of their respective proportions, might easily be mistaken for the leaves of some kind of fucus adhering to the spines. The animal's body is throughout of a dusky-olive colour, thickly sprinkled everywhere, except on the follicle appendages, with small circular spots of white, and bearing on the abdomen a kind of metallic lustre. The fins are soft, tender, and transparent. The Foliated Pipe-fish is a native of the Indian seas.

The Little Pipe-fish (*Syngnathus ophidion*) is about five or six inches long, nearly cylindrical, and tapers off to a point. It is found in the British seas.

OSSEI, OR BONY FISHES.

I. *Plectognathi, or fishes in which the upper jaw is attached to the cranium*; from πλεκτὸς, interlaced, or bound together, and γνάθος, a jaw.

This order includes the natural families characterized by what may be called the offensive and defensive armour of their jaws. They are the GYMNODONTA and the SCLERODERMATA.

In the former the jaws have no apparent teeth, which are represented by a kind of ivory beak, or bill. To this family belong the Sun-fish (*Tetraodon*), and the Globe-fish (*Orthagoriscus mola*). The latter is distinguished from the former by its compressed spineless body; the former, bristling all over with slightly projecting spines, which keep off their enemies, and wound the fisherman's hand if he attempts to seize them. The Sun-fish, moreover, possesses the singular faculty of being able to inflate the lower part of their body, until it assumes the outline of an expanded ball, in which the real shape of the animal is lost.

The Globe-fish is remarkable for its phosphorescent qualities. At night it glows beneath the watery surface like a disc of silver light, and may be seen swimming in the soft radiance which flows from its body, the lustre rendered undulating by the motion of the waves which it traverses, so as to resemble the tremulous glory of the moon when partly veiled by misty vapours. Hence it is sometimes called the Moon-fish. It abounds in the Mediterranean, where it attains the length of about thirty inches.

The Diodons resembles the Globe-fish in its nature, structure, and habits, but differs from it in the conformation of its ivory jaws, each forming a single piece. Apparently it possesses a couple of teeth; whence its name, from δίς, two, and ὀδοὺς, tooth. Its spines, moreover, are larger than those of the Sun-fish. It may be described as the hedgehog of the sea, and, like the hedgehog, can inflate its body and crest its spines, which are at once its offensive and defensive weapons

Belonging to this same remarkable family are the File-fish (*Balistes*, an inhabitant, with the exception of one species, of the tropical seas; and the Coffers, or *Ostracions*, whose habitat is the Indian Ocean and the American waters.

The former has a compressed body; its jaws are furnished with eight teeth, arranged in a single row on each jaw, and covered with true lips. Its eyes are placed almost on a level with its skin. It has a small mouth, and a body enveloped in very hard scales, which are connected in groups, and distributed in more or less regular compartments, strongly connected by means of a thick skin. The animal is thus incased in an almost impenetrable coat of mail.

Of the Trunk, or Coffer-fish (*Ostracion*), it is enough to say that it is distinguished from all the other denizens of the Ocean world, by the bony crust or covering in which it is enveloped, while the spines also differ from one another in certain peculiarities of form. The head and body are covered with bony plates, so welded together as to form an inflexible cuirass; only the tail, fins, mouth, and a small portion of the gill-opening, are capable of motion—these movable parts passing through apertures in the armadillo-like defensive armour. The vertebræ are fixed together in án equally compact fashion. There are no ventral fins, and the dorsal and anal are small, and placed far back. There is little flesh, and what there is cannot be praised for its flavour; but the liver is large, and abounds in oil. The surface of the body is often covered with spines. In some the body is triangular, in others quadrangular.

II. *Lophobranchii: fishes in which the upper jaw is movable, and the gills are arranged in* circles, *like bent hoops.* From λόφος, a crest, or tuft, and βράγχια, a gill.

The fishes of this order consist of two genera, the *Syngnathus* and the *Hippocampus*—the Pipe-fish and the Sea-horse.

SQUALIDÆ.

The Dog-fish (*Scyllium catulus*) is from two to three feet in length, with a large head; the snout prominent and slightly pointed; a rough skin; general outline of the body cylindrical; the colour a brownish grey, slightly tinted with a dusty red, and marked with very numerous spots of brownish black; the belly whitish, and very smooth. At its full growth this fish weighs about twenty pounds. It is very voracious, devouring great quantities of fish, and it does not hesitate to attack the fishermen, and especially bathers in the sea. On our British coasts it abounds, and in some parts of Scotland it is eaten by the poor; but its flesh is hard, and has a disagreeable musky odour. Its rough skin is used, under the name of "fish skin" and "shagreen," by joiners and other artificers in polishing various substances, and also for covering spectacle-eases and similar articles.

The Small-spotted Dog-fish (*Scyllium canicula*) closely resembles the preceding, but the upper part of

its body is crowded with small, dark, reddish-brown spots on a pale reddish ground; the spots being rather larger and less numerous on the fins. It is a very common species on the south coast of England, where it feeds on small fish and Crustacea, lying in ambush to surprise its prey.

The Picked Dog-fish (*Spinax acanthias*), a species exceedingly common on the Kent and Sussex coasts, where it is popularly known as the Bone Dog, is also frequently met with on the west and north-east, and in the shallow waters of the Western Islands. It is distinguished from other species of its genus by the single spine placed in front of each of its two dorsal fins. According to Mr. Couch, they are sometimes found in incalculable numbers, so as greatly to obstruct and annoy the fishermen, whose hooks they cut from the lines in rapid succession.

The Picked Dog-fish curves itself into the form of a bow for the purpose of using its spines, and by a sudden motion causes them to spring asunder in opposite directions; and so accurately is this movement effected, that if a finger be placed on its head, it will strike it without lacerating its own skin. Its usual length is about twenty inches; the upper part of its head and body are of a slaty grey colour; the under parts wear a yellowish tint.

The Black-mouthed Dog-fish, so called from the colour of the interior of its mouth, is a common species in the Mediterranean. Its average length is from two feet to two feet six inches; its colour on the head and upper part of the body is a light brown; and along each side run two rows of ocellated spots.

It has been suggested that of all marine animals the HAMMERHEADED SHARK (*Zygæna malleus*) is probably the most deformed, though it must be remembered that we do not as yet know all the monstrous shapes and "chimæras dire" which the dark unfathomed caves of ocean may contain. Certain it is, however, that its aspect is calculated to disgust, and even terrify, the spectator. It resembles the ordinary shark in the subcylindrical conformation of its body, but is distinguished from it by the peculiar shape of its head, which is dilated on either side so as to resemble a double-headed hammer. The eyes, which are very large, are placed at the extremity of these lateral prolongations; they are grey, prominent, and with a gold-coloured iris. When the animal is irritated, the irides seem to light up with a sudden flame, much to the horror, it is said, of the fishermen who behold them.

The mouth, which is semi-circular, is placed beneath the head, and near to the junction of the trunk. It is furnished in each jaw with three or four rows of large teeth pointed and barbed on both sides.

The Hammerhead is a native of the Mediterranean and the Indian seas, and is scarcely less formidable for voracity and fierceness than the ordinary shark, attacking any person who may be unfortunately bathing in its vicinity. In our European seas the most common species is long and slender in the body, which is grey, with a blackish-coloured head. It usually attains the length of eleven or twelve feet, and the weight of four to five hundred pounds. Its voracious fury often brings it round vessels even in the roadsteads, and close in upon the coast. It is frequently observed about the shores of the South Sea Islands, those—

"Summer-isles of Eden, lying in dark purple spheres of sea,'

and particularly in the bright blue waters of Otaheite; but the natives, confident in their surprising dexterity as swimmers, and their consequent ability to escape its jaws, appear to hold it in very little terror. Everywhere, however, it is equally distinguished by its lust of blood, its violent fury, its curiously characteristic conformation, and its hideousness of aspect, which stamps itself on the memory of every beholder. Naturalists do not suggest any particular function discharged by its singularly-shaped head, which seems to be simply a specific distinction.

THE LOBSTER.

The manner in which the female lobster relieves herself of her young is very curious. Whether she bends or stands erect, she is still able to hold her burden obscurely or to expose it to the light. Coste asserts that the eggs are sometimes left immovable, or simply submerged; at others, they are subjected to frequent washings and gentle oscillations of the false claw which shelters them, from right to left.

The eggs, when first exuded from the ovary, are very small; but they seem to increase during the time they are borne about under the tail, and attain the size of small shot before they are intrusted to the water. The evolution of the germ continues for six months. The female, at the moment of extrusion, projects the tail, and communicates to the eggs an oscillating motion, so as to destroy the shell and disperse the larvæ. In the course of two or three days she delivers herself of her entire burden. As the young lie inclosed within the membrane of the egg, says Couch, the claws are folded on each other, and the tail is flexed on them as far as the margin of the shield. The dorsal spine is bent backwards, and lies in close contact with the dorsal shield; for the young is quite soft when it emerges from the egg, but is rapidly indurated and solidified by the deposition of calcareous matter on what may be called its skin.

No sooner are they born than the young Crustaceaus abandon their mother, and ascend to the surface of the water in order to gain the open sea.

There they swim with a constant circular motion, but for no very protracted period. After their fourth *moult*, or sloughing, which occurs between the thirtieth and fortieth days of their young existence, they lose their temporary organs of natation, and unable to maintain themselves any longer in the upper waters, descend to the bottom, thenceforth to assume the ordinary habits of their kind. As they increase in size they draw nearer to the shore, which they had previously abandoned, and return to the localities inhabited hy the parent Crustacea.

In form the larva differs so largely from the adult that it would be difficult, except on the strongest evidence, to decide the particular species to which it

may belong. The embryo Cray-fish (*Palinurus*) was considered by the earlier naturalists a distinct genus, and named *Phyllosoma*, or Glass-crab. The popular name refers to the transparency of their bodies; the scientific to the remarkable horizontal expansion of the carapace. In the members of this genus the head is represented by a large oval plate, bearing eyes mounted on very long stalks; the thorax by a second plate, much broader than it is long, carrying the feet, most of which are long and some bifid, with one branch exceeding the other in length. Milne-Edwards described them as deficient in special respiratory apparatus, but having the blood aerated through the general superficies of the body.

It is now understood, however, that the so-called Phyllosoma are, in reality, the young of the higher forms of Crustacea, undergoing a process of metamorphosis. In the *Macroura* this metamorphosis is less remarkable than in the *Brachyura*, while no change at all is undergone by the fresh-water cray-fish.

From experiments made by Mr. Couch, we find that metamorphosis takes place in the following genera:—

Cancer; Zantho; Pelumnus; Cacernus; Portumnus; Maia; Galathea; Homarus; and *Palinurus.*

Metamorphosis has been demonstrated, adds Dr. Bell, in no less than seventeen genera of the Brachyourous order of Decapoda, in which it is most decided and obvious; in the Leptopodiadæ, Maiadæ, Canceridæ, Portumnidæ, Pinnotheridæ, and Grapsidæ. In the Anomourous order it occurs in the Pagurus, Porcellana, and Galathea; and in the Macrouran order in Homarus, Palinurus, Palæmon, and Crangon.

There exists almost as great a diversity in size and species among Crabs as among the Mytilidæ. Not one of the least curious is the Long-clawed Crab (*Corystes Cassivelaunus*) of Pennant and Leach, whose antennæ considerably exceed its body in length. In the jaw-feet the third joint is longer than the second, and terminates in an obtuse point, with a notch on its interior edge. The eyes are set wide apart upon large peduncles, which are short, and nearly cylindrical. The anterior feet in the males are large, being twice the length of the body, and nearly cylindrical; in the females they are flatter, and not longer than the body. The other feet terminate in an elongated nail or claw, which is straight-pointed, with a longitudinal groove or furrow. The carapace is an oblong oval, ending in a rostrum truncated in the fore and bordered in the binder parts; the various regions are not very plainly marked, with the exception of the cordian, the branchial or lateral being very much elongated.

This genus received the name of Corystes, or warrior-armed (κόρυς, a helmet), from Latreille; and it had already been christened *Cassivelaunus*, by Pennant, in allusion to the old Celtic warrior that so gallantly withstood the invading Normans. According to Gosse, Pennant was inspired to choose this name, because the carapace bears, in old males especially, a ludicrous resemblance in its numerous wrinkles to the rugose countenance of a venerable elder. But Pennant was too enthusiastic a Celt to have cast any ridicule on the great British warrior. Seeing in the formidable Crustacean a creature armed *cap-a-pie*, he named it after the hero of his imagination.

The surface of the carapace in this species is somewhat granulous, with two denticles between the eyes, and three sharp points inclined forward on either side. The male has only five abdominal pieces, but the vestiges of the separation of the two others are conspicuous on the outer mediate, or third piece, which is the largest of all.

Mr. Couch* remarks on the extraordinarily long antennæ, that they are of service beyond and in addition to their common ability as feelers; perhaps, as in some other Crustacea, they assist in the process of excavation; and, when soiled by labour, I have seen the crab effect their cleansing by alternately bending the joints of their stalks, which stand conveniently angular for the purpose. Each of the long antennæ is thus drawn along the brush that fringes the internal face of the other, until both are cleared of every particle that adhered to them.

Mr. Gosse, however, is of opinion that the function of these antennæ is to keep open a passage for the emission of the deteriorated water after it has bathed and aerated the gills or branchiæ.

"I have observed," he says, "that, when kept in an aquarium, these crabs are fond of sitting perfectly upright, the antennæ placed close together, and pointing straight upwards from the head. This, doubtless, is the attitude in which the animal sits in its burrow, for the tips of the antennæ may often be seen just projecting from the sand.

"When the chosen seat has happened to be so close to the glass side of the tank as to bring the antennæ within the range of a pocket lens, I have minutely investigated these organs without disturbing the old warrior in his meditation. I saw on each occasion that a current of water was continuously pouring up from the points of the antennæ. Tracing this to its origin, it became evident that it was produced by the rapid vibration of the foot-jaws drawing in the surrounding water, and pouring it off upwards *between the united antennæ as through a tube.* Then, on examining these organs, I perceived that the form and arrangement of their bristles did indeed constitute each antennæ a semi-tube, so that when the pair was brought face to face the tube was complete."

It should be added that the Corystes, notwithstanding its formidable appellation, is harmless and inoffensive in its habits.

Lobsters abound on the British coast; inhabiting the clearer water and rocky shores, and frequenting the shallows near the shore about the time of depositing their eggs. In Scotland they are collected and kept in perforated chests, floating on the water, until they can be transported to market. They are conveyed to the Thames, the Clyde, or the Mersey, in welled fishing smacks constructed specially for this purpose. But, as M. Frédol points out, this antiquated system is giving place to the greater conveniences afforded by artificial storing ponds or reservoirs. Mr. Humble has established one of these near Southampton, where he can accommodate with ease as many as fifty thousand

* Couch, Cornish Fauna.

The Argonaut sailing in the Open Sea.

We may not wonder that this graceful but curious animal attracted the attention and excited the admiration of ancient naturalists, who were prone to invest it with a mythic interest and surround it with all the ornaments of a luxuriant fancy. "The Nautilus Polype," says Aristotle, "is of the nature of animals which men call extraordinary, being able to float on the sea; it raises itself from the depths of the waters, with shell reversed and empty; when it has reached the surface re-adjusts its habitation. Between the arms spreads a kind of tissue similar to that which unites the toes of web-footed birds. When the wind blows gently, it employs this tissue as a rudder, letting it fall into the water with the arms on each side. On the approach of the least danger it fills its shell with water, and sinks down into the deep."

Oppian's account is still more circumstantial:—"Hiding itself in a concave shell, the Pompylius [a name given to it by Pliny] can walk on land (!), but can also rise to the surface of the water, the back of its shell uppermost, for fear that it should be filled. The moment it perceives itself to be discovered, it turns the shell and navigates it like a skilful seaman. For this purpose it throws out two of its feet like antennæ, between which is a thin membrane, extended by the wind like a sail, while two others, which touch the water, guide, as with a rudder, the house, the ship, and the animal. On the advent of danger, it quickly folds up its antennæ, its sail, its rudder, and dives; its weight being increased by the quantity of water which it admits into its shell. As we see a man who is victor in the public games, with a crown encircling his head, while vast crowds press around him, so has the Pompylius a throng of ships ever following in its track, whose crews no longer fear to quit the land. O fish, justly dear to mariners! thy presence heralds soft propitious winds; thou art the harbinger and the usher of calm weather!"

Oppian alludes in this passage to a superstition current among the Romans, that it was a favourable omen to meet the Nautilus. They regarded it as a kind of tutelar divinity, who guided the seaman on his way, and assured him of a fortunate voyage.

