

ICHTHYOLOGY.¹

By John Richardson

Intro-
duction.

INTRODUCTORY CHAPTER.

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duction.SECTION I.—DEFINITION AND GENERAL OBSERVATIONS. THE
PRINCIPAL EPOCHS IN THE SCIENCE OF ICHTHYOLOGY.
VERTEBRALS.

FISHES may be technically defined as *vertebrated animals with red blood, breathing through the medium of water by means of branchiæ or gills*. This definition, as Baron Cuvier has remarked, is the result of observation; it is a product of analysis, or what is termed in physics an empirical formula; but its accuracy is demonstrable by the inverse method, for, when once duly perceived, we may, in a great measure, deduce from it a knowledge of the entire nature of the beings to which it is applied. Being vertebrated, they must be possessed of an internal skeleton; of a brain and spinal marrow, inclosed in a vertebral column; of muscles exterior to the bones; of four extremities only; and of the organs of the first four senses, situate in the cavities of the head; with other relations not necessary to be here named.

The greater portion of the surface of the earth is covered by the waters of the translucent sea; and wherever continents and the larger islands protrude their rocky bulk, we find them coursed by flowing rivers, or intersected by lakes and marshes. These present in their aggregate an enormous mass of waters, and afford protection and nourishment to myriads of living creatures, probably superior in number and in no way inferior in beauty, to those which inhabit the earth. On land, the matter susceptible of life is mainly employed in the construction and continuance of vegetable species; from these, herbivorous animals draw their nourishment; and this being animalized by assimilation, becomes an appropriate food for the carnivorous kinds, which scarcely amount to more than one-half of the terrestrial creatures of all classes. But in the liquid element, and more especially among the saline waters of the ocean, where the vegetable kingdom is so much more restricted, almost all organized substances are pervaded by animal life, and each lives at the expense of some smaller or feebler foe. There we meet not only with the greatest and most wonderful variety of forms, but also with the extremes in respect to size,—from the myriads of microscopic monads, which, but for artificial means, must have remained for ever invisible and unknown, to the ponderous whale, which surpasses, by twenty times, the bulk of the largest elephant. There, too, we may discover the majority of those magnificent combinations of organic structure, on the relations of which naturalists have established the distinction of classes, or great primary groups; in other words, the sea may be said to contain representatives of each; for, even among birds, those aerial creatures which usually inhabit so light an element, we find species so constructed as to dwell almost for ever on its waves. The mammiferous

class is still more fully represented in the numerous tribes of seals, morses, manaties, and whales, all of which require a moist abode, and some of which immediately perish when deprived of it. Most reptiles are aquatic, many insects are so, more particularly in their larva state; and almost all the Mollusca, the Annelides, the Crustacea, and Zoophytes, four great classes, which on *terra firma* are few and far between, exist in countless numbers in the waters of the ocean. Hence that ancient dictum recorded by Pliny, “*Quicquid nascatur in parte naturæ ulla, et in mari esse; præterque multa quæ nusquam alibi.*”

But amongst all the teeming wonders which vivify the vast expanse and liquid depth of waters, none so predominate, or are so truly characteristic, as the subjects of our present treatise; nor are any more worthy of our careful consideration, whether we regard the beauty or eccentricity of their forms, the metallic splendour of their colours, or the innumerable benefits which, through the foresight of Providence, they confer upon the human race. We therefore deem it incumbent upon us to exhibit an ample view of the present condition of Systematic Ichthyology; but before doing so, we shall endeavour to add to the interest of the subject by a few general observations.

We may state, in the first place, that we here intentionally refrain from any bibliographical inquiry, or historical exposition of the progress of Ichthyology. If such were complete, or even ample, it would occupy too much of that space which we deem more usefully devoted to the actual condition of the science; and we more willingly set that department aside, when we consider how perfectly it has been presented by Baron Cuvier.² We shall, however, briefly allude to what may be regarded as the principal epoch in the progress of Ichthyology. During many remote ages it consisted, in common with all the kindred branches of human knowledge, of nothing more than a few partial and disjointed observations. Aristotle, about 350 years before the Christian era, made some progress towards connecting these together as a body of doctrine; but still it was a feeble body, reposing upon truths (perceived indeed with surprising skill when we consider the scanty data) as yet obscurely known and vaguely expressed, owing to the entire absence of all proper standards for the distinction of species. For more than eighteen hundred years ensuing, the writers on natural history can scarcely be regarded in any other light than as either copiers or commentators of Aristotle; but about the middle of the sixteenth century, Belon, Rondelet, and Salviani, the true founders of modern Ichthyology, made their appearance (we mean as authors), by a singular coincidence, almost precisely at the same time,—the first in 1553, the second from 1554 to 1555, and the third from 1554 to 1558. Differing from their compiling predecessors, they saw and examined for themselves, and made drawings from nature, if not with the elegant accuracy of modern days, at least with a recognisable exactness. Yet, true to the ge-

¹ From *ἰχθύς*, a fish, and *λόγος*, a discourse.