The peculiar features of the Nautilus have been observed by the Chinese, who call it the Boat-polyp. According to Rumphius, its shell is highly valued by the Hindoos, whose females consider it a superb ornament. In their religious festivals the dancers carry it proudly aloft in the right hand, holding it above the head. To recommend it to the notice of modern naturalists, however, it does not require any adventiticus aid. No one can see it sailing along the tranquil waters like a fairy skiff, as our artist has depicted it in the accompanying illustration, without a transport of admiration. But we reserve our wonder rather for Him who made it—for the power and wisdom, almighty and infinite, which called it into existence—than for the thing itself, however graceful its appearance, and however curious its properties.

It should be added, that opportunities of observing the Nautilus are not easily obtained. It never comes near the shore. It is a timid and cautious creature, which almost always prefers the vast solitudes of the open sea. It seems to be gregarious in its habits, and voyagers speak of it as living in families, some hundreds of miles from the nearest land. It is only at night, or as the sun withdraws its purple splendour, that the Nautili gather together to enjoy their innocent sports on the surface of a tranquil ocean.

It enjoys, like other Cephalopods, the strange faculty of changing colour under the influence of any sudden impression; blushing, or turning pale, and through its transparent shell revealing the rapid changes of its body.

Three species are at present recognized in our scientific classifications:—the *Argonauta Argo*, already described; the *Argonauta tubercula*, which is entirely confined to the Indian Ocean: and the *Argonauta baillant*, which is occasionally met with in the Pacific and the Atlantic Oceans.

PHOLADIDÆ.

The *Pholadidæ* form a family of lamellibranchiate molluscs, remarkable for their boring habits. While some of the species burrow in the sand, like the Solen, others work out for themselves a dwelling-place in timber and stone. Their mission in nature seems to be the excavation of these strange retreats; and to appear at their openings, or to sink into their depths, makes up all the variations of their seemingly monotonous existences.

In this family we find the shell open at either extremity; it is thin, white, of great hardness, and sometimes furnished with accessory valves; the two principal valves are covered with calcareous protuberances, connected by fine transverse ridges, and thus composing a kind of saw or rasp, which the animal uses in its mining operations.

The animal itself has a thick, white, elongated, fleshy body, club-shaped or vermiform; its mouth ejects a long tube traversed by two canals or syphons: through one of which it absorbs the water necessary for respiratory purposes, and through the other gets rid of it. A short thick foot, acting like a sucker, protrudes through an aperture in the mouth.

"We lift one from its cavity," says Gosse, "all helpless and unresisting, yet manifesting its indignation at the untimely disturbance by successive spasmodic contractions of these rough, yellow syphons, each accompanied with a forcible *jet d'eau*, a polite squirt of sea-water into our face; while at each contraction in length the base swells out, till the compressed valves of the sharp shell threaten to pierce through its substance."

How the Pholades, or *Piddocks*, as they are vulgarly called on the British coast, contrive to excavate the holes wherein, like true Troglodytes, they live, has been a constant subject of dispute among naturalists. It was long asserted that the animal possessed an excavating instrument, beset with hard silicious particles; but it is unquestionably true that no such

instrument exists. It is with its rasp-like shell, covered, as we have seen, with rows of calcareous projections, that the animal works. "If you examine," says Gosse, "the living shell, you will see that the fore-part, where the foot protrudes, is set with stony points arranged in transverse and longitudinal rows; the former being the result of elevated ridges, radiating from the hinge, the latter that of the edges of successive growths of the shell. These points have the most accurate resemblance to those set on a steel rasp in the blacksmith's shop. It is interesting to know that the shell is preserved from being itself prematurely worn away, by the fact that it is composed of aragonite, a substance much harder than those rocks in which the Pholas burrows. The animal turns in its burrow from side to side when at work, adhering to the interior by the foot, and therefore only partially rotating to and fro. The substance is abraded in the form of a fine powder, which is gradually ejected from the month of the hole by contraction of the bronchial syphon."

The Pholades have a very extensive range. On both coasts of the Channel they are found in abundance, especially the species, *Pholas dactylus*, *Pholas crispata*, *Pholas papyracea*, and *Pholas melanoura*.

The Pholades possess the quality of phosphorescence, and in the dark emit a peculiarly brilliant light. "Those who eat them in an uncooked condition (a not unfrequent circumstance, as the mollusc does not need the aid of cooking to render it savoury), appear in the dark as if they had swallowed phosphorus; and the fisherman who, in a spirit of economy, sups on it in an unlighted chamber, affords to his little ones the amusing spectacle of a fire-eater on a small scale."

The ravages caused by these alithyic borers and miners are very considerable. In a geological sense, however, they have an unexpected utility, for they demonstrate the former levels of the ocean-waters, and show how, in certain places, the sea may have receded from or have gained upon the earth. A remarkable example of this strange use of the Pholades, is that memorial of a remote antiquity, the temple of Serapis, situated on the coast of Pozzuoli.

Pozzuoli, an ancient Cumean colony, the Puteoli of Latin writers, is situated on the Bay of Naples, on its northern shore. Its principal relic of a once splendid past is the temple already referred to—the Serapion or temple of Jupiter Serapis—which, in the course of time had become completely overgrown, and had almost been forgotten, until disinterred by order of Charles III. of Naples, in 1750.

The building was then found to consist of a quadrilateral abattoir surrounded with chambers, inclosing a circular temple in the centre. The court is 140 feet long by 122 feet wide; the main entrance on the S.W. or seaward side, by a doorway of one central and two lateral passages, forming a kind of vestibule, supported by six pilasters. Internally the court was embellished by a portico of forty-eight shapely columns, partly of marble, partly of granite; beneath which were thirty-two small chambers, sixteen opening upon the court, and sixteen having no apparent communication with the centre. It is obvious, from the remains of stairs, still in existence, that there was once an upper story. The chambers in the angles of the N.E. side are twice the dimensions of the others; they have channels in their walls for the passage of water, and are surrounded by marble seats supported by dolphins.

Between these two spacious chambers the wall of the building is recessed, so as to form a semicircular niche, and in front of this niche stands a pronaos of six Corinthian columns and two pilasters, which seem, from the shattered sculpture found in their vicinity, to have anciently supported a richly decorated frieze, and to have been the loftiest portion of the structure.

Three of the columns are still erect, and are each cut out of a single block of cipollino, 40 feet 3 inches high; three others lie prostrate and in fragments on the ground.

It is with these three erect columns of cipollino we have here to concern ourselves, for they record a history of physical change in character which, it has been justly said, every one may read, and which no controversy can alter. This history comprises two distinct epochs — one of submergence beneath the ocean-waters, another of elevation above their level.

If the visitor examines these columns closely he will see that their lower portion, for about twelve feet above the pedestals, has a smooth surface, but shows at different heights unmistakable traces of ancient water-marks. Above this portion, the columns, for about nine feet, are perforated with holes, the work of a species of Pholades—the *Modiola lithophaga* of Lamarck, according to some authorities. The upper half of the columns is uninjured, except by atmospheric influences and the action of the waves. These appearances were at first attributed to an elevation of the sea above its present level—"an hypothesis now known to be untenable, since all the changes on the shores of the Gulf of Naples have been proved to be local. There is no doubt that the coast of the Bay of Baia has undergone ultimate changes of subsidence and elevation from the date of the foundation of this building."

From certain inscriptions still extant among the ruins, it is known that the Serapion was used for pagan worship as late as the reign of Septimius Severus. In less than a century after his death, the heathen temples were suppressed by Constantine the Great, and there can be little doubt that it was then abandoned. After this event the ground would appear to have subsided by successive stages—not the level of the sea to have risen—until the lower part of the columns was entirely and permanently submerged. In the twelfth century, the eruption of the neighbouring Solfatara seems to have accumulated in the court, to the height of twelve feet, a mass of scoriæ and other volcanic matter, which, as the ground sunk down beneath the sea, preserved that portion of the columns from the action of the burrowing Pholades. The subsidence continued until the columns were submerged to the height of nine feet above this volcanic deposit, in which condition they must have undergone the operation of the sea-water for a period of nearly three and a half centuries, while the upper half of the columns rose above the waves. That such was the

case, is proved by the immense number, the large size, and the depth of the perforations effected by the Pholades, whose shells are still to be found at the bottom of many of the cavities, together with others of existing species, which have concealed themselves in the same hollows.

Belonging to the same family is the genus *Teredo*, distinguished by its elongated, vermiform body; its thick, equivalve, hingeless shell, which opens at both ends; and its very delicate mouth, open both in front and at its lower part, so as to admit of the passage of a short foot. The species are numerous, and generally known by the name of *Shipworm* or *Pileworm*, because they perforate and dwell in timber.

Their burrows take the same direction as the grain of the timber, but if a knot occurs, or the shell of another Teredo lies in the way, they are suitably diverted. The cavity is invariably coated all over with a calcareous incrustation. The Teredo effects an entrance, in the first place, by a very small aperture, and grows within the cavity which it works out. Its growth, however, is very rapid, and the ravages effected by a number of these animals are almost incredible. We have seen piles so riddled by them as to fall in pieces when handled with any degree of force. A piece of deal has been found honeycombed by their burrows after an immersion of only forty days. But by a peculiar instinct each Teredo confines itself to its own cavity, and never makes any communication with its neighbours. It is by secret undermining of this kind that the piles and other submarine constructions of bridges, and quays, and piers are frequently destroyed, and that ships have been silently eaten into, until their timbers have crumbled and sunk under the feet of their crews. As a protection against these dangerous enemies, the bottoms of vessels are now sheathed with copper, or the wood is soaked in some preservative liquid, or driven full of broad copper-headed nails, which serve as a kind of armour.

M. de Quatrefagés refers to a boat, employed as a passage-boat between two villages on the Mediterranean coast of Spain, which at the commencement of spring was accidentally sunk. Four months afterwards she was raised by some fishermen, who hoped to turn her materials to their profit. But in that short period, the Teredos had so perforated and riddled her timber as to render it utterly useless.

Early in the eighteenth century, half the coast of Holland was menaced with inundation by the destructive labours of the Teredos. They had attacked the piles sustaining the formidable dikes and sea-walls, which the industry of the Dutch had raised to defend them against the encroachments of Ocean. To avert the threatened peril necessitated a very heavy expenditure. Fortunately it was discovered, on a close examination of the habits of the mollusc, that it is animated by a singular antipathy to rust, and that, consequently, timber impregnated with oxide of iron is secure against its attacks. It was only necessary, therefore, to soak the timber intended for the repair of the dikes, in a tank of prepared oxide of iron; in other words, to invest them in a coat of iron rust.

The *Teredo navalis* appears to the eye like a long worm without articulations. Between the valves of a little shell, with which the anterior portion is protected, a kind of smooth truncature is conspicuous, surrounding the projecting pad or cushion which forms the animal's foot. From this point all its body is inclosed in the sheath and mantle, forming a sort of sheath which communicates with the exterior through two syphons.

The mantle is attached to the circumference of the shell. Above, it gathers in two considerable folds which are capable of expansion by the afflux of the blood. The *cephalic* or foremost fold, is of a greyish tint, very light, and tolerably transparent, so that the liver, the ovary, the branchiæ, and the heart, may be distinguished in the interior, and the pulsations of the latter counted. The syphons are extensible, and attached to one another for about two-thirds of their length, the upper part being longer and thinner than the lower. These tubes admit the water necessary for the animal's respiration, and when deprived of its oxygen, discharge it, and along with it the useless products of digestion.

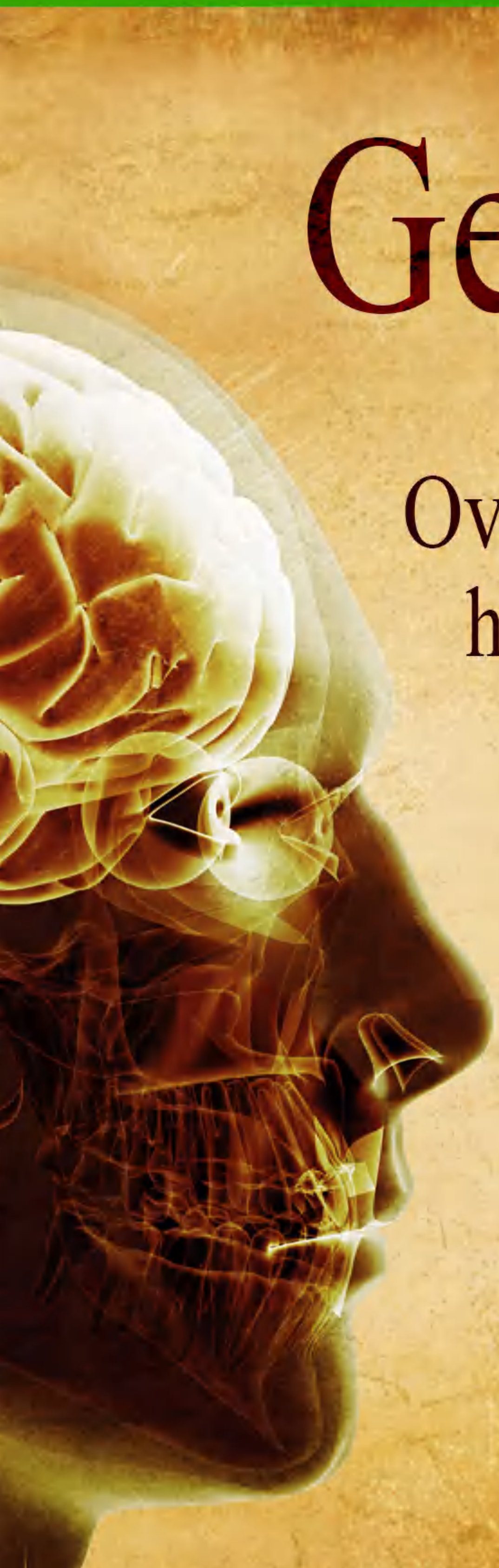
On the upper edge of the anterior truncature of the animal's body is the mouth—a flat, and slightly bell-shaped aperture, furnished with four labial palpi, a stomach, and a well-developed intestine.

The heart consists of two auricles and a ventricle, which beat at irregular intervals, four or five times in the minute. The blood is colourless, transparent, and loaded with small corpuscles of different sizes. The respiratory organs are the branchiæ, or gills, and the mantle; but one-half of the blood returns to the heart without traversing the branchiæ. The nervous system is very complete, and includes a brain, nervous filaments, the branchiæ, the syphon tubes, and certain ganglions distributed through the mantle.

The solid mucus, or sheath, inclosing the adult animal is frequently, but erroneously, described as forming part of its body. Shut up in this tube the Teredo is necessarily restricted in its movements, which are simply those of extension and contraction. It neither climbs, nor creeps, nor floats, nor swims, but by alternate expansion and contraction slowly and laboriously impels itself forward.

It deposits a spherical, greenish-yellow egg, which, soon after fecundation, is transformed into a larva—a larva naked and motionless, but which, after a while, is invested with vibratory ciliæ. Then it begins to move, and swim about freely in the water. "When one of these larvæ," says a recent writer, "has discovered a piece of submerged wood, without which it probably could not live, the curious spectacle is observed of a being which fabricates step by step, and as it requires them, the organs needful for the due performance of its functions." The long feet with which it is furnished in its larva state enable it creep along the surface of the timber, until it has found a portion sufficiently soft and porous for its purpose. There it halts, commences the attack, and soon accomplishes a tiny pore or cell, the entrance to its future burrow.

"Having thus secured a lodgment, the young Teredo begins to grow; covers itself with a coating of mucous



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moulded in the groove of the foot, until it attains the shape and consistency of a thread.

When the mussel wishes to fix its byssus, it elongates its foot, moves it to right and left, feels the different objects around it, rests its point against that which it selects for its future support, deposits thereon the extremity of the thread, and abruptly withdrawing its foot, leaves this extremity adherent. The bivalve repeats this manœuvre several times, each time attaching a new thread. It securely fastens four or five of these in about twenty-four hours, each thread being several centimètres in height, and terminating in a small hook (*empâtement*). The anchorage is complete when it has produced a bundle. In the byssus of some species of mussels we find as many as a hundred and fifty of these tiny cables; none of our men-of-war can be more securely moored.

When the mussel has extended its first rope, it puts it to the test, that it may make certain of its being firmly fastened. It draws on it strongly as if to break it. If the thread resists this effort, the industrious bivalve sets to work to produce and attach a second cable, which it proves like the former. Decidedly the mussel has more intelligence than the oyster.

With the help of its byssus this bivalve suspends itself at different elevations; it seldom touches the ground, and for this reason its shell is always very smooth and clean. We cannot say as much of the valves of its proud rival, which, grey and rugged, frequently inclose in their intervals small particles of earth, sand, and all kinds of foreign filth.

The mussels, like the oysters, are social molluscs. They are found in great numbers in almost every part of the world. They love the blending of salt and fresh water; there are few rocky points, at the river mouths, where we do not meet with some flourishing colony. Sometimes they attach themselves to the branches of polypods, and the roots of trees; sometimes to submerged pieces of timber, the piles of the shore, and the keels of boats.

The mussel may be eaten either raw or cooked. Its taste is not pleasing to everybody; yet there are persons of gastronomic reputation who hold it in high esteem. Louis XVIII. of France was passionately fond of mussels, and had them brought every week from Rochelle to Paris. The monarch one day, in a fit of special good humour, taught Talleyrand the recipe for a sauce of Cayenne pepper, which thenceforth placed this bivalve in the rank of dainties of the first order.

Yet it must be acknowledged that the mussel is less appetizing than the oyster, less stimulating, and, above all, less digestible. We must not forget a gastronomical recommendation of great importance: oysters may be eaten in every month whose name in the calendar contains the letter *r*, while the contrary is the case with mussels.

At an early period man conceived the idea of bringing up, training, or, if you prefer the word, *educating* the mussel. There exists a *mytiliculture*, as well as an *ostreiculture*. This education in some localities is conducted on a very extensive scale; as at Esnandes, at Marsilly, and at Charron, in the Bay of Aiguillon, near Rochelle.

A recent writer gives the following account of the establishment of the mussel farms in this vicinity:—In 1236 a vessel freighted with sheep, and manned by three Irishmen, was wrecked upon the rocks in the creek of Aiguillon, a few miles from Rochelle. The neighbouring fishermen hastened to the rescue of the little crew, but only succeeded, with great difficulty, in saving the life of the master, one Patrick Walton. Exiled on the solitary banks of the Aunis, Walton at first supported himself by hunting the sea-fowl, which frequented the shore and adjacent marshes in immense numbers. He was a man of considerable ingenuity, and to facilitate his captures he invented or adapted a peculiar kind of net, which he called the *night net*. This apparatus was a net of from three to four hundred yards in length by three hundred in breadth, stretched horizontally, like a screen, along the tranquil surface of the bay, and secured in its position by stout posts driven into the muddy bottom. In the dark night the wild fowl, as they sailed along the waters, would come in contact with the net, and entangle themselves in its tenacious meshes.

But the Bay of Aiguillon was little more than a vast expanse of mud, which could with difficulty be ploughed by boats; and Walton, having arranged his bird-net, found himself compelled to devise some kind of machine in which to navigate with greater ease and swiftness. The result of his labours was the flat-bottomed square-sided boat, which we in England call a *punt*, but which, on the Roman coast, is known as an *acon*.

Walton's punt had a wooden framework, nine feet long by three feet broad and deep, with the fore part descending into the water like a prow, at a slight angle. In propelling the boat, the puntsman placed himself in the stern, and kneeling on his right knee, bent forward, with one hand on each gunwale, and his left leg outside the boat. A vigorous push with the left foot communicated an impetus to this strange machine, which made it slide over the mud with rapidity, from one point to another.

Mussels were plentiful in this muddy bay, and Walton's quick observation soon remarked that they attached themselves by preference to that part of his posts which rose above the surface of the mud, and that those so placed were both fatter and more savoury than those which lay embedded in the slime. In this circumstance he detected the foundation of a kind of *musselculture*, which promised to be more profitable than fowling, and less laborious. He was a man of more than ordinary ability, and he speedily worked out the new principle to a very successful result.

"The practices he introduced," says M. Coste, "were so skilfully adapted to the necessities of the industry he had founded, that, though six centuries have elapsed, they still remain the rules by which it is governed. He seems to have applied himself to the enterprise, not only with a consciousness of the service he was rendering to his contemporaries, but also with a yearning to be remembered by posterity, for in every instance he gave to the apparatus he invented the form of the initial letter of his name, W. It was not until prolonged consideration that he commenced to carry

his schemes into execution. Then he planted a long range of piles along the low marshy shore, each pair being arranged like the two sides of the letter V, with the front of the letter towards the sea, and either limb diverging at an angle of forty-five degrees. These posts were separated by intervals of about three feet; each was twelve feet in length, six feet being above water, and they were so interlaced with branches wattled together as to resemble continuous hurdles." Each hurdle, if we may so call it—the French name is *bouchot*—was about two hundred yards in length. This apparatus intercepted the spat, or spawn, that would otherwise have been carried out to sea, and to a great extent wasted. Walton soon formed a magnificent mussel farm, but he did not abandon his isolated piles; which, being without fascines or branches, and always submerged, arrested the spat as it was emitted from the parent mussels.

The advantages of *mytiliculture* soon became apparent to Walton's neighbours, and his system was adopted by one after another, until the whole shore of the bay was covered with *bouchots*; and to the present day this curious but useful industry flourishes in the same locality.

The hurdles now form a perfect forest. About two hundred and thirty thousand piles support a hundred and twenty-five thousand fascines, which bend, throughout the year, under a harvest that a squadron of ships-of-the-line would be unable to float. There are about five hundred bouchots in the bay, each measuring from two hundred to two hundred and fifty yards in length.

The isolated piles are only uncovered at spring-tides. In the months of February and March the spat collected on them scarcely equals in size a grain of linseed. By the month of May it has enlarged to the dimensions of a split pea. In July it is as big as a small haricot bean, and consequently, is fit for transplantation. In this month the *bouchotièrs*, as the men engaged in this culture are called, launch their punts, and proceed to the part of the bay where these piles are planted. They then detach with a hook the accumulated clusters of the young mussels, which they collect in baskets, and carry to their bouchots; the said bouchots being of four different heights, accommodating the four stages of the mussel's growth.

In the first stage it cannot endure atmospheric influences, and remains almost constantly under water. As it becomes hardier it is removed to the second stage, the third, and finally, when able to remain for hours exposed to the air, to the fourth stage, or *amont*, which continue above water in all tides. Here they rest until fit for market, which usually happens after ten or twelve months of education on the more advanced *bouchots*.

From July to January the mussel trade is in full operation, and the flesh in perfection. From February to April is the close season, and the flesh is then poor and leathery.

A well-stocked *bouchot* furnishes annually, according to the length of its wings, from four to five hundred charges, each charge weighing upwards of three hundred pounds, and selling in the market for about five francs, or 3*s*. 9*d*. The harvest reaped from a single bouchot is therefore worth £100 (being in weight a hundred and thirty to a hundred and fifty thousand pounds avoirdupois). The total mussel fishing in the Bay of Aiguillon may consequently be valued at £480,000 to £500,000 a year—a fact showing that pisciculture, under proper conditions, is capable of yielding an extraordinary large return for the capital and labour laid out upon it.

The last section of acephalous molluscs includes the numerous families of the Solens, Pholades, and Teredos (the *Acephales renfermé* of Cuvier). These are the borers or miners of the watery world, which excavate for themselves, by unceasing labour, a habitation in the solid rock or hardest timber.

The *Solen*, or razor-fish, a genus of lamellibranchiate molluscs, is a type of the family *Solenidæ*, and derives its English name from its long narrow shell, open at both ends, and not unlike the handle of a common razor. In some of the tropical species the shell is of great beauty. The Solens are found in every sea, except within the Polar circle, and burrow in the sand; working a hole perpendicularly, sometimes to the depth of two feet. After it is once made they never quit it, but ascend or descend at need by means of their foot, which is capable of alternate elongation and contraction. They are used as food, and also as bait. The fishermen catch them with a peculiar hooked iron instrument; or by dropping a quantity of salt into the mouth of the hole. This attracts them to the surface; but they must be immediately seized, or they will disappear again with surprising quickness.

The shell is thin, transparent, and bivalve, with parallel edges, and truncated at both extremities. The tints are violet, a greyish blue, and rose; the valves slightly covered with a greenish-brown epidermis. The animal itself has the form of an elongated cylinder, with its mantle closed throughout its entire length; and only opened at one end for the admission of food, and at the other for the passage of a tube consisting of a couple of syphons united together.

One of the largest British species is the *Solen siliqua*, which measures about eight inches in length and one in breadth, and is perfectly straight.

The *Solen ensis*, another British species, is sabre-shaped; *Solen vagina* resembles in form a sword sheathed; *Solen cyanea* is slightly rounded at both ends.

THE OYSTER.

Societies for the protection of animals bestow rewards, says a recent French writer, on those sympathizing persons who have surrounded the old age of dogs and horses with affectionate cares. They preach the duty of good treatment and humane conduct towards all the quadrupeds, and even towards birds, and severely censure--nay, visit with legal penalties—the hardened men who beat, wound, and torture them. In their extreme zeal, they have of late attempted to prohibit our men of science, in the anatomical schools and veterinary colleges, from making operations and performing experiments on living animals.

We know that, as early as the days of Linnæus, the "faithful companion and servant of mankind"—for so our poets style the dog—was one of the principal victims of professional experimentalists (*anatomicorum victima*). But against their cruelty there have never been wanting enthusiastic protests, and it has always received a wide-spread and permanent reproach.

No reproach, however, has been levelled at, no societies for the protection of animals have censured, man's cruelty towards the poor oysters! Following in the footsteps of M. Prédol, let us now endeavour to supply this signal void.

Man's barbarity commences in fishing for oysters; that is, in violently dragging them from their native element. Afterwards, they are placed in basins of water, more or less brackish; frequently unclean; and filled with a vile green matter, which gradually chokes up and colours their respiratory apparatus. The oyster swells, grows fat, and speedily attains a condition of obesity approximating to disease.

When they can endure no more, and their sojourn in such a medium has rendered them of a livid green, they are fished for a second time. But they are never again to revisit the sea, or their native rocks. They will have no more water at their disposal than the very small quantity of liquid contained within their two valves; a quantity barely sufficient to prevent asphyxia.

Soon afterwards, the oysters are imprisoned in a narrow and obscure barrel, an ignoble prison—without either door or windows. We seem to forget that they are animals; pile them up like so much dead merchandise; heap them one upon another like paving stones.

The barrel is despatched to town by rail, and well-shaken on its journey. It is delivered at a restaurant or a fish-shop.

Now comes the most critical moment for the wretched molluscs! A remorseless individual seizes them in quick succession; with a large pointed knife, he or she brutally amputates the portion of their body adhering to the smooth inner surface of their shell, and violently detaches that shell after having separated the fish.*

This cruel operation being terminated, the animal is exposed, without any precautions, to currents of air. It is brought, while suffering keenly, to table. There a pitiless epicure sprinkles some pulverized pepper or juice of citron—in other words, citric and malic acids—on the body of the unfortunate, and its still bleeding wound! Next, with a small silver knife, which never cuts, he a second time makes an incision in the queen of molluscs; or rather, saws it, rends it, and snatches it from its concave home. He seizes it with a couple of pointed prongs which he digs into its liver and stomach, and precipitates the delicious but agonized morsel, into his mouth. His teeth compress and crush it, knead the living and palpitating substance, reducing to a shapeless mass its organs—first murdered, then triturated, and finally absorbed in its blood, its fat, and its bile!

* "The ancients," as Seneca informs us, "opened their oysters at table; each man for himself."

You will assert, perhaps, that the oysters have neither teeth, arms, nor legs; that they are without eyes, ears, and nose; that they neither move nor cry out!

That these statements are true, we fully admit; but negative characteristics do not prevent them from *feeling and suffering*.* Two great German physiologists, Messieurs Brandt and Ratzeburg, have shown that they possess a tolerably developed nervous system. Therefore, as they can feel, they must suffer. *Quod erat demonstrandum.*

Let us hasten, nevertheless, to reassure the minds of our fishers, breeders, vendors, openers, and consumers. We may excuse the indifference of societies for the protection of animals, and the silence of professed philanthropists, by the enormous difference which exists between these imperfect molluscs and the superior animals—a difference so great that their appearance wholly fails to connect them in the minds of the public with the common idea of an animal. They are inhabitants of another element than ours; they live in a medium where we cannot live; they present to the gaze a degraded structure, an obscure vitality, imperfect movements, and undefinable manners. We can therefore see them mutilated, or mutilate them ourselves, masticate and swallow them, without emotion and without compunction!

It is told of a man of science, who dwelt at the seaside, that one day he purchased a dozen oysters from a sincere desire to study their organization. He turned them over and over, examined their various parts outside and inside, drew them, and described them. After he had finished his task, he found that the interesting molluscs had lost none of their excellent qualities, and his study of them in no wise prejudiced him against swallowing them.

This story, says M. Frédol—whose lively summary we are here adopting—has always appeared to us apocryphal; because, generally, when one has dissected an animal, good or bad, one is not the least tempted to eat it. Nay, more, zoologists who understand, *ex professo*, the organization of oysters, ordinarily endeavour to dismiss all thoughts of past dissections, and to ignore their very knowledge, when they would taste without repugnance these very estimable animals."

For this reason, we have hesitated for some time to include in our work a more or less anatomical resumé of the facts collected by zoologists, respecting the organs of our famous but unfortunate bivalves. And we beg the reader, if he is on the point of regaling himself with a dish of oysters, not to read the details we are about to give. We should be sorry to injure his appetite.

Let us suppose that we have before our eyes a fine, fresh, and well-fattened oyster, which has been carefully opened, and is spread out before us in its concave shell.

At the first glance we see a compact, soft, and very flat animal, semi-transparent, and of a greyish or

* "Because an animal has no nerves," says Voltaire, "is it impassible? We cannot suppose so impertinent a contradiction in nature."

not impossible that, in spite of their defective intelligence, they may have their sympathies and their antipathies—we do not venture to say, their motives and intentions..

The locomotive apparatus of our bivalves is very simple and very imperfect, and therefore we need not be astonished that they remain nearly all their life attached to the rock where they were born. Their organ of movement is situated immediately beneath the heart. It is a thick and fleshy body, half grey and half white, traversing the mouth on two sides, and attaching itself about the centre of the valves. When we open an oyster, and despoil it of one valve, our knife cuts right across this fleshy substance, and we cut it a second time when preparing to eat the unfortunate mollusc.

It is by its powerful contraction of this muscle that the oyster hermetically seals itself in its habitation. When it relaxes the muscle, an elastic ligament, adhering to the fleshy dainty, acts on the valves and makes them fly open. And it is said that by repeatedly and quickly opening and shutting these two valves, the animal contrives to change its position, and even to drag itself a short distance along its rock; but the statement seems almost incredible.

Voltaire wrote in 1767, "I am always at a loss to understand how oysters can make love." He probably never conceived the idea, as Iago did, of "an oyster crossed in love."

Oysters possess two sexes, but fulfil, at one and the same time, both the paternal and maternal functions. It is a curious circumstance that the organs of fecundity only appear in our molluscs, like flowers in plants, at the definite epoch when their function should be accomplished; and this time having passed, they wither and disappear. The spat, or spawn, is lodged among the lobes of the mantle and the respiratory apparatus. Their number is very considerable. Some writers assert that a solitary individual will produce one hundred thousand; others that it can give birth to one million two hundred thousand; while Leuwenhoeck raises the "sum total" to ten million. Most modern naturalists reduce these latter figures by four-fifths, which appears very reasonable.

The eggs are of a yellowish colour. They are hatched in the bosom of the mollusc, which gives its offspring to the world of waters in the action of breathing. The young oysters form a whitish living cloud, of greater or less density, which momentarily disturbs the transparency of the liquid, shoots afar from the source of its existence, and is rapidly dispersed by the motion of the waters.

These larvæ are provided with a transitory apparatus of natation, which permits them to spread to a considerable distance in search of some solid body to which they may attach themselves. This apparatus consists of a kind of sinuous pad, covered with numerous thickly-set ciliæ; it emerges from the valves, and re-enters at pleasure. It is provided with powerful muscles for the purpose of moving it. By means of this apparatus the young oysters can swim with facility, and when they have quitted their mother, float round about her. It is said that at the outset of their career, if any danger threatens, they take refuge between the maternal valves. But it is not long before they attach themselves to some substantial object, where they grow, and prosper, and arrive at an adult condition. It takes about three years for the mollusc to attain an average size.

The favourite habitat of oysters is the shallow moving water near shore. They sometimes develop into considerable masses, which are called *oyster banks*. These are frequently thousands of yards in extent, and apparently inexhaustible. One was discovered in 1819 near one of the islands of Zealand, which so abundantly supplied the Dutch markets for a whole year, that the price of these molluscs fell to ninepence per hundred. But the bank being placed nearly at the surface of a very shallow sea, it was entirely destroyed in the severe winter which followed.