² See the *Tableau Historique des Progrès de l'Ichthyologie, depuis son origine jusqu'à nos jours*, in the first volume of the great though unfortunately uncompleted work, the *Histoire Naturelle des Poissons*. We deem ourselves fortunate beyond our predecessors in encyclopædic labour, in having as a guide in so difficult a subject as that on which the reader is about to enter, the volumes of Baron Cuvier's and M. Valenciennes' signal publication. As far as this great work extends we have availed ourselves of the labours of its authors, and have endeavoured to present the general and miscellaneous information scattered through it, as amply as our limits would permit, and in a form and sequence the most advantageous to those unacquainted with the voluminous original. In the present revision of this treatise we have also borrowed freely from the writings of our British Cuvier, whose work on the *Comparative Anatomy and Physiology of Fishes*, forming part of his Hunterian Lectures, gives the fullest and most accurate view of the animal economy of fishes, and most philosophical account of the skeleton, that have hitherto appeared. We beg also to repeat our acknowledgments to Mr Couch, the acute discoverer and describer of new species frequenting the Cornish coasts, and Mr Yarrell, whose work on *British Fishes* is *facile princeps* among works illustrative of local Ichthyology.

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nus of their time, they continued to attach much more importance to the ascertainment of the names which the species bore in the classical pages of antiquity, than to the composition of their history, as it were afresh, by the light of nature and their own knowledge. Nevertheless, they rectified as well as extended the observations of Aristotle, and laid a positive foundation of the subject, by figures and descriptions of a certain number of well-determined species. About the close of the seventeenth century, Willughby, and his illustrious friend John Ray, gave for the first time a history of fishes, in which the species were not only clearly described from nature, but distributed in accordance with characters drawn solely from their structure, and in which we are no longer unnecessarily burdened with inapplicable passages from either Greek or Roman writers. Finally, about the middle of the eighteenth century, Artedi and Linnæus completed what the others had commenced, by establishing well-defined generic groups, consisting of ascertained species precisely characterized. From that period it may be said that no radical defect existed, nor any obstacle in the way of a gradual perfecting of the system, which could not be overcome by zeal, accuracy, and perseverance. Nevertheless, it is to the genius of Baron Cuvier that we owe the gigantic stride which has been made in our own more immediate days.

It is only by a profound study of the whole animal structure that we can, to the extent of our limited intellect, correctly appreciate that part of the works of the great Creator, and get some insight into the branching and anastomosing affinities by which the almost numberless kinds of living beings are linked together. Many years spent in anatomical investigations gave Baron Cuvier such a knowledge of the mutual dependence of the various parts of the organism of each of the numerous species which came under his observation, that he was able, from the inspection of a single bone, to reconstruct, mentally as it were, the animal to which it had belonged, and to assign the species its place in the system of nature. This great step in the history of Zoology placed its discoverer in the first rank of the cultivators of the science. In none of the greater divisions of the animal kingdom were Cuvier's labours, in forming a natural arrangement of the species, of more value than in the class of Fishes, the lowest of the *vertebrata*, or of that division of animals whose proper character consists in the possession of a *central bony axis on which the soft parts are sustained, and from which the motive powers diverge*. The Latin word used above has been adopted into the English scientific language, though by many the more Anglicised term of "vertebrals" is used, and we call the internal chain of bone the vertebral column, while its several successive component joints are named "vertebræ." The German equivalent of *vertebrata* is "wirbelthiere."

We must remark, at the outset, that neither this term of *Vertebrata*, nor any other definition of a group which the ingenuity of man has hitherto devised, is logically correct. In Mammals, indeed, the highest class of the division, the internal bony frame is strong and massive, and fitted to support the limbs, by which, with the firm earth for a fulcrum, the animal moves through a medium greatly lighter than itself. In Birds, too, constituting the second class of the division, the bones of denser texture but more slender form and often hollow, are admirably fitted for sustaining the powerful muscles exercised in the maintenance of extended aerial flight; and in both classes, the turning joints of the vertebral column, and more especially of the cervical portion of it, are adapted to the various motions of the ani-

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mal, and for enabling it to rotate its head from side to side, and survey whatever comes within its field of vision. As we descend to the less highly organized vertebrals, we come to other and remarkable modifications of the spinal column. In the third class, or the Reptiles, there is one order, namely, that of the *Ophidia*, or Serpents, whose locomotion is performed by creeping without external limbs, and solely by the flexibility of the vertebral column and the muscles attached to it, and to its appendages the ribs. The vertebræ are accordingly much more numerous in these animals than in any others, and their motions on each other more extensive. In another group of the same class the vertebræ of the body are soldered together by bone, and power of motion is preserved only in the neck and short tail. A third group, named Amphibians, are fishes in their embryo or tadpole condition, and undergo a kind of metamorphosis in becoming terrestrial and air-breathing creatures. A fourth remarkable group, of which only a few species have been hitherto detected, presents, with much of the piscine form, the peculiarity of the existence of both gills and lungs, and a residence in water during life. In the Fishes, the proper subjects of this treatise, and the lowest class of vertebrated animals, there is a large group named by some authors *CARTILAGINEI*, or *CHONDROPTERYGII*, because the internal skeleton remains in the state of cartilage, the bony structure being wholly absent in some species, and in others only very partially present; and thus the precision of one part of the character of the *vertebrata* given above is impaired. In certain of the *Cartilaginei* the joints of the column are obsolete, and flexibility is substituted for the turning motions indicated by the word *vertebræ*. These brief notices point at some of the difficulties which beset the zoologist when he endeavours to convey the knowledge he has acquired to others, by concise and definite phrases. Yet however difficult it may be to construct a correct definition, it is certain that the idea of the type of an animal group may be conceived in the mind, on the basis of exact observation and legitimate deduction, in proof whereof the reader is confidently referred to the works of Professor Richard Owen of the British Museum, and particularly to his treatise *On the Archetype and Homologies of the Vertebrate Skeleton*.¹

The vertebrated animals agree in having a spinal chord or elongated bundle of nervous filaments running along the body, and protected by bony arches composed of the neural apophyses, or processes which rise upwards from the body or centrum of each vertebra. The anterior expansion of the spinal chord, named the brain, is most fully developed in the higher classes of vertebrals, and is comparatively very small in fishes whose encephalon has the character of a series of ganglions, or knots of nervous matter, arranged in single succession or in pairs. In the lowest known form of fish, the Lancelet, the whole vertebral column is merely a pulpy nervous chord invested by a membranous sheath; and Pallas, the first describer of this animal, ranked it, in accordance with the progress that science had made in his time, among the Slugs. In all the vertebrals the vascular trunks and organs of digestion are protected by the inferior processes and diverging appendages of the vertebræ; and the type of this division of animated beings is essentially tetrapodal (fig. 1), though in some groups one or both pairs of limbs are either rudimental or absolutely wanting—examples of these deviations from the ordinary type being most frequent in the classes of Reptiles and Fishes. The four limbs are produced in lateral pairs; and in fishes the first pair are named pectoral fins, and the second pair, being situated on the ventral aspect of the fish, are called ventral

¹ *On the Archetype and Homologies of the Vertebrate Skeleton*, 8vo. London, 1849. Also *Report of the British Association, 1846—On the nature of Limbs*; Richard Owen, &c., 8vo. London, 1849.

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fins, even though their relative position, as is the case in some kinds of fish, should be in front of the pectorals, when they



Fig. 1.

Cheironectes caudimaculatus of the family of Lophiidae.

obtain technically the name of jugular fins. In the above woodcut we have a front view of *Cheironectes caudimaculatus*, belonging to a group of fish which actually walk at times on their four limbs. The vertical fins of fishes are of a different nature, and the rays which support them, whether jointed and soft, or hard and spinous, are not parts of the interior skeleton, but belong properly to the skin or dermal skeleton. The fins that rise vertically in the mesial plane of the back, whether one or more, are named "dorsal." Those from the opposite ventral aspect, situated in all cases posterior to the vent, and therefore appertaining truly to the tail, are termed "anals," and the solitary fin at the end of the tail is named the "caudal." Artedi denominated the fish which have spinous rays on the back, Acanthopterygians, and those which have only flexible and jointed rays, Malacopterygians—other groups having however been previously detached by the forms of their branchial apparatus, or the cartilaginous condition of the skeleton. Among the Reptiles there are species which have dermal crests on the back or tail, supported by rays, and analogous to the vertical fins of fishes.