The favourite edible varieties of oysters are:—

The Common Oyster (*Ostrea edulis*) and the Horse-shoe Oyster (*Ostrea hippopus*).

The "Native" is a kind of the Common Oyster, which flourishes in the neighbourhood of Colchester, in Essex, and Whitstable, in Kent.

From the Mediterranean shores we obtain the *Ostrea rosacea* and the *Ostrea lacteola*.

Corsica yields the *Ostrea lamellosa*.

Two small and indifferent species found in the Mediterranean, but seldom sent to the Paris or London markets, are the *Ostrea cristata* and *Ostrea plicata*.

We have also the Medina oysters from the river Medina, in the Isle of Wight; and the Pandora oysters, from Prestonpans on the Firth of Forth.

In France the two principal varieties of the Common Oyster, differing in size and delicacy, are the *Cancale* and the *Ostend*. When the former has been kept for sometime in a reservoir or basin, and has assumed a greenish colour, it is called the oyster of *Marennes*. We shall shortly refer to the source and nature of this coloration.

The ordinary oyster is the palm and glory of the table. "It may be considered," says a French writer, "as the most digestible of all substances; it is the basis of everything capable of nourishing and using without effort the stomach; it occupies the first place among the pleasures of the table reserved by Providence for delicate stomachs, the sick, and the convalescent.

"Experience has so completely established these gastronomic truths that no feast takes place, no banquet worthy of connoisseurs, without the oyster figuring conspicuously among its most valued delicacies. It is the oyster, in truth, which opens and gently stimulates the ducts, and seems to bid the stomach prepare itself for the sublime functions of digestion; in a word, it is the key to that paradise which we name the appetite."

"There is no alimentary substance," says a medical authority, "not even bread, which will not produce indigestion under certain given circumstances; but oysters, never! This is a homage we are bound to pay them. You may eat of them to-day, to-morrow, and always; eat of them abundantly, and yet no indigestion need be feared."

The Latin historians relate that Vitellius partook of them four times daily, and eat twelve hundred at each repast, which would give a total of four thousand eight

hundred daily. But we must beg to refuse our credence to this fabulous exaggeration.

Montaigne says:—"To be subject to the colic, or to deprive oneself of eating oysters, are two serious evils. If we must choose between the two, let us hazard something in pursuit of pleasure."

According to M. Payne, sixteen dozen oysters represent the three hundred and fifteen *grammes* of dry azotized food necessary for the daily support of a man of average stature. Consequently, to nourish a hundred persons for one day upon oysters only, we should require nineteen thousand two hundred!

Dredging for Oysters.

In Mr. Bertram's valuable and interesting work on "The Harvest of the Sea," we find a graphic description of oyster-dredging as practised in the Firth of Forth.

The times for going out to dredge are, he says, at high tide and low tide. The boats used are the smaller-sized ones employed in the white fishery. In shape the dredge is not unlike a common clasp purse; it is formed of network, and attached to a stout iron frame, which serves to keep the mouth of the engine open, and acts also as a sinker, giving it the requisite degree of pressure as it travels over the oyster-beds.

When the boat reaches a point above the oyster scalps the dredger is lowered by a rope attached to the upper ring, and is worked by one man, except in cases where the boat has to be sailed swiftly, when two are employed. Of course, when the wind is unfavourable or the weather calm, recourse must be had to the oars. The tension upon the rope is the signal for hauling the dredger on board, when the entire contents are emptied into the boat, and the dredge is again returned to the water.

These contents, not including the oysters, are of a very motley character—stones, sea-weed, young lobsters, anemones, star-fish, crabs—all of which are usually re-committed to the deep, some of them being considered as the most fattening ground-bait for the cod-fish. The whelks, mussels, clams, cookies, and occasionally the crabs, are employed by the fishermen as bait for their white-fish lines.

During the time the dredging process is carried on, the crew maintain a sort of wild monotonous chant, supposed to possess a peculiar charm for the oyster:—

"The herring loves the merry moonlight;
The mackerel loves the wind;
But the oyster loves the dredger's song,
For he comes of a gentle kind."

In England the principal oyster-grounds are on the coasts of Kent and Essex. At Whitstable the beds are famous for their abundant and savoury growth, and from their long-continued prosperity have attained the name of the "happy fishing-grounds." A space of twenty-seven miles is here occupied in oyster farms, and the industry connected with them involves the incoming and outcoming of a very considerable sum of money, and the employment of about three thousand people.

At Whitstable the course of work, according to Mr. Bertram, is as follows:—

The business of the company is to feed oysters for the metropolitan and provincial markets, for which purpose they buy brood or spat, and lay it down in their beds to grow. When the company's own oysters produce a spat—that is, when the spawn, or "floatsome," as the dredgers call it, emitted from their own beds falls upon their own ground—it is of great benefit, as it saves purchases of brood to the extent of what has fallen; but this falling of the spat is in a great degree accidental, for no rule can be laid down as to whether the oysters will spawn in any particular year, or where the spawn may be carried to.

The whole extent of the layings is annually explored by means of the dredge; successive portions are dredged over daily, till it may be said that almost every individual oyster has been examined. On these occasions the brood is detached from the cullet, double oysters are separated, and all kinds of enemies—and these are very numerous—are seized upon and killed.

To work the beds effectually requires about eight men per acre. During three days a week dredging is carried on for what is called *planting*—that is, the transference of the oysters from one place to another, as may be thought suitable for their growth, the clearing away of mussels, and the removal of the dead molluscs. On the other three days of the week the dredges are at work for the market, lifting so many oysters as may be necessary to meet the demand. A bell is carried round and rung every morning to rouse the dredgers whose turn it is to be on duty, and who start to their daily avocations at a certain signal.

The ratio of oyster reproduction will be clearly understood from the following table, which shows the estimated annual rate of development and increase of value—calculated at fourfold, during a period of four years—of a breeding oyster-bed of the extent of one acre, situated in the Thames estuary, capable of producing a good quality of "natives," and stocked with one thousand bushels of oysters of sixteen hundred each*:—

FIRST YEAR.	
256 bushels, each containing 25,000 oysters, first year's spawn, in first year of growth, spat at 20*s.* per bushel,	£256
SECOND YEAR.	
1000 bushels, each containing 6400 oysters, first year's spawn, in second year of growth, brood at 25*s.* per bushel,	£1250
256 bushels, each containing 25,000 oysters, second year's spawn, in first year of growth, spat at 20*s.* per bushel,	256
	£1506
THIRD YEAR.	
2667 bushels, each containing 2400 oysters, first year's spawn, in third year of growth, ware at 30*s.* per bushel,	£4000
1000 bushels, containing each 6400 oysters, second year's growth, brood at 25*s.* per bushel,	1250
256 bushels, each containing 25,000 oysters, third year's spawn, in first year of growth, spat at 20*s.* per bushel,	256
	£5506

* Barry, Blue Book on the Irish Oyster Fisheries.

FOURTH YEAR.

4000 bushels, each containing 1600 oysters, first year's spawn, in fourth year of growth, oysters at 35*s.* per bushel, ...	£7000
2667 bushels, each containing 2400 oysters, second year's spawn, in third year of growth, ware at 30*s.* per bushel, ...	4000
1000 bushels, each containing 6400 oysters, third year's spawn, in second year of growth, brood at 25*s.* per bushel, ...	2500
256 bushels, each containing 25,000 oysters, sixth year's spawn, in first year's growth, spat at 20*s.* per bushel, ...	256
	£13,756

Naturalists "agree to differ" respecting the fecundity of the oyster. Some calculate the young by thousands, others by millions. It is certain that the number is prodigious, and so great that they cannot all be contained in the parent shell at one time, but there seems no good ground for believing that it amounts to "millions." Probably half a million is, on the average, the amount of *spat* "brewed" by an oyster in one season. A microscopical examination of the oyster-spawn shows it to be a liquid of some little consistency, in which the young oysters, like so many dots, or points of a hair, swim to and fro in unresting activity. It is greenish in appearance, and each little globule may be compared to "an oyster nebula," which resolves itself, when examined by a powerful glass, into a thousand distinct animals.

According to the Abbé Diguemine, oysters possess a greater facility of locomotion than is usually supposed. They are perfectly able to transport themselves from one place to another by causing the sea-water to enter their shell, and suddenly ejecting it from between their valves. This they do with surprising force and rapidity. The same operation is its means of defence against its smaller enemies, among which the small crab is particularly pertinacious, lying in wait to dart within the shell while it is partially open.

From a remote antiquity this delicious mollusc has been a favourite article of food. How highly it was esteemed by the Romans is known to every reader of the Latin poets. The British oysters especially were held in high repute. To a Roman, one Sergius Orata, we owe the original idea of pisciculture. He invented an oyster pond, wherein he bred oysters for the supply of his own table. The luxurious Lucullus was also a pisciculturist on an extensive scale.

In all countries, says the agreeable writer already quoted, there are records of the excessive fondness of great men for oysters. Cervantes, the author of "Don Quixote," was an oyster-eater, though he satirized the oyster-dealers of Spain. Louis XI., in a laudable desire to encourage the growth of scholarships in France, feasted the learned doctors of the Sorbonne, once a year, on the famous edible; and another Louis invested his cook with an order of nobility in reward for his exquisite skill in dishing up the dainty mollusc. It is to the credit of Napoleon, the hero of a hundred fights, that he was an oyster-lover. So was the "melancholy" Jean-Jacques Rousseau, though it is difficult to believe that, if he had properly appreciated its merits, he would have preserved his gloom. It is said of Turgot that he was wont to eat half a dozen, just to sharpen his appetite for breakfast. The French encyclopédists were particularly fond of oysters. Helvetius, Diderot, Voltaire, the Abbè Raynal—all were persevering oyster-eaters.

And if we turn to our own islands, we meet with oyster-lovers in most of our great men. Such was Alexander Pope; such was that master mind, Dean Swift. Thomson, the poet of "The Seasons," fully understood the admirable merits of this mollusc. The erudite Bentley could never pass an oyster-shop, until he had satisfied his craving for the delicacy. Hume, Dugald Stewart, Cullen, and, more recently, "Christopher North," were all great oyster-eaters. Such is the esteem, at the present day, in which the Londoners hold the far-famed crustacean that no less than eight hundred millions are consumed by them yearly. What number is required for the supply of all Britain we have no idea, but it must be prodigious, and the demand increases with such rapidity as literally to exhaust the resources of our oyster-dealers; so that unless its cultivation be vigorously prosecuted, there is reason to fear that this favourite dainty, before many years have elapsed, will be obtainable only by the wealthy, and at an enormous cost.*

Oyster-fishing is conducted in several different manners. Off the coast of Minorca, intrepid divers, armed with a hammer attached to their right wrist, descend to so great a depth as twelve fathoms, and load the left arm with a heap of the bivalves. Two mariners generally go shares in this harvest. They dive in turns, and often fill up their boat to the gunwale.

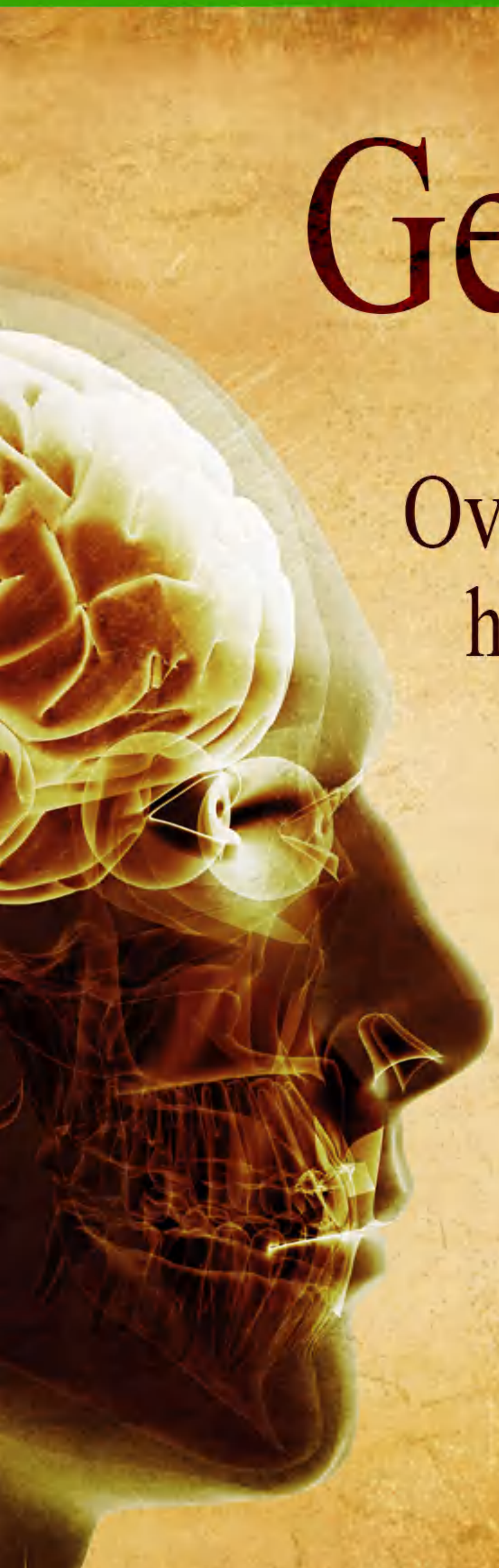
On the British and French coasts oysters are "dragged for." Each boat has a crew of ten men, and is provided with a couple of engines, weighing on an average nine kilogrammes. The drags are fastened to the end of a rope. Lowered into the sea, they rake over the bottom, grapple, loosen, and pick up the oysters they fall in with.

The oyster-banks are divided into several zones or belts, which are worked alternately, and allowed for a definite period to remain undisturbed, so that each zone may be easily and regularly repeopled.

On the coast of Campeachy, in the Gulf of Mexico, the oysters locate themselves among the submerged roots of the mangrove trees, and there develope themselves in considerable quantities. The Indians cut off the radical branches, without detaching the clustered bivalves, and proceed to market with actual roots (*regimes*) of oysters.

The idea of cultivating oysters has occurred to men's minds at different epochs. Sergius Orata, according to Pliny, was the first who devised the plan of inclosing them in artificial basins, or *parks*, in the neighbourhood of Baiæ, in the time of the orator Lucius Crassus, before the Marsic war. It was the same Sergius who made the reputation of the oysters of the Lucrine Lake by first attributing to them an exquisite savour. He actually created an industry, a new branch of trade, which is still flourishing at a few miles distant from its original site. To express the degree of perfection to which Sergius brought it, his contemporaries

* Bertram, The Harvest of the Sea.



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coast, and the Indian Archipelago, realize a yearly income of £800,000; whilst on the Arabian coast, the produce from the fisheries is estimated at £350,000. At Ceylon, however, the pearl diving was found still more lucrative, and, in proportion to its extent, was the most valuable in that neighbourhood. In 1797 they produced about £144,000, and in 1798 as much as £192,000. Of late years the banks have been less productive, and yield the comparatively small amount of £20,000 per annum.

The island of Ceylon is remarkable as the seat of the great fisheries for mother-of-pearl Pintadines (*Meleagrina margaritifera*), which take place, during the months of February and March, in the Gulf of Manaar, a large piece of water to the north-east. Two hundred and fifty boats, or thereabouts, each boat's crew consisting of some twenty men, ten of whom are rowers, set sail from different parts of the coasts, and reach the ground at daybreak, summoned by a gun-shot signal. Ten men of each boat then strip for diving, five to rest, whilst five are working; and with a large stone fastened to a rope, to hasten their descent, are let down into the water. Thus the oars are first laid across the boat, and, with the help of sundry planks, become a sort of stage to which the diving-stone—a pyramid in form, and weighing about half a hundredweight—is then suspended. Each diver naked, saving the band of calico about his loins, places his foot within a stirrup fashioned in the rope, or, if this be wanting, rests his foot upon the stone with the cord between his toes; and, clutching the signal-rope with one hand, whilst with the other he presses his nostrils together, is slowly deposited at the bottom of the sea. Detaching a large net which he carries on his left foot, he gathers hastily what pintadines may happen to lie within his reach, and, after the expiration of some thirty seconds—eighty seconds being the longest time they can possibly afford—pulls the signal-rope, mounts the diving-stone, and is drawn up into the boat. Generally, on reaching upper air, he discharges water tinged with blood from mouth, nose, and ears. If a good diver, he repeats the whole operation three or four, or sometimes twenty times, during the same day. The exertion, however, is severe; the long stay under water renders divers unhealthy and short-lived; and there is constant danger to be apprehended from the sharks. It is usual to fish, after the manner we have indicated, until mid-day, when the signal is given by the gun to cease work. The proprietors then receive the boats upon the shore, and are compelled to keep vigilant watch over their property to prevent robbery.

On the Persian coast, on the Arabian Gulf, along the coast of Muscat, and in the Red Sea, the pearl fishery is prosecuted in a manner very similar to that in vogue in the Bay of Manaar. It does not commence, however, until July and August, when the water is as hot as, or more hot, perhaps, than the air itself. The fishermen assemble in great numbers, stationing their boats at the proper distance from each other, and casting anchor in water from seven to nine fathoms deep. The process they pursue is simple in the extreme. Each diver passes a cord, of which the end is tied to a bell fastened on the boat, beneath his arm-pit; stuffs cotton into both his ears; hermetically seals his lips; presses his nostrils together with a piece of horn; attaches a heavy stone to his feet, and, arrived at the bottom of the sea, fills a bag he carries with him with the precious shells; sounds the bell, and is at once hoisted on the deck. This process is repeated at each separate dive.*

We have already indicated those places in America where pearl fishery is practised. Once upon a time, before the conquest of Mexico, the diving was confined to Acapulco and the Gulf of Tehuantepec; but since that time the chief seats of fishery have been the islands of Panama, Cubagua, and Margarita. The produce yielded from these sources may be imagined. In the time of the Emperor Charles V. it amounted to £160,000; at the present day the oyster fields are valued at about £60,000, and yet, the mode of diving is peculiar, and might be supposed comparatively ineffectual when contrasted with that of Indian fishermen. The American has no machinery whatever; dives into the water naked; snatches up a few pintadines, and swiftly emerges into the air. He is more frequent, however, in his diving than his Indian compeer, and, on the average, collects between thirty and forty bivalves a day.

The oysters yield two substances, of which the pearl is by far the most valuable and important. The less sought for substance is the nacre, which is obtained from the valves by raising their external surface, and disclosing it to view. The valves, however, must have been previously decomposed, thrown into reservoirs of sea-water, opened, washed, and handed to the dealers. Of nacre there are three different kinds used in commerce. The first, silver-faced, is sold in cases, each weighing some two hundred pounds. The second, bastard-white, is delivered in somewhat the same way; it is often a yellowish-white, and sometimes greenish, in many cases red, blue, and green.

The bivalves carried to the shore, strewn upon mats, permitted to decompose, opened, washed, and ready for examination, pincers are applied to the valve to sever it from the pearl, which is generally found, however, in the parenchyma. "In this case," says M. Louis Figuier, "the substance is boiled and afterwards sifted, in order to obtain the most minute of the pearls; for those of inconsiderable size are sometimes overlooked in the first operation. Months after the mollusc has been putrified, miserable Indians may be observed busying themselves with the corrupt mass in search of small pearls, which may have eluded the vigilance of the workmen." But these must be extremely rare indeed. Every precaution is taken, it is almost needless to say. The pearls are first scooped out from the parenchyma, are then thrust into a bag, are powdered over with nacre, until perfectly round in shape, and when polished, are passed through a succession of numbered sieves. Those which refuse to go through a certain sieve are termed pearls of the first order, because the holes through which they have refused to pass are of such a size that the pearls must be large indeed. These, then, are considered of prime value, whilst those which have passed through are

* Louis Figuier, The Ocean World.

subjected to the test of other sieves with smaller holes, and are classed according to their size and worth. The whole are then threaded on differently coloured silk; and in this way, assorted according to their size and colour, are exposed for sale.

We proceed to notice some other varieties of *Ostreadæ*.

The Scallop-shell (*Pecten*), so called because they were worn in their hats by the mediæval pilgrims, is round, nearly equal-sided, and resting on the right valve, which is more convex, and distinguished by numerous radiating ribs. Their channelled edges and surfaces bear some resemblance to the teeth of a comb, whence their scientific name, *Pecten*.

Towards the summit the shell terminates in a straight line, forming a kind of triangular appendage, called the *ear*, to which the hinges are attached. Though the valves are very regular, they do not resemble one another. In some species, whose shell is closely shut, the lower valve is more or less convex than the upper one. In others, both valves are convex. The hinge is without teeth, and the ligament, by which the shell is closed, is let into a triangular depression, or "dimple." The retractile muscle is unequal, and located nearly in the centre. Sometimes the edges are smooth, as in the Watered Pecten (*P. pseudamussium*); but more frequently they are arranged in strips or scales, as in the Smooth-shelled Pecten (*P. glaber*).

Other species, remarkable for elegance of form and beauty of colouring, are:—The Ducal Mantle (*Pecten pallium*), the Coral Pecten, the Tiger Pecten, the Purple Pecten, the Foliaceous Pecten, and the Northern Pecten. Upwards of a hundred species are known and have been described, of which twenty (including the exquisite *P. opercularis*) inhabit the European seas.

On the Mediterranean shores and along the coast of the Atlantic the genus *Pectunculus* are abundant. The shell is round and robust, and the animal inhabiting it is also round and compact, with a large thick mouth, and double branchiæ.

The genus *Spondylus* are remarkable for the rich colouring of their shells, and their elegantly varied forms. They are thick and solid, with unequal adherent valves that are strongly covered with spines. Their tenants in some respects resemble the oyster, but more closely the pecten. Two rows of tentacles fringe the edges of the mouth; the exterior row being frequently furnished at their extremities with coloured tubercles. The most interesting species are *Spondylus regius*, *Spondylus radians*, *Spondylus avicularis*, *Spondylus crassisquama*, and *Spondylus imperialis*.

We have also the genus *Malleus*, or Hammerhead, included in the family of Ostreadæ. The shell bears some resemblance to the implement from which it takes its name. The valves are blackish, nearly equal, somewhat rugose on the outer surface, and on the inner often brilliantly nacred. Being enlarged on either side of the hinge, the prolongation gives them an outline not unlike that of the head of a hammer; and as they grow in a direction opposite that of the hinge, the extension is not unlike its handle.*

* These resemblances are particularly noticeable in the species described by Lamarck, and named *Malleus alba*.

Only twelve species of this genus are known, and these inhabit the Australian seas, and the Pacific and Indian Oceans.

Sea Urchins lodged in the rocks they have excavated.

Michelet represents this strange product of the ocean as narrating his life-history in the following graphic language:—"I was born without ambition. I crave none of the splendid gifts possessed by those brilliant gentlemen, the Molluscs. I have no desire to be converted into mother-of-pearl or pearls; no longing have I for lustrous colours, a luxury of ornament which would render me fatally conspicuous; still less do I wish for the grace of your volatile Medusas, the undulating charm of whose shining locks attracts observation and exposes one to calamity. O mother Ocean! I desire but one thing only: *to be*—to exist without these external and compromising appendages; to be thick-set, robust, and globular, the shape in which I shall be the least exposed; in fine, I would remain a centralized being. I have very little instinct for travel. It is enough for me to roll occasionally from the surface-waves to the bottom. Firmly adhering to my rock, I could then resolve the problem of safety, whose solution is vainly sought by your future favourite—Man. To shut out all enemies, and admit all friends—especially air, light, and water—would, I know, cost me a certain degree of labour and a continual effort. Covered with movable spines, I shall be avoided by my foes, who, while I bristle like a bear, will call me a sea-urchin."*

The structure of this remarkable organism, so admirably adapted for its peculiar functions, is deserving of the minutest examination. We may imagine it built up in something like the following manner:—A globular hollow box, to use Mr. Gosse's expression, must first be made—a globular hollow box, about three inches in diameter, with sides scarcely thicker than a wafer, formed of unyielding limestone, and yet curiously fitted for the reception of the soft tender parts of an animal which, at all periods of its existence, completely fills the interior; a globular hollow box, moreover, which will never be cast off or renewed, which must hold the urchin in its old age as in its infancy. The limestone can only increase in size by being deposited; and as all the vascular tissues are concentrated within, they must deposit their particles on the interior walls. It is true that this thickening of the sides or walls from within necessarily diminishes the size of the cavity, while, on the other hand, the animal's incessant demand is for space, more space. Day by day it feeds, it assimilates its food, it fattens and expands; it needs a larger house, or cribbed, cabined, and confined, it will perish!

How is the difficulty to be conquered? By an arrangement which, like everything else in this world of ours, demonstrates the infinite wisdom of the Creator. The globular hollow box of the sea-urchin is not made in one piece, in ten pieces, or in a hundred; but it is composed of six hundred pieces, all so accurately

* Michelet, La Mer.

adjusted that the perfect symmetry of the exterior outline remains unbroken. And though all are of extreme tenuity, yet they retain their proper positions with undeviating exactness, and the slight brittle tenement possesses all requisite strength and solidity, for each piece is enveloped in a coat of living flesh; a vascular tissue passes up between the joints, where one meets another, and spreads over the entire outer surface. The glands of this tissue secrete lime from the sea-water, and deposit it in a regular and even fashion on every part of the box, so that every part is simultaneously enlarged, while the general form of the animal is preserved with a mathematical precision.

The external organs of the sea-urchin are its spines and tentacula—the former its instruments of defence; the latter its ambulatory appendages. Each of these prickles, which vary in shape and dimensions, and often exceed twelve hundred in number, is put in motion by several muscles, so that the entire mechanism of the animal is wondrously complex, and a marvel—may we say it without profaneness?—of ingenuity.

The mode in which it walks is singular. The reader must understand that the tentacula, or suckers, are hollow internally. When filled with liquid they become inflated in such a manner that, at the will of their owner, they can adhere to any solid body by means of their terminal suckers. How is this done? Let us imagine an urchin at rest, with his spines immovable and his filaments shut up within their shell. Some of these involuntarily escape, extend themselves, and feel the ground all about them; others follow, yet the urchin still remains in a condition of profound tranquillity. But perhaps he wishes for a change of scene, in which case he contracts his anterior filaments at the same time that the posterior ones abandon their hold, and the shell is carried forward. Thus he advances, not only with ease, but even with rapidity.

During his forward course his tentacles receive but slight assistance from the spines. He can travel either on his back or stomach—a convenience which is denied to man! Whatever his posture, he has always a certain number of prickles to support him, and suckers with which to take possession of a resting-place; and under certain conditions he actually walks by revolving upon himself, like a wheel in motion.

His mouth is an extraordinary organ, owing to its immense size compared to that of the body. It is placed underneath the body in the centre of a soft space covered with a thick defensive membrane; here it opens and shuts continually, displaying five strong sharp teeth, which project from the surface and meet in a point, supported and protected by a complex framework, fancifully named Aristotle's Lantern. These formidable grinders are set in motion by five powerful muscles.

It is needful they should be thus powerful, for they are used by the animal, not only to seize and masticate its food, but to excavate an asylum and a place of shelter in the solid rock. Each pick or saw, for it answers both purposes, is about the eighth of an inch in length. In opening the jaws the five teeth strike the stone forcibly, rather than scrape it, and thus by dint of continuous labour their owner obtains for himself a comfortable lodging in the solid rock.

Synapta Duvernea.

The habits of the Holothuria are not known with any degree of certainty or fullness. They are found, however, in almost every latitude, but on sheltered rocks, and secluded from the light, for which they are said to cherish a special aversion.

When held in the hand, they contract and stiffen their bodies, ejecting at the same time the water with which they are filled. In our European seas the fisherman treats them with contempt, and they never figure on the tables of the epicure or of the most omnivorous fish-eater; but among the Chinese their esculent qualities are more highly esteemed, and their fishery plays no unimportant part in the commercial economy of the East. One species, however, is held in favour by the Neapolitans, the *Holothuria tubulosa*, which is a native of the Mediterranean. In the Ladroue islands *Holothuria guamensis* holds the place of honour; while in the Malayan and Chinese seas the fisher pursues the *Holothuria edulis*, better known by the common appellation of *Trepang*.

Hundreds of junks are annually employed in the Trepang fishery, which is, in truth, a very amusing and exciting scene for the spectator. The following account is condensed from the narrative of the great French navigator, Dumont d'Urville, who witnessed what he describes in the neighbourhood of Observatory Island:—

Four Malay proas, flying Dutch colours, having entered Raffles' Bay, their crews immediately set to work, and in the first place commenced the erection of some curing-houses for the proper preparation of their expected booty.

Dumont d'Urville, in the course of his voyage, had frequently observed little walls built up of dry stones, after the plan of a series of semicircles joined to one another. He had often wondered what might be their object or utility; he was now enlightened. The Malays quickly deposited upon their tops several large semi-cylindrical boilers, about forty inches in diameter, and under these kindled enormous fires. Near to them were constructed suitable sheds, consisting of four strong posts driven into the earth, and roofed over with hurdles, grass, and leaves.

The boats, meanwhile, put out into the bay, and from each some seven or eight Malays sprung overboard, and commenced diving for Holothuria. Each diver quickly returned to the surface with at least one fish, and sometimes with two, as a reward of his exertions. The higher the sun is above the horizon, the more easily, it seems, can the creature be distinguished at the bottom, and, mid-day is, therefore, the time generally selected for fishing operations. So swift and skilful are the divers in their movements, that they scarcely touch the boat into which they fling their prey before they dive again. When the boat was filled it proceeded to the shore, and its place was sup-

functions the Acalephæ perform. The fact, he says, admits of easy illustration, both in the Beroes and in the Medusæ. On one occasion he took a dead Cydippe, and, placing it on a glass, exposed it in the sun. As the moisture evaporated, the different parts appeared to be confusedly painted on the glass; and when it had become perfectly dry, a touch removed the only vestiges of what had been so lately a graceful and animated being. With regard to the Medusæ, Mr. Patterson relates an anecdote communicated to him by the late eminent zoologist, Professor E. Forbes. He had been delivering some zoological lectures in a seaport town in Scotland, in the course of which he had reverted to some of the most remarkable points in the economy of the Acalephæ. After the lecture, a farmer who had been present came forward, and inquired if he had understood him correctly as having stated that the Medusæ contained so little of solid material that they might be regarded as little else than a mass of animated sea-water? On being answered in the affirmative, he remarked that it would have saved him many a pound had he known that sooner; for he had been in the habit of employing his men and horses in carting away large quantities of jelly-fish from the shore, and using them as manure on his farm; and he now believed they could have been of little more real use than an equal weight of sea-water. Assuming that so much as *one ton* weight of Medusa recently thrown on the beach had been carted away in one load, it will be found that, according to the experiments of Professor Owen, the entire quantity of solid material would be only about *four pounds* of avoirdupois weight—an amount of solid material which, if compressed, the farmer might with ease have carried home in one of his coat pockets.

The appearance of the Medusæ as they float in the clear waters near a rocky coast is very fairy-like and attractive. Some are uncoloured, and translucent as crystal; others shine and gleam with beautiful rose hues or azure tints; others are of a rich purple, emerald, ultramarine, or dark warm brown; and others again seem to coruscate and glow with all the colours of Iris!

In certain species only the central parts are coloured, exhibiting the most brilliant reds and yellows, the intensest blues or violets, while all the rest is purely limpid; in others again the central mass seems invested in a thin diaphanous veil, like the evanescent soap-bubble blown by playful children.

In moving through the water the Medusæ keep their convex part in advance, and in a slightly oblique direction. If lightly touched while swimming, they contract their tentacles, fold up their mushroom-like discs, and sink into the sea. Like Ehrenberg, M. Kölliker thought he could discover visual and auditory organs in an *Oceania*, and Gegenbauer supposed he had detected them in other genera, such as *Rhizostoma* and *Pelagia*. The eyes consist, it is said, of certain small, hemispherical, coloured particles, in which are deposited small crystalline globules, whose free parts are completely undefended. The ears are seated close to the optical organs; they are small vesicles filled with liquid, the eyes having neither pupil nor cornea, and the ears without opening or arch.

The most interesting particular connected with the economy of the Acalephæ is their mode of reproduction. At one period of the year they are loaded with festoons of the liveliest colours, which, on examination, prove to be wholly composed of very minute eggs. These, in some cases, develop themselves while attached to the parent bodies, and are only thrown off when they reach maturity. In other cases no resemblance is apparent between the mother and her offspring. They are elongated like worms, and broad at the extremity: these are "microscopic leeches," whose scarcely perceptible vibratile cilia enable them to dart to and fro with extreme agility. After a while they progress into Polypes, and are provided with eight tentacles. This preparatory kind of animal seems to exercise the reproductive faculty by means of certain buds or tubercles which appear on the surface of the body, and also by occasional filaments, so that, as in the case of the corals, a single individual becomes the founder of a numerous colony. This Polype undergoes a still more remarkable metamorphosis. It attains a complicated organization and an articulate body, which seems to consist of a dozen bodies piled one upon another "like the jars of a voltaic pile." The upper disc, which is convex, separates itself from the aggregate mass by a violent effort, becomes free, and develops into a minute star-like Medusa: every disc, or in other words, every individual, in like manner secures its freedom and an independent existence in its turn.