In the great majority of vertebrals a lateral symmetry exists externally and in the skeleton; only one group of fishes, namely, the Flounder family, presents a remarkable dissimilarity in the two sides of the fish.

All the vertebrals also agree in the separation of the sexes, two individuals being required for the reproduction of the species.

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By using the comparative terms of highest and lowest class of vertebrals, we do not imply that there is any deficiency in the structure of fishes which constitute the fundamental group, for every creature was perfectly organized when called into existence by the fiat of the Creator for the functions he destined it to perform; but He, having designed the fishes to play a part in the scale of nature requiring less intelligence, has furnished them with a simpler nervous system and less sentient organs, a more obtuse sense of touch, restricted organs of smell and taste, and an acoustic apparatus shut up within the head, without any exterior ear or auditory canal for collecting and conveying the vibrations by which sound is produced and transmitted. Light being required to enable the fish to discover its prey or avoid its enemies, the eye is larger in many of them

than in other vertebrals, and only in a very few diminutive or almost obsolete. Lubricated by the surrounding medium, it needs no lachrymal gland; and as the light is tempered greatly by a small increase of the depth at which a fish glides through the water, few species have anything like eyelids or nictitating membranes. The function of nutrition is very active, the appetite being very generally voracious, digestion remarkably rapid, and the growth, when suitable food is abundant, extremely rapid. The reproductive power, also, is exceedingly great. Destined to pass their whole lives in a medium whose variations of temperature are much more limited than that of the atmosphere which the other vertebrals breathe, but whose conducting power is greater, the temperature of fishes exceeds only by a few degrees that of the water in which they swim, and their blood is cold. A less vigorous respiration, therefore, suffices to keep up the animal heat, and the oxygenation of the blood is accomplished by the agency of the water on certain vascular organs named gills. Through these organs venous blood is propelled by a simple heart, consisting of one auricle and one ventricle. In these and various other parts of their organization, fish preserve permanently structures that exist in the higher vertebrals only in an early stage of their embryonic development. Palæontologists have ascertained, moreover, that fishes were the first of the vertebrals which appeared on the theatre of the earth's history, and at an epoch long antecedent to the deposits in which the remains of the higher animals are found. These primitive fish, however, were not types of the lower forms of the class, but, on the contrary, many of them were powerfully built, and resembled the saurian reptiles in parts of their structure, so that they were at least on par with the more highly organized fishes of the present day. We have not learned that the remains of fish having the embryonic vermiform shape, have been discovered in the oldest ichthyogenous deposits.

The Salmon is a familiar example of one of the more common forms of a fish, and one frequently quoted as being pre-eminently qualified for cleaving through the liquid element in which it lives; but there is a vast variety of shapes to be found in the class. The common Salmonoid form

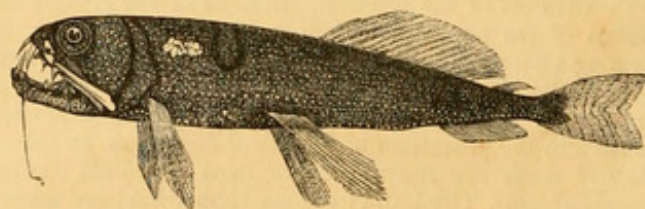


Fig. 2.

Astronesthes niger (*Chauliodus Fieldii*, Valenciennes), one of the *Scopelina*, a group of the Salmon family.

(fig. 2) of the osseous fishes passes in different species, by compression and abbreviation, to the thin vertical disks

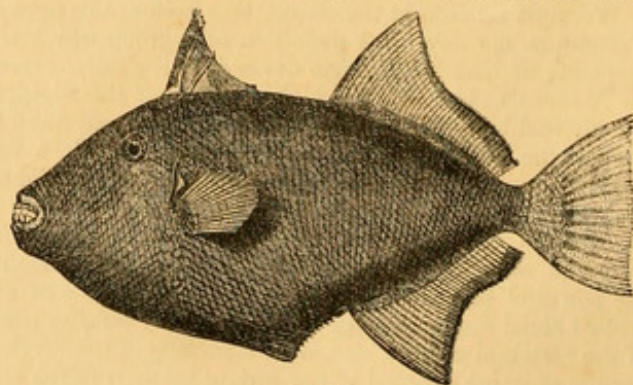


Fig. 3.