Gosse, whose researches in reference to the Acalephæ form a very valuable contribution to the natural history of the Zoophytes, divides them into three great divisions.

1. *Discophora*, whose form is that of a circular disc, more or less convex and mushroom-shaped, and which moves by an alternate contraction and dilatation of the disc.

2. *Ctenophora*, whose body is cylindrical, and whose movements are effected by means of many parallel rows of cilia set on the surface in longitudinal order; and—

3. *Siphonophora*, with an irregularly-shaped body, having no digestive cavity, but organs of suction, and moving either by means of certain air-vessels, or by means of a contractile air reservoir.

The Discophora are again sub-divided into—A, *Gymnopthalmata*, having the optical apparatus uncovered or wholly wanting, a large central digestive cavity, and simple or branched circulating vessels, which strike off to the margin; and, B, *Steganophthalmata*, in which the eye-specks are defended by membranous hoods, or lobed coverings, and circulating vessels so ramified as to form a labyrinthine network.

Of the *Gymnophthalmata* we have an admirable example in *Æquorea violacea* (Milne-Edwards), whose disc may be compared to a crystal saucer reversed, and fringed all round the edge with short, slender, thread-like tentacula of a delicate violet colour. Its circulating vessels, eight in number, are quite simple, and the ovaries are placed upon them. The peduncle is wide, and expands into several broad and long fringed lobes.

The *Steganophthalmata* include the Medusadæ proper, whose umbrella-shaped disc is furnished with

marginal filaments, eight lobe-covered eyes, four ovaries, four chambers, four fringed arms, with a central and four lateral openings.

As a type of this group may be instanced the *Aurelia aurita* (Lamarck, the *Cyanea aurita* of Cuvier), or Auriculated Aurelius, which abounds in the waters of the Baltic, and has been made the subject of special study by the Swedish naturalists.

In the same group we find the *Pelagia cyanella*, with its globose body, and eight marginal tentacles; the *Pelagia noctiluca*, a transparent, glass-like disc of a reddish brown colour, very plentiful in the Mediterraneau; and the *Pelagia panopyra*, an inhabitant of the tropical seas.

Many species of the Medusadæ are phosphorescent, and the luminous appearance presented by the ocean, frequently compared to a sheet of many-coloured flame, is due to the peculiar light-emitting faculty of these remarkable creatures.

The class of Discophoræ may be divided into four orders or families:—

The Hydraidæ—having single, naked, gelatinous, sub-cylindrical, but very contractile stems, mutable in form; the mouth fringed all around with a single series of granulous filiform tentacula.

The Sertulariidæ—plant-like, horny polypiers, rooted and variously branched, filled with a semi-fluid organic substance, and the polypes contained within sessile cells which are disposed along the sides of the main stem or branchlets, but are never terminal. Individually they have no digestive cavity; one stomach is common to the numerous group!

The Medusadæ—already described as possessing an umbrella-shaped disc, provided with marginal tentacles, and eight lobe-covered eyes, four ovaries, cells, and fringed arms, one central and four lateral openings.

The Siphonophoræ—wherein the animals are two-fold and bell-shaped, fitting into one another.

Of the Hydraidæ and the Sertulariidæ we speak elsewhere; our remarks in the present section will still be confined to the Medusadæ. Their aspect, as seen by the poetical observer, is elegantly described by Michelet, in his delightful volume of facts, fancies, thought, and emotion, "La Mer:"—

"Among the rugged rocks, the lagunes or pools left by the receding tide were filled with little animals, which had been too slow to overtake the retiring waters. Some shells were there, folded up in themselves, and suffering from exposure to the dry air. In the midst of them, shell-less and without an asylum, and fully expanded, lay the living umbrella, which naturalists have so inappropriately named *Medusa*. But why was so terrible a name bestowed on this attractive being? I had frequently had my attention arrested by these castaways, which one sees so often on the sea-borders. This one was not larger than my hand, but singularly pretty, with soft light shades and of an opaline white, which melted, like a cloud, into a tender lilac-coloured crown. The wind had overturned it. Its chaplet of lilac tresses floated above, and the delicate umbel (that is, its preper body), finding itself beneath, clung to the rock. Shuddering throughout its delicate substance, it was sorely wounded and torn in those delicate hairs which are its organs of respiration, absorption, and even of love. All its substance, thus reversed in position, received the direct rays of the Provençal sun, so keen and severe at its first rising, and rendered keener by the breath of the mistral which blew at intervals. This double shaft transfixed the lucent creature. Living in the bosom of the sea, whose touch is ever caressing, it needs no armour of resistant epidermis, like the terrestial animals; it receives everything to the quick.

"Was it dead or dying? I could not make up my mind that it was dead; I maintained that it lived. At all hazards, it would cost but little trouble to remove it from the rock and deposit it in the adjacent pool. To tell the truth, I felt some repugnance at touching it. The delicious creature, with its transparent innocence and its rainbow of soft colours, was like a trembling jelly—glided, and escaped from my fingers. However, I slipped my hand underneath it, carefully lifted up the motionless body, whence all the filaments fell back into their natural position when the animal is swimming. In this manner I transferred it to the neighbouring water. It sank, without giving any sign of life.

"I walked about the shore, but in ten minutes returned to my Medusa. It was undulating under the wind. It positively moved itself, and rose to the surface. With singular grace its tresses floated under it, and softly moved it from the rock. It did not go very quickly, but still it went, and soon I saw it a long way off."

The Medusæ are found in every sea, floating with unconcern on the surface of the swelling waves. Their locomotion is singularly slow, and indicates a very feeble muscular energy; nevertheless, what is wanting in quickness is compensated by its continuity. Since their specific gravity considerably exceeds that of the element in which they are immerged, and since their softness of substance precludes their reposing on solid ground, it is necessary they should agitate constantly in order to keep themselves afloat. When they rest they sink. They are also compelled, by the nature of their organization, to maintain a continual state of contraction and expansion, of systole and diastole.

We are told by Spallanzani, who examined their movements with careful accuracy, that those of translation are accomplished by the edges of the disc approximating to such an extent that the diameter is very perceptibly diminished. This effort forces out a certain quantity of the water absorbed in the body with more or less violence, and consequently projects the body in the inverse direction. Reinvigorated by the cessation of force in its first state of development, it again contracts itself, and makes another step in advance.

When the body is perpendicular to the horizon, these successive movements of contraction and expansion cause it to rise upwards; when it is more or less oblique, they effect its advance more or less horizontally. If the animal would descend, it has only to cease its efforts, and its descent results from its specific

gravity. This double movement of its evanescent organism had been observed by the ancients, who therefore bestowed upon it the fanciful name of *Sea Lungs*.

The Medusæ furnish the whale with the principal portion of its food—a fact from which the reader may infer their prodigious abundance. Sometimes their innumerable legions overspread the sea for many miles. They themselves prey upon molluscs, young crustacea, and worms, for which purpose they are provided with a mouth in the centre of the body. Their voracity is extreme, and they dispose of their victim at one mouthful, without waiting to divide it.

In size they vary considerably. Some are not above two or three inches; others are from thirty to thirty-six inches in diameter.

The human body, when it comes in contact with them, experiences an acute stinging sensation. Dicquemare compares the pain to that which is produced by the touch of a nettle; only, he says it is more painful, and of longer duration. It is also accompanied by swellings with a whitish point.

"During the first voyage of the *Princess Louise* round the world," says Frédol, "Meyen, the naturalist of the expedition, remarked a splendid Physalia passing near the ship. A young sailor leapt naked into the sea to capture it. Swimming towards the animal, he got hold of it; immediately it wound its numerous thread-like filaments, each nearly a yard in length, round its assailant's body; compelling him, in the excess of his agony, to cry for assistance. He had scarcely strength to regain the vessel and get on board again, before the pain and inflammation so increased as to induce brain fever, and great fears were entertained for his life."

Among the Medusæ proper, the most common species are Aurelia, Pelagia, and Chrysaora. It has a hemispherical disc, festooned with numerous elegant tentacles, which are attached to a sac-like stomach that opens by a single orifice in the centre of the peduncles. Its arms are four in number; they are long, unfringed, and furbelowed. The *Gaudichaudi* is found all round the Falkland Islands.

We must now glance at those Medusæ which bear the distinctive term of *Rhizostoma*. Their disc is depressed, without the ornament of marginal tentacles, but hemispherically festooned. Its peduncle expands four pairs of arms, forked and numerously dentated, and with two auricles at the base of each. The disc of the *Rhizostoma Cuvieri* is white tinged with azure, with a deep violet edging its circumference. This species is a native of the Atlantic, is gregarious, and of great size. In August it is found on the English coast, and in the vicinity of every port in the Channel it may be seen in October gathering in swarms, or lying high and dry upon the shore, where they have been untimely wrecked by wind and wave.

The *Rhizostoma Aldrovandi* is formidable to bathers; its stinging apparatus being far more powerful than the nettle. If the animal touches the fisherman as it is raised from the water, his skin will become inflamed, and swell in disagreeable pustules.

Cassiopeia and *Cephea* also belong to this group.

We have said nothing as to the respiratory organa of the Medusæ. The fact is, they breathe through the skin, which, for this purpose, is provided with various elongations and marginal fringes.

The digestive organs are no less peculiar. The mouth is placed on the under part of the body, and pierced at the extremity of a trumpet-like tube, hanging not unlike the tongue of a bell. The walls of the stomach, we may add, are provided with numerous elastic appendages, which originate in the cavity of that organ. By means of these vibratile cells, the stomach appears to secrete a solvent juice, which attacks the food and renders it digestible.

The central mouth is wanting in some of the Medusæ. In these cases the stomachal cavity communicates with the canals that perforate the thickness of the arms, and open at their extremity through numerous small apertures. From these root-like openings the animals derive their appellation of *Rhizostoma*, or Root-mouth, from the Greek ῥίζα, root, and στόμα, mouth.

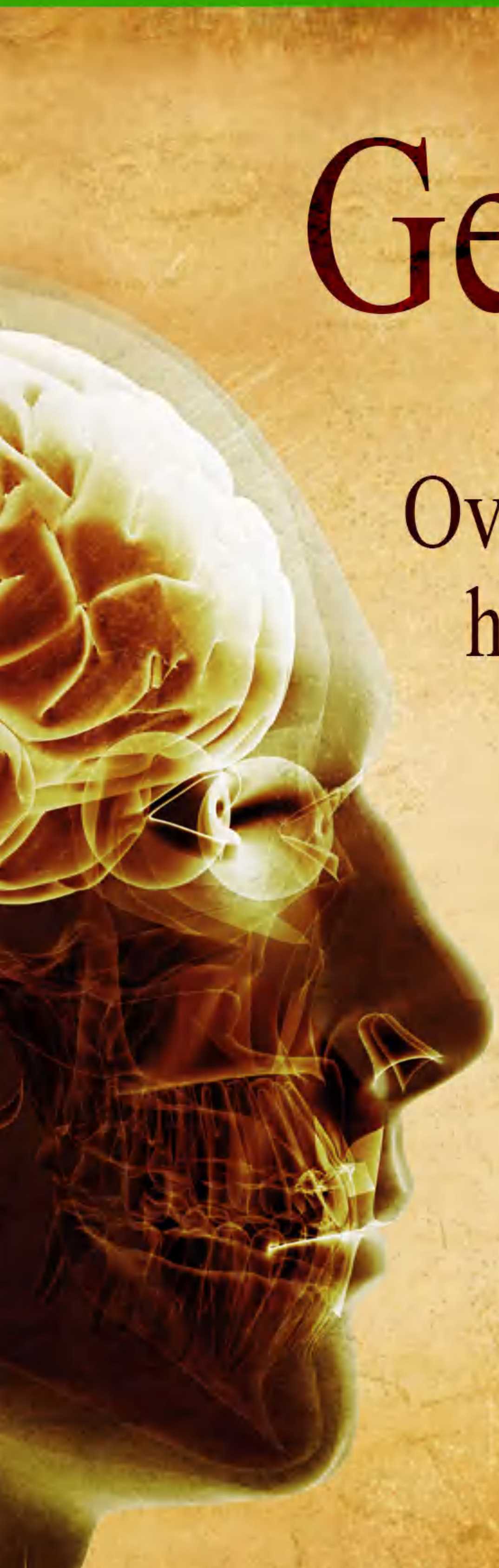
The Medusæ were long considered a *lusus naturæ*, and supposed to be utterly deficient in organization. But recent inquiries have raised them higher in the scale of being.

During my residence on the shores of the Red Sea, says Ehrenberg, although I had frequently examined the brownish bodies on the edge of the disc of the Medusæ, it was only in the past month that I succeeded in ascertaining their true nature and function. Each of these bodies consists of a little yellow oval or cylindrical button, attached to a thin peduncle. This peduncle is fastened to a vesicle, in which the microscope reveals the presence of a glandular body, yellow when traversed by the light, but white when the light is simply reflected from it. From this body come two branches, and strike towards the peduncle or base of the brown button-like body up to the button or head. Ehrenberg found that each of these presented a very distinct red point placed on the dorsal face of the yellow head, which, when compared with similar red points in other animals, he discovered to resemble very closely the eyes of the Rotifera and Entomostraca.

The bifurcating body situated at the base of the brown spot appears to be a nervous ganglion, and its two branches may be regarded as optic nerves. Each pedunculated eye bears a small yellow sac, containing, in greater or smaller numbers, bright, tiny, crystalline bodies, as clear as water. These, perhaps, like the crystalline facets in the eyes of animals, assist in refracting the light.

Our closing remarks will be devoted to the reproductive system of the Medusæ, which is one of the most romantic facts in natural history, Which of us, says Quatrefages, would not proclaim the prodigy, if he saw a reptile issue from an egg laid in his courtyard, which afterwards gave birth to an indefinite number of birds and fishes! Well, the generation of the Medusæ is no less remarkable than the instance we have imagined.

Take, for example, the Rose Aurelia. It lays eggs, each of which includes three concentric spheres. These



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The naturalists of antiquity were not ignorant of the fact, though in error respecting its attendant conditions. They believed that the star-fish waited until the oyster or the mussel opened its valves to seize its prey, which it did, by introducing first one and then its other four feet or fingers into the opening, until it reached and devoured the unfortunate inhabitant. But the researches of modern inquirers have corrected our ideas upon this point. To secure its savoury victim, it seems that the star-fish commences operations by bringing its central mouth to the closed edges of the bivalve; and this effected, it injects from that mouth a few drops of an acrid or poisonous liquid into the interior of the oyster shell, which compels it to open its valves. An entrance once effected, it soon completes the destruction of its prey.

It is true, however, that Professor Rymer Jones describes the operation in a different manner. The oyster, he says, is firmly grasped by the rays of its foe, and held under its mouth by the aid of its suckers. The Asterias then inverts its stomach, and envelops the bivalve in its interior cavity, distilling, meanwhile, a poisonous liquid. The victim compulsorily opens its shell, and is quickly devoured.

The Asterias, we may add, devours dead flesh or garbage of every kind, and is one of the most active of nature's scavengers, being incessantly engaged in the great work of cleansing the shore to prevent the creation of contagious and miasmatic vapours.

Zoologists differ as to the mode in which it discharges its respiratory functions. The general opinion seems to be that the principal portion of the task devolves upon the sub-cutaneous branchiæ, which, in each ray, constitute two double series of bladders. Its circulatory organization is imperfectly known.

The vascular apparatus is, however, sufficiently developed, and its centre appears to be an elongated canal with muscular walls, which naturalists consider to be the heart. A little ring encircling the œsophagus, and throwing off a number of delicate white fibres, which extend into the furrowed arms, forms the whole of its nervous system. Among its organs of sense we find that of touch in the *tentacula ambulacraira*, or the suckers which garnish its rays, as well as in those which are scattered over the dorsal surface of the disc. Its eyes, if it have any, which Rymer Jones does not admit, and which, at all events, must be of a singularly imperfect character, are the bright red points situated at the extremity of the arms, and on the inferior surface. Any defectiveness in the visual organs is, however, more than compensated by the extreme delicacy of touch with which the Asterias is gifted.

The star-fishes have distinct sexual differences. The female lays a number of round reddish eggs, which produce little vermiform creatures, covered with fine vibratile cilia, and swimming about incessantly, like the infusoria. Each of these is afterwards developed into a *Bipinnaria*, a kind of polype, with one extremity of the body terminating in arms, and the other in a tail, furnished with two fins. To the extremity provided with arms is attached a young asterias, which in due time the *Bipinnaria* throws off, giving up at the same time its stomach and intestines, which the asterias converts to its own use. This act of sublime renunciation, however, does not kill the *Bipinnaria*, which, though retaining only a portion of itself, manages to live for several days after the sacrifice has been performed.

We have not yet completed our list of wonders connected with the economy of the star-fish. This animal, as a recent writer observes, exhibits in the highest degree the vital phenomena of dismemberment and restoration; that is to say, it possesses the remarkable faculty of reconstructing any organ of which it may accidentally be deprived. If it loses a ray it suffers no disquietude; it can easily replace the missing member. Professor Rymer Jones mentions a curious instance. He had picked up a single ray of an asterias; at the end of five days it developed four little rays and a mouth; when a month had elapsed the old ray was completely destroyed, and the apparently useless fragment had created a new asterias, quite perfect, with four little symmetrical branches.

But another and a stranger circumstance remains to be told. The asterias, it is said, commits suicide, when menaced by any overwhelming danger. Extremes meet. It is only at the highest and lowest degrees of the grand scale of animal life, that we meet with creatures possessing the power of voluntarily terminating their existence. It should be noted, however, that it is only found in its fullest extent in two genera of asterias—the *Ophrocoma* and the *Luidia*.

The following narrative by Professor Forbes of what he observed take place in an attempt which he, on one occasion, made to capture a specimen of the *Luidia fragillissima*, an inhabitant of our British seas, will interest the reader:—

"The first time," he says, "that I caught one of these creatures, I succeeded in placing it in its entirety in my boat. Not having seen one before, and being ignorant of its suicidal powers, I spread it out on a rowing bench, the better to admire its form and colours. On attempting to remove it for preservation, I found it, to my horror and disappointment, only an assemblage of detached members. My conservative endeavours were all neutralized by its destructive exertions; and the animal is now badly represented in my cabinet by a discless arm and an armless disc. Next time I went to dredge, at the same spot, I determined I would not again be cheated out of my specimen; I carried with me a bucket of fresh water, for which the star-fishes evince a great antipathy. As I hoped, a Luidia soon came up in the dredge, a most gorgeous specimen. As the animal does not generally break up until it is raised to the surface of the sea, I carefully and anxiously plunged my bucket to a level with the dredge's mouth, and softly introduced the Luidia into the fresh water. Whether the cold was too much for it, or the sight of the bucket was too terrific, I do not know; but in a moment it began to dissolve its corporation, and I saw its limbs escaping through every mesh of the dredge. In my despair I seized the largest pieces, and brought up the extremity of an arm with its terminal eye, the spinous eyelid of which opened and closed with something like a wink of derision."

Coral Island of Clermont-Tonnerre in the Pomotuan Archipelago.

Most of our readers will probably be familiar with the exquisite lines of Southey, describing the garden-scenery which flourishes at the bottom of the ocean; lines which are no less true than beautiful:—

"It was a garden still beyond all price,
Even yet it was a place of Paradise;
For where the mighty ocean could not spare,
There had he with his own creation
Sought to repair the work of devastation.
And here were coral bowers,
And grots of madrepores,
And banks of sponge, as soft and fair to eye
As e'er was mossy bed
Whereon the wood-nymphs lie
With languid limbs in summer's sultry hours.
Here too were living flowers
Which, like a bud compacted,
Their purple cups contracted,
And now in open blossom spread,
Stretched like green anthers many a seeking head.
And arborets of jointed stone were there
And plants of fibre fine as silkworm's thread;
Yea, beautiful as mermaid's golden hair
Upon the waves dispread.
Others that, like the broad banana growing,
Raised their long wrinkled leaves of purple hue,
Like streamers wide out-flowing."*

But besides these ocean-gardens the sea has its far-spreading forests—forests of purple and rosy hues—which cover the wildest and most irregular rocks, and lift their crests up to the very surface of the waves; forests formed by the untiring labours of generations upon generations of Polypes, the Red Coral.

By ancient naturalists the coral was regarded as a marine plant, and the Greeks fancifully named it Κοράλλιον, from κόρη and ἁλός—that is, the daughter of the sea. This opinion was also held by Tournefort, and even by the illustrious Réaumur, who asserted that coral was the stony product of certain plants. The Comte de Marsigli, no undistinguished name in the history of science, also looked upon it as a member of the vegetable kingdom, and declared that he had discovered its expanded flowers. But the researches of Peysonnel revealed its true character. A long series of carefully conducted observations showed him, that the supposed flowers were true animals, and the coral one of the rudimentary forms of created life. He communicated these results to Réaumur and Bernard de Jussieu, but both these naturalists professed to be unconvinced. At length the discoveries of Trembley in reference to the fresh-water Hydræ, which, formerly mistaken for plants, like the coral, proved, like the coral, to be animalcules, threw a fresh light upon the value of Peysonnel's experiments, and secured them universal respect. From that time the animal nature of the coralline has never been contested.

Coral is now admitted to be a family of polypes living in association and forming a *polypier*. They belong to the great and remarkable order of Zoophytes.

A branch of living coral, so to speak, is an aggregation of animals derived from a parent individual by a process resembling budding. They are united to each other by a common tissue, and while all labour towards one and the same end, each enjoys a distinct and independent existence. The branch originates in an egg, which is spherical in form, opaque, and of a milky white. Gradually it increases in length, and clothes itself in numerous vibrating ciliæ. As soon as it is laid, or more correctly speaking, vomited, it opens in itself a central aperture or pore, destined to become its mouth. Next it assumes the form of a small, whitish, semi-transparent worm, which swims to and fro with considerable swiftness, and turns about when it encounters one of its own kind. It rises and sinks in the shallows which it inhabits, carrying its base or larger extremity always in front, and its mouth behind. Thence it happens, that on coming into collision with any object, it immediately adheres.

As soon as it has found a place of fixation it abandons its worm-like form; it expands, as it were, losing in length what it gains in breadth; growing shorter and of a discoidal shape. It may now be described as a nearly cylindrical, whitish, membranous tube, whose upper disc is encircled by eight tentacula, bearing numerous delicate lateral filaments or fibres. Its appearance is not unlike the corolla of some kinds of flowers, and is characterized by remarkable grace and even beauty.

Occasionally the arms of the polype are subject to a violent agitation; the tentacula fold and roll themselves up like the coils of a serpent. If, under such circumstances, we should examine its expanded disc, we should find, within the eight tentacula, a perfectly circular space, whose centre is occupied by a small mammal; and we should detect, on the summit of this mammal a small slit like two rounded lips, being the mouth of the polype.

A cylindrical tube connected with the mouth is the œsophagus or gullet, which seems to be suspended in the interior of the body by certain folds issuing with admirable symmetry from eight points of its circumference. The folds which thus secure the œsophagus in its place form a series of cells, above each of which it attaches itself, and supports an arm or tentaculum. The polype thus attached to its life-long home, becomes the founder of a great arboreal colony. Buds or *bourgeons* form upon its axes, and produce, by course of development, a small world of Corallines.

Among all adhering animals it is an invariable law that the larvæ should be mobile. The young polypes, on emerging from their eggs, differ in almost every respect from their parents. They have to undergo a series of metamorphoses, as we have seen, before they can attain their perfect state; but these metamerphoses are in an inverted order to those of insects. Among the latter, the chrysalis, which is immovable, changes into the butterfly, which flies. Among the corals, the larva, which swims and moves, is transformed into the fixed polype.*

The different polypes are imbedded in a kind of fleshy substance, thick, soft, and easily dinted by the lightest touch of the finger. This is the living part which produces the coral, and is so far extended as to cover the entire polypier. Wherever it perishes the

* Southey, The Curse of Kehama, xvi. 5.

* Frédol, La Monde de la Mer.

corresponding part of the axis ceases to develop. Between it and the polypier an intimate relation, therefore, exists. Examine it closely, and you will find it to consist of three principal elements—a common *tissue*, certain *spiculæ*, and divers *vessels*.

Of the tissue it is only necessary to say that it resembles a glossy, transparent membrane. It is cellular and contractile.

The spiculæ are minute calcareous concretions, more or less elongated, covered with knotted joints which bristle with spines, and of a regular determinate form. They possess the power of refracting light with intense vividness, and their colour is that of the coral, though less intense on account of their thinness. They are uniformly distributed throughout the fleshy substance we have been describing, and communicate to the coral its peculiar and much-prized colour.

The vessels form a close compact network, which extends and repeats itself in the thickness of the crust. They are of two kinds: while some of tolerable size are embedded in the axis and arranged in parallel layers, the others are more regular and much smaller. This vascular network has a direct and important connection with the polypes, on the one hand, and with the axis or central substance, on the other. It also maintains a close communication with the general cavity of the animal's body by every channel which approaches it, while the two ranges of network stretch towards each other a great number of anastomosing processes.

How do the corals feed? The alimentary fluids are conveyed to the animalcules which inhabit the various cavities of the polypier by delicate intermediary canals. The alimentary fluids elaborated by the Polypes themselves, flow into the branches of the secondary and irregular network system, and so pass to the great parallel tubes that stretch from one extremity of the organism to the other, and thus supply the entire community.

When one end of a branch of living coral is ruptured or broken, a whitish liquid immediately gushes from the wound, which mingles with the water, and is exactly like milk. This is the fluid aliment which has escaped from its containing vessel, charged with the debris of the organism.*

"What occurs," says a modern writer, "when the bud produces new polypes? It is only in round well-developed animals, and particularly those with branching extremities, that this phenomenon occurs. The new organisms resemble little white points pierced with a central orifice. With the help of the microscope, we discover this white point to be starred with radiating white lines, the edge of the orifice bearing eight distinctly traced indentations. All these organs are gradually enlarged until the young animal has attained the shrub-like or branched aspect belonging to, and characteristic of, the compound polype or polypier. The tube is branching, and the orifices from which the polypes expand dilate into cup-like cells."

True corals are divided into the *Melites* and the *Isis*; whose ramifications are articulated, and whose polypes possess *six* tentacula instead of eight. These tentacula are entire and unbroken. In the Melites the axes are knotted or jointed at intervals, and covered with a permanent adhering crust; in the Isis, they are etrangles, and clothed in a loose decaying envelope. The tissue of the former is stony and homogeneous; that of the latter, is composed of two distinct substances; their spiculæ are hairy and blackish; their articulations striated and calcareous.

The stem of the Isis is often used in commerce for white coral; but the structure of the two is so different that, with a glass, they may readily be distinguished.

Each coral, true or false, is a distinct workshop or laboratory of tiny labourers, skilful, numerous, and ever active; a wonderful workshop, where they manufacture, at one and the same time, the original material, horn or marble, which is indispensable to them, and the graceful products, stems or branches, which are their characteristic products.

From these explanations of the nature of coral, says Frédol, it is evident that these polypes more nearly resemble plants than animals. It is for this reason that they are frequently included under the designation we have already used, Zoophytes, or animal plants—a designation which is extended to a great number of marine Invertebrata.

The points of resemblance between these animals and the members of the vegetable kingdom are as curious as they are interesting. To the unscientific eye they might reasonably pass for petrified plants. Like vegetables they have a stem, branches, and twigs—all covered with a veritable bark. Their axes are horny or calcareous, while those of vegetables are woody or herbaceous. In both the tissue is of greater or lesser solidity, striated, channelled, twisted, and composed of concentric layers. Moreover, the animal bark is spongy, and more or less tender, like the vegetable bark.

The gems represent buds; the Polypes, flowers. The filaments expand in rosettes like petals; they form a living coralla, which alternately opens and shuts. In the polypier, as in the vegetable, the elementary individuals are situated at the extremities of the axes, or on the sides, or, rather, are both terminal and lateral. Finally, another point of resemblance is found in their mode of reproduction. Both the coral and the vegetable give birth to isolated organisms, eggs or seeds, which detach themselves from the parent mass, delvelop gradually, and produce a colony, whose members remain adherent, and, in succession, other corals and other vegetables, that is to say, other collective beings. It is the synthesis which engenders analysis, and the analysis which reconstitutes the synthesis. In plainer language, from the addition springs division, and from the division again occurs addition. The many produce the one, and the one, in its turn, produces the many.

The coral of commerce, once so highly valued by all collectors of *vertu*, is, of course, the Polypier. It is a cylindrical substance, much channelled on the surface; the lines generally running parallel to the axis of the cylinder, and the depressions corresponding to the animal's body. Examine the transverse section of a polypier, and you will find it regularly festooned on

* Figuier, The Ocean World.

esteemed for its vivid and dazzling colour. The Italian species is probably not inferior, but that of Barbary is coarser and less brilliant.

In commerce four kinds of coral are recognized, and distinguished by somewhat fantastic designations, as, 1st, Foam of Blood; 2nd, Flower of Blood; 3rd, First Blood; 4th, Second Blood. Rose coral is very rare and very dear.

But the labours of these curious animalcules are productive of more important results than the mere decoration of the persons of the wealthy and luxurious. Those species which belong to the order *Tubiporinæ* are the creators of the coral islands of Southern seas. The manner in which they work is truly marvellous. Their toil is slow, but it is continuous; for as fast as one animalcule dies another takes its place. It is not for themselves; they derive no advantage from their industry; they are simply fulfilling the functions imposed upon them by Almighty power, and by building up reefs and islands, which hereafter may be expanded into continents, hastening the completion of the grand scheme of creation.

The examination of a coral reef is, therefore, a peculiarly interesting study for the scientific observer. When the sea has receded from it for some time it becomes dry, and appears to be a compact rock, exceedingly hard and ragged; but as soon as the waters return, and the tide washes over it, myriads of corallines emerge from holes which were previously invisible. They are of great variety of shape and size, and in such prodigious numbers, that (says Basil Hall) the entire surface of the rock seems alive and in motion. A very common form is that of a star, with arms from four to six inches long, which it moves about with a rapid motion in all directions, probably in quest of food. Captain Hall observed some of a very sluggish disposition, so that they were frequently mistaken for pieces of rock; they are generally of a dark colour, and from four to five inches long, and two or three round.

When the rock, says our authority, was broken from a spot near high-water mark, it was found to be a hard solid stone; but if any part were detached at a level accessible to the tide every day, it was discovered to be full of worms of all different lengths and colours —some being as fine as a thread, and several feet long, generally of a very bright yellow, occasionally of a blue colour; others resembled snails; others were not unlike snails and worms in shape, but soft, and not above twenty-four inches in length. The growth of coral ceases when the worm which creates it ceases to be exposed to the action of the tide. Thus a reef rises in the form of a gigantic cauliflower till its summit has reached the level of the highest tides, above which the worm has no power to carry its operations, and the reef, consequently, no longer extends itself upwards. The surrounding parts, however, advance in succession until they reach the surface, where they also must stop. Thus, as the level of the highest tide is the eventual limit to every part of the reef, a horizontal field comes to be formed coincident with that plane, and perpendicular on every side. The reef, however, continually increases, and, being prevented from going higher, must extend itself laterally in all directions; and this growth being probably as rapid at the upper edge as it is lower down, the steepness of the face of the reef is preserved; and it is this circumstance which renders the coral rocks so dangerous in navigation. In the first place, they are seldom seen above water; and in the next, their sides are so abrupt that a ship's bows may strike against the rock before any change of soundings indicates the approach of danger.*

A popular English poet has described the *modus operandi* of the coralline in eloquent and yet scientifically accurate terms:—

"Millions of millions thus, from age to age,
With simplest skill, and toil unweariable,
No moment and no movement unimproved,
Laid line on line, on terrace terrace spread;
To swell the heightening, brightening, gradual mound,
By marvellous structure climbing towards the day.
Each wrought alone, yet all together wrought,
Unconscious, not unworthy instruments,
By which a Hand Invisible was rearing
A new creation in the secret deep.
Omnipotence wrought in them, with them, by them;
Hence what Omnipotence alone could do,
Worms did.
I saw the living pile ascend,
The mausoleum of its architects,
Still dying upwards as their labours closed:
Slime the material, but the slime was turn'd
To adamant, by their petrific touch;
Frail were their frames, ephemeral their lives,
Their masonry imperishable. All
Life's needful functions, food, exertion, rest,
By nice economy of Providence
Were overruled to carry on the process
Which out of water brought forth solid rock.

Atom by atom thus the burthen grew,
Even like an infant in the womb, till Time
Delivered ocean of that monstrous birth—
A coral island stretching east and west." †

In the Pacific and Indian oceans are four different kinds of coral formations, all the results of the labours of these minute organic beings. Dr. Darwin describes them as Lagoon islands, or Atolls; Encircling reefs; Barrier reefs; and Coral fringes. The Atolls are only found in the Pacific and Indian oceans; the others in every Tropical sea.