Melichthys vidua, one of the *Balistidae*, discovered on Cook's first voyage.

of the *Chaetodons* or *Balistes* (fig. 3), or, by compression and elongation, into the riband-form of the *Gymnetri* and

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Leptocephali (fig. 4). Totally opposed to these is the

Flounder family we have nearly the same external form produced by compression, and that lateral dissimilarity already alluded to. Other forms, curious from their gro-

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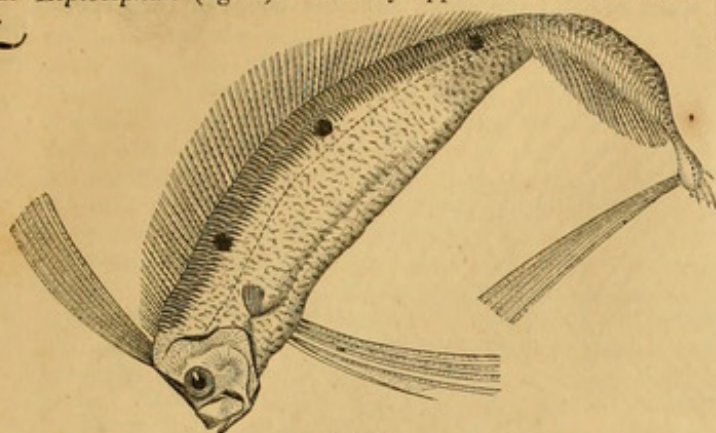


Fig. 4.

Trachipterus falx, an example of the thin elongated *Ternioidei* or Ribband-fish family—the *Gymnetridæ* of our table.

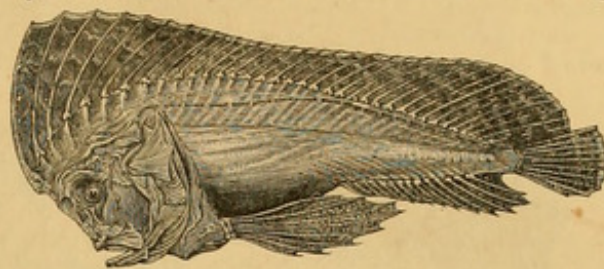


Fig. 8.

Patæcus fronto, one of the many singular forms which the *Lophiidae* exhibit. It was discovered by Governor Sir George Grey in South Australia. The generic name has reference to the figure-head of an ancient ship.

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tesqueness, or from the redundancy of certain parts, are not uncommon; and we need not adduce other examples than those which exist among the *Lophiidae*, *Gobiidae* (fig. 8),

square box-like shape of the cubical *Ostracion*s (fig. 5), the pyramidal form of others of that tribe, or the round bladder-like figure of the inflated *Diodon*s or the hard-scaled spheroid *Monocentris*. We

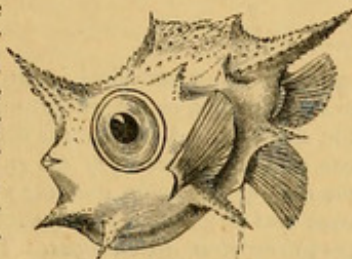


Fig. 5.

Centaurus boöps of the *Ostracionidae* discovered on Sir James Clark Ross's memorable voyage to the Antarctic seas.

have examples of a slender elongated cylindrical form among the *Syngnathidae* or Pipe fish, and among the Eels (fig. 6), Lampreys, and Sharks. Indeed, the vermiform type exhibited by embryos of vertebrals in their earliest stage, is persistent in many fishes, which by the assemblage of other points of their structure enter totally different groups. A depressed, dis-

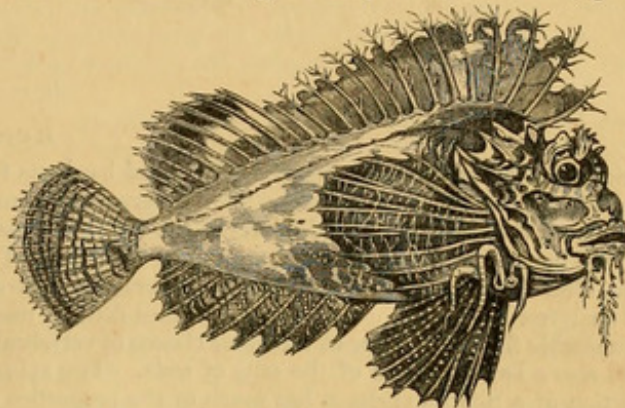


Fig. 9.