An Atoll is a ring of coral which incloses a lagoon or circular tract of ocean in its centre. That part of the ring which rises above the water is generally about a quarter of a mile in breadth—frequently, much less—and seldom rises higher than from six to twelve feet above the water. Consequently, they are not discernible even at a small distance, unless they happen to be covered with a leafy growth of the screw-pine, palm, and cocoa-nut. On the outer side this coral circle shelves down for some one hundred or two hundred yards, and the sea gradually deepens to twenty-five fathoms; beyond which it plunges straight down into the unfathomable depths of ocean, like the precipitous sides of an abrupt volcanic cone. Even at the distance of some hundred yards, says Mrs. Somerville, no bottom has been found with a sounding-line one mile and a half in length.

* Captain Basil Hall, Narrative of a Voyage to Loo Choo, &c.
† James Montgomery, The Pelican Island.

All the coral at a moderate depth below water is living; all above is dead—being the debris of the living masses, washed up by the incessant action of a seething and waving surge.

On the lagoon side the water is necessarily calm—as calm as a mountain-lake on a silent summer's day. There the encircling coral chaplet shelves into the sapphire waves by successive terraces or ledges; also of living coral, but not of the same species as those which lay the foundations and build the exterior wall. It has been suggested that the luxuriant growth of the latter is promoted by the perpetual change of water with which the breakers bring them in contact. But the same cause operates to deprive the whole of the coral in the interior of the more nourishing part of their food; and species of a more delicate kind and a slower growth take the place of the hardier corallines.

The depth of the lagoon varies, in different atolls, from twenty to fifty fathoms, the bottom being partly detritus and partly living coral. Owing to the coral-growth a few of the lagoons have been filled up; but, for the reasons already stated, the process is very slow, and the growth of the coral is also checked by the depredations of various marine animals. For here, as in all nature, operates the great law that the prodigal increase of one genus is always checked by the innate hostility of another.

The coral is of the most varied and graceful configurations and the most exquisite tints, which gleam beneath the azure waves like a rainbow against a blue sky: dark brown, rich lustrous purple, vivid emerald green, orange, pink, peach-bloom, dazzling white. Among the gay branches of this submarine garden dart fish of the most splendid hues, and the whole scene is one of a fairy character, with a peculiar and flaunting beauty distinctively its own.

Lagoon islands are sometimes circular in form, but more frequently oval, or else entirely irregular. They are frequently found in groups; sometimes they lie scattered over the ocean, like dropped pearls; and very generally they occur in elongated archipelagos. In size these "fairy-rings of ocean," as they have been happily called, vary from two to ninety miles in diameter, and islets are frequently formed upon these by the accumulation of the detritus, which the atmospheric influences reduce, in due time, into a kind of soil. Here the sea-birds drop a few seeds brought from remote lands or other islands; grasses and mosses spring into existence; the palm tree uplifts its slender columnar stem; and before long a miniature world is formed. Those atolls, which are not filled up, furnish in their lagoons the most admirable harbours.

Encircling reefs resemble atolls in every respect but this; they inclose within their ring one or more islands, generally mountainous, at a distance of two or three miles from the shore, and separated by a channel two hundred or three hundred feet in depth. Tahiti, the largest of the Society Islands, is an instance of this kind. The lagoon encompassing it is like "an enormous moat," thirty fathoms deep, and divided from the ocean by a rampart of coral, at a distance varying from half a mile to three miles.

Barrier reefs only differ from the latter in their position with regard to the land. They skirt the shore in an elongated direction, like the great Australian barrier reef, which extends one thousand miles along the north-east coast of the continent of Australia. The long ocean-swell of the Pacific, being suddenly impeded by this colossal barrier, lifts itself, says Mr. Jukes, in one great continuous ridge of deep blue water, which, curling over, falls on the edge of the reef in an unbroken cataract of dazzling white foam. Each line of breaker runs often one or two miles in length, with no break perceptible in its continuity. There is in such a scene a display of power, grandeur, and beauty, which almost rises to the sublime. The unbroken roar of the surf, with its regular pulsation of thunder, as each successive swell falls first on the outer edge of the reef, is almost deafening, yet so deep-toned that it interferes not with the slightest nearer and sharper sound. Both sound and sight are such as to impress him who hears and sees with a consciousness of standing in the presence of an overwhelming majesty and power.

Coral reefs, or fringes, are mere edges of coral lining the margin of a shore, and as they frequently surround shoals, they are regarded by the mariner with just apprehension.

Lagoon islands, as already stated, are built up by various species of polypes, the most vigorous being engaged in the erection of the exterior wall. Even these, however, cannot exist at a greater depth than twenty or thirty fathoms, and they die immediately the water ceases to cover them. Yet the coral precipice shoots down to awful depths, and though the whole of it is not the work of the corallines, the perpendicular thickness of the coral is known to be very great, and to extend *hundreds of feet below the depths* at which they cease to live. How is this phenomenon to be explained?

The theory put forward by Von Buch is, that the coral ring is only the edge of a submarine elevation crater; the latter having served as the foundation on which the animalcules have raised their structure. In support of this view its advocates refer to the circumstance of a lagoon island having been seen to rise in 1825, in latitude 30° 14′, accompanied with smoke; and to the resemblance between the shape of many lagoon islands and well-known volcanic craters.

Another theory—Dr. Darwin's—is so concisely stated by Mrs. Somerville that we shall give it in her words:* —"Since there are certain proofs that large areas of the dry land are gradually rising and others sinking down, so the bottom of the ocean is not exempt from the general change that is slowly bringing about a new state of things; and as there is evidence, on multitudes of the volcanic islands in the Pacific, of a rise in certain parts of the basis of the ocean, so the lagoon islands indicate a subsidence in others—changes arising from the expansion and contraction of the strata under the ocean bed.

"There are strong reasons for believing," continues Mrs. Somerville, "that a continent once occupied a considerable area of the Tropical Pacific; and that some

* Mrs. Somerville, Physical Geography.

portion of it subsided by slow and imperceptible degrees. As tracts of it gradually sunk below the surface of the deep, the summits of mountains and table-lands would remain as islands of different magnitude and elevation, forming archipelagos elongated in the direction of the mountain chains. Now the coralline which constructs the exterior wall and mass of the reefs never builds laterally, and cannot exist at a greater depth than twenty-five or thirty fathoms. Hence if it began to lay the foundation of its reef on the submerged flanks of an island, it would be obliged to build its wall upwards in proportion as the island sunk down, so that at length a lagoon would be formed between it and the land. As the subsidence continued the lagoon would decrease, the island would diminish, and the base of the coral reef would sink deeper and deeper, while the animal would always keep its top just below the surface of the ocean till at length the island would perfectly disappear, and a perfect atoll be left. If the island were mountainous, each peak would form a separate island in the lagoon, and the encircled islands would have different forms, which the reefs would follow continuously."

Between the two hypotheses we leave the reader to choose. Probably both may be true, and certainly both are compatible with each other.

SEA ANEMONES.

Various species of Sea Anemones, and particularly those which it is customary to keep in Aquaria, are represented in our Illustration. Figs. 1, 2, and 3 are the *Actinia sulcata*, which some authorities will not recognize as a separate species, but believe to be the young of *Actinia effœta* (Linnæus). It is also cited as a synonym of *Anthea cereus*, from Michael Drayton's couplet in his "Polyolbion:"—

> "Anthea of the flowers, that hath a general charge,
> And Syrinx of the weeds, that grow upon the marge."

Fig. 4 is the *Phymactis Sanctæ Helenæ*, so named by Milne-Edwards from one of its favourite habitats; Fig. 5, the *Actinia Capensis* of Lesson; Fig. 6, *Actinia Peruviana* (Lesson); Fig. 7, *Actinia Sanctæ Catherinæ*; Fig. 8, *Actinia amethystina* (Quoy); and Fig. 9, *Comactis viridis* (Milne-Edwards).

The latter, or Green Actinia, is an exquisitely beautiful creature; the brilliancy of its hues and the extraordinary gracefulness of its tentacular crown, when fully expanded, render it peculiarly attractive. Hundreds, says Professor Allmann, may often be seen in a single pool, and few scenes can give greater delight to the naturalist than that in which these little Zoophytes figure, when they unfold their emerald and rosy crowns amid the algæ, millepores, and feathery corals, the co-tenants of their rocky home. The Green Actinia is much esteemed in Greece, Italy, and Provence as a table dainty. Other species, as *Actinia dianthus*, *Actinia crassicornis*, and *Actinia coriacea* are spoken of as savoury food.

The first section of the Antiniadæ includes the genera Anemonia, Actinia, and Metridium. We proceed to notice a few of the more remarkable species.

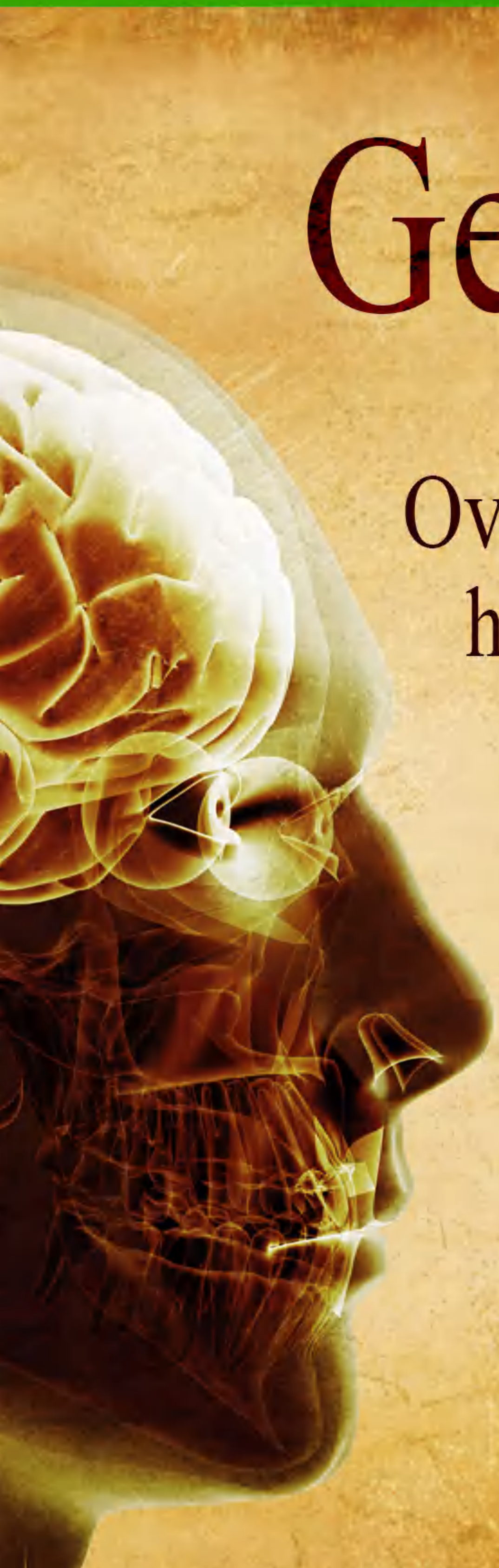
Actinia viridis has very numerous tentacula (sometimes not less than two hundred), exceeding in length the breadth of the body, of a beautiful brown or olive green, with a shade of rose at the extremity. The trunk is of a greyish green or brown; the disc brown, with greenish rays. This species abounds in the Mediterranean and in the English Channel. When adhering to the sides of a rock a little below the surface of the water—a position in which it is often found in the Mediterranean—the tentacles hang suspended as if the animal lacked room to extend them in their radiate form; but when swimming horizontally in a tranquil sea, they are outstretched in all directions, and kept in a state of continual agitation. Fully expanded, they float and balance themselves in the water, despite its incessant motion, and the anemone sparkles in the emerald depths like a globe of fire. When numbers of them are assembled, the spectacle is at once strange and interesting, recalling to the spectator's mind the beautiful description of Charles Kingsley:—

> "Onward they came in their joy, and around them the lamps of the sea-nymphs,
> Myriad fiery globes, swam panting and heaving; and rainbows,
> Crimson and azure and emerald, were broken in star-showers, lighting
> Far through the wine-dark depths of the crystal, the gardens of Nereus,
> Coral and sea-fan and tangle, the blooms and the palms of the ocean."*

Actinia dianthus (known also by a variety of confusing and perplexing synonyms) has a smooth cylindrical body; its disc is marked in the centre with clavate radiating bands; the tentacula are numerous, irregular, the outer of small dimensions, and the whole forming an edge or fringe of thick filaments. It is the character of this species to attach itself permanently to rocks, shells, and other objects in deep water, or below low water-mark, and it cannot be removed without organic injury to the base. When contracted, the body presents a short, thick, sub-cylindrical form about three inches in length and one and a half in diameter, or five inches if fully expanded. The skin is smooth, and either of a flesh colour, uniform olive, or yellowish creamy white. A ring of white bands radiating from the mouth ornaments the centre of the disc, and is intercrossed by the usual lamellæ — the tentacula originating from the colourless transparent interspaces. The margin is encircled by a dense fringe of great and sparkling brilliancy, composed of innumerable short tentacula or filaments, forming a thick, furry border.

The *Actinia mesembryanthemum* of Johnston, the *Actinia equina* of Lesson, known in France as the *Cul d'ane*, is frequently met with in the Channel on rocks lying between high and low water marks. Its favourite localities are those which the recession of the tide exposes to the air at regular intervals. Its body measures from two to three inches in height, and from one inch to one inch and a half in diameter; hemispherical in shape when contracted, but when dilated resembling a bell pierced at the summit. The ten-

* Kingsley, Andromeda, and Other Poems.



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in a calm sea. Handfuls of sand steeped in oil are thrown into the water all around the fishing-boat; the oil spreads over the surface, and smoothens it, by neutralizing the action of the atmosphere. The fishers can then see distinctly the sponges clinging to the ocean bed.

Sponge fishing is also carried on in the Gulf of Mexico, on the Bahama banks; the divers being English, American, and Spanish. As in this region the sponges grow at an inconsiderable depth, the divers have only to let themselves drop along a mast or pole moored to the boat's side.

The fishing being over, the boatmen press the sponges tightly, tread them under foot, and wash them repeatedly, first in sea-water and afterwards in fresh water, until they are entirely cleansed from their gelatinous mucus. Afterwards they are soaked for a short time in hot water, to free them as much as possible from the chloric odour peculiar to them, and due to the animal matter absorbed in their fibrous tissue.

The various kinds of sponges which figure in commerce are distinguished by differences of appearance and texture.

The fine soft *Syrian* Sponge is remarkable for its lightness, its blonde colour, its cup-like form, and its peculiar surface; which is convex, voluted, and pierced with innumerable minute orifices; the convex part furrowed by considerably larger canals, that pierce through the entire mass. This sponge is occasionally blanched by means of caustic substances, acids, or alkalies; but this process changes its colour and renders it less durable. It is used for toilet-purposes, and its price is high.

The *Fine Sponge of the Archipelago* can hardly be distinguished from the Syrian, either before or after it is cleansed; it is, however, of greater weight, of coarser texture, and pierced with fewer but larger holes.

The *Hard* or *Greek Sponge* is inferior to both the preceding, but has its value for domestic and certain industrial purposes. Its mass is irregular, its colour fawn; it is hard, compact, and pierced with small holes.

The *White Sponge of Syria*, called Venetian, is esteemed for its lightness, solidity, and regularity of form. In its rough state it is brown of colour, fine in texture, compact, and firm. When purified, its texture becomes looser, and its colour yellower. The orifices of the great furrows or tubes which penetrate it are lined with rough bristly hairs.

The *Brown Barbary Sponge*, or *Marseileise*, when first brought from the water, is a flattened elongated body, gelatinous, circular of shape, and charged with blackish mud. It is then coarse, hard, heavy, but compact, and of a reddish colour. By simply washing it in water it becomes round and globular, but still remains heavy and reddish. Owing to its facile absorption of water and remarkable strength, it is much esteemed for domestic uses.

Other sorts of sponge are very abundant.

These are—the Blonde Sponge of the Archipelago, which must not be confounded with the Venetian; the Hard Barbary Sponge (or Gelina), occasionally imported into England; the Salonica Sponge, which is only of medium quality; and the coarse, cheap, Bahama Sponge from the West Indies.

Regarding SPONGES as apolypiferous zoophytes, Dr. Grant has arranged them in the following groups:—

I. *Groups of which the Constituent Structure is known.*

Spongia; Calcispongia; Halispongia; and Spongilla.

II. *Groups depending on Characters of Surface or General Figure.*

Geodia; Cœloptychium; Siphonia; Myrmecium; Scyphia; Eudea; Halirrhoa; Happalimus; Cnemidium; Ierea; and Tethium.