Choridactylus multibarbus, a member of the *Apistes* group among the *Sclerogenidae*, and furnished like the other *Apistes* with a treacherous spine on the preorbital scale bone. The free rays of the pectoral fin are organs of touch analogous to fingers, and similar to the free rays of the Gurnards, and many other fish that habitually frequent the bottom of the sea.

Pristidae, *Sclerogenidae* (fig. 9), *Siluridae*, or *Acanthuridae*. Some of the forms which we have thus noticed in general terms, and others which the woodcuts exhibit, are ill calculated for swift progression, and the small and delicate fins of the *Ostracion*s, for instance, can serve little more than the office of rudders to the inflexible scaly case from which they protrude. The chief organs of locomotion in the rapid swimming fish is the tail, which, in a majority of such fish, equals or far exceeds the trunk in length. It sculls a fish along like an oar worked at the stern of a boat. In the vermiform apodal fishes, and in many *Cartilaginei*, swift motion is produced by lateral undulatory strokes of the entire body and tail. When the body is suspended in an element of the same or nearly the same specific gravity with itself, it is moveable by a slight impulse; and we find, accordingly, that if the limbs exist, they are more tender than the analogous members of the higher classes, and that the want of one or both pairs is more common than in other classes.

Before we enter on the consideration of the proper vertebral skeleton, it may be well to premise that the bones, or hard parts of fishes, are primarily divisible into those of the—1. *Neuro-skeleton* or endo-vertebral series; 2. The *Splanchno-skeleton*, for the special protection of certain organs; 3. *Dermo-skeleton*, parts, as the name denotes, of the cutaneous system, and analogous to the exterior skeletons of the lower divisions of animals.



Fig. 6.

Channo-muræna vittata of the *Murenoid* family of *Apodals*. In this genus there are no fins, except a slight vestige of rudimentary rays at the end of the tail lying in the thick skin.

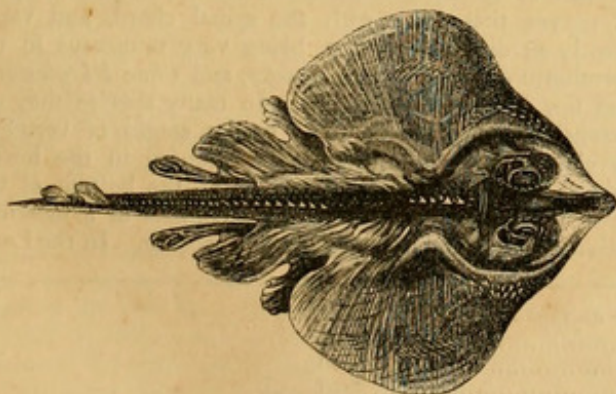


Fig. 7.

Raja Lemprieri, a Skate from Australia.

coid shape, with the appendage of a whip-like tail, is common among the Rays (fig. 7) and their allies; and in the

SECTION III.—THE OSTEOLOGY OF FISHES.

The structure and growth of bone have been described elsewhere; and it is sufficient to say here that it consists of animal matter, with diffused earthy particles, chiefly of

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phosphate of lime, which gives it its hardness. Of the vertebrals, birds have most earthy matter in their bones,

and fishes the least; but there is great variety in this respect even in the same class, the bones of each species

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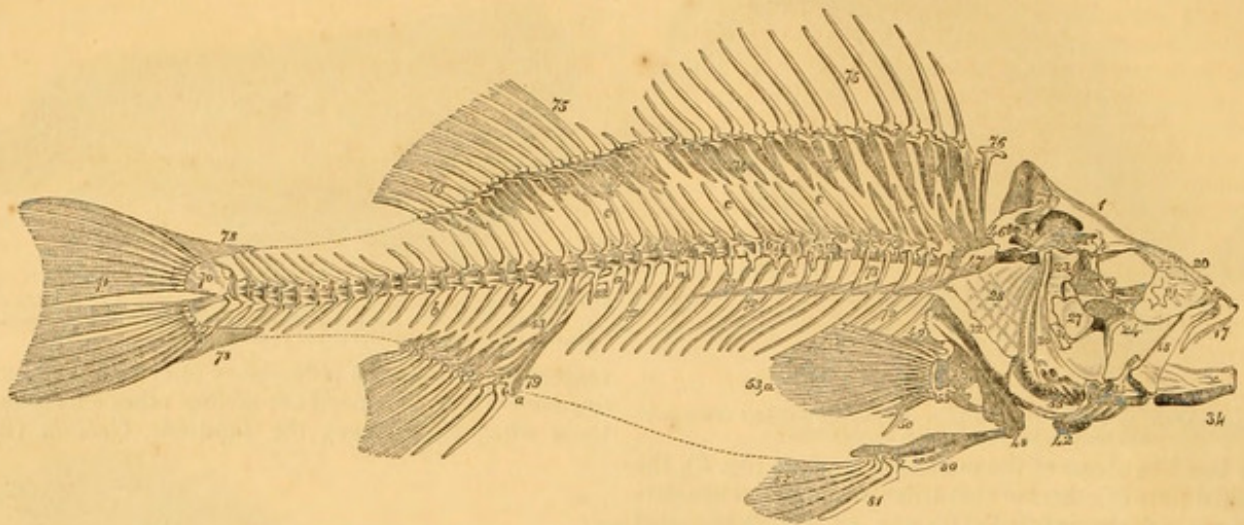


Fig. 10.
Skeleton of the Perch.

being adapted by their degrees of firmness and hardness for the shocks they have to sustain. The difference depends chiefly on the quantity of fluid matter in the cells and canals of the bone. In a note the composition of the bones of a cod, after the fluid portions had been evaporated, is given as analysed by Bibra.¹ The bones of fishes contain more evaporable fluid than those of the other classes of vertebrals, and also a larger portion of the salts of soda. The animal portion of a Shark's skeleton has much of the properties of mucus, yields no gelatine when dissolved in boiling water, and is not precipitated from the solution by infusion of galls, in which respect it differs from the cartilaginous foundation of the bones of beasts. The unossified skeleton of the Lamprey holds only 1½ per cent. of earthy salts. In the vascular canals, which are permeated by the vessels that deposit the bone and carry on its circulation, there is usually some oil, which is composed chiefly of oleine, and is easily converted into soap, and then produces oleic acid, glycerine, and a minute portion of margaric acid. It has odour, and for the most part a yellow colour. In the Belone and Lepidosiren it imparts a deep green colour to the bones. The bones of fishes continue to grow in size almost throughout life.

The limits of this treatise do not admit of a detailed account of the skeleton and other parts of the structure of fishes, of all which, in connection with many admirable remarks on the homologies and analogies of the several parts of ichthyic structure with the corresponding parts of the other vertebrals, the student will find a full account in Professor Owen's *Lectures on the Comparative Anatomy and Physiology of the Vertebrate Animals*. So complete a work, so easy to be procured, renders it unnecessary to introduce more anatomical details here than are absolutely requisite for the understanding of the systematic review of the class which follows; and these we shall borrow from the work referred to, as being the best authority existing.

The first step in the knowledge of the skeleton of a fish,

or of any other vertebral, is the determination of the vertebral segments, or natural groups of bones which compose the skeleton. A vertebra is defined by the Professor to be *one of those segments of the endo-skeleton which constitute the axis of the body, and the protecting canals of the nervous and vascular trunks*: such a segment may also support *diverging appendages*. The elements of a vertebra are—1. The body or *centrum*, from which the others radiate; 2. *Two neurapophyses*, which, rising upwards, form the neural canal, that incloses and protects the longitudinal central chord of the nervous system; 3. *Two parapophyses* or transverse processes; 4. *Two pleurapophyses* or costal processes; 5. *Two hæmapophyses*, which form, with the centrum, a canal for lodging the central organ and large trunks of the vascular system. This canal is on the ventral, that is, the opposite side of the centrum to the neural one, and is less regular and more interrupted. 6. A *neural spine*, which crowns the neurapophyses, or is interposed between their tips, and is very conspicuous in the figure of the skeleton of the perch, as it is in most fishes. 7. A *hæmal spine*. 8. *Two diapophyses* or upper (anterior or proximal in fishes) transverse processes of human anatomy; and, 9. *Two zygapophyses* or oblique processes.

In fishes a complete typical vertebra can only be obtained from the head: in the rest of the column the hæmapophyses are always absent or unossified; their hæmal canal being formed by modifications of the parapophyses. The number of vertebræ is governed by the number of pairs of nerves that unite with the spinal chord, and varies greatly in different species, being very numerous in the vermiform or serpentiform *Apodes*, and some *Plagiostomi*, and few in the *Plectognathi*. In many species they are extensively anchylosed. The earlier stages of vertebral development are permanently represented in the lowest fishes. In the Lancelet, which is at the bottom of the scale, the entire vertebral column consists of a gelatinocellular chord and its membranous sheath. In the Lam-

¹ Chemical composition of bones of the cod after drying—

Phosphate of lime with trace of fluuate	57.29
Carbonate of lime.....	4.90
Phosphate of magnesia	2.40
Sulphate, carbonate, and chlorate of soda	1.10
Gluten and chondrin.....	32.31
Oil	2.00

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prey, cartilaginous arches and spines are added above the "chorda," in the membranous wall of the neural canal, and in the tail also beneath it. In the Sturgeon and Chimæra the bases of the cartilaginous arches inclose the "chorda." In the Lepidosiren, the neural and hæmal arches and their spines are ossified, but the centrums are still confluent as a dorsal membrano-gelatinous chord; and Agassiz has shown that this was the condition of the vertebræ of the most ancient fossil fishes—those of the Silurian and Devonian rocks. In many Sharks and Rays the "chorda" is encroached upon by osseous or cartilaginous convergent laminae, and by concentric, successively shorter, centripetally developed cylinders, and is thus reduced to a string of gelatinous beads, each bead occupying the interspace between the opposed concave surfaces of the vertebral bodies. This moniliform state of the "chorda" is persistent in most osseous fishes; whilst in some others the gelatinous biconical segments of the "chorda" are insulated by the completed centripetal process of ossification; and in one genus, the *Lepidosteus*, they are converted into osseous balls, fixed to the fore part of each vertebral body, which plays in the concavity or cup of the vertebra next in advance. The slightly compressible jelly-bags that fill the concave opposing articular surfaces of the vertebræ are admirable contrivances for facilitating the motions of the fish. The neural and hæmal arches and spines are bony in all osseous fishes; and in all fishes chondrification and ossification of the vertebral column commences in these arches. The skeleton of fishes presents many instances of what Owen terms "vegetative repetition of perivertebral parts." There being no distinct neck in fishes, we find no peculiar cervical vertebræ, the series posterior to the head consisting of abdominals and caudals. With the former the ribs are connected, and in the latter the hæmal canal is formed by the deflection and union of the parapophyses, as mentioned above. The pleurapophyses, or ribs, are generally articulated in fishes to the ends of the parapophyses, but in *Platex* and *Polypterus* they articulate with the bodies of the vertebræ. In the Salmon and Dory they continue to be attached to some of the parapophyses after these are bent down in the tail to form the hæmal canal and hæmal spines. The *Diodontidæ*, *Ostracionidæ*, *Fistularidæ*, *Syngnathidæ*, *Cyclopteridæ*, and *Lophiidæ*, are destitute of ribs.

Slender supplementary ribs often issue from near the head of the ribs, passing outwards and backwards from between the lateral muscles. Professor Owen names them "epipleural spines." They are highly developed in the *Salmonidæ*, *Clupeidæ*, and *Scomberidæ*. In the common Herring, dermal bones are connected with the lower ends of the ribs, and have been called, though erroneously, sternal bones, since they do not belong to the endo-skeleton.

In osseous fishes, imposed above the proper neural spines, there is a second row of spines belonging to the dermo-skeleton, of greater or less extent, and serving to support the dorsal fin or fins. From their bases other spines of an inverted shape usually descend into the intervals of the neural spines, and are hence named by Owen "interneural spines." These interneurals are sometimes in lateral pairs, as in the *Pleuronectidæ*, the *Chatodontidæ*, *Zeidæ*, and some other compressed fish.

The modifications of the dorso-interneural and dermal spines are repeated on the ventral aspect, posterior to the anus, producing inter-hæmal and dermo-hæmal spines which support the anal fin. Each dermal spine or ray is either readily divisible into two laterally, or presents a furrow indicative of a tendency to such a division. The caudal fin is extended also on compressed intercalary and dermal spines, diverging from a few coalescent and abbreviated caudal vertebræ. In the base of the caudal formed of these elements, the hæmal spines are more developed than the neural ones in very many species, as in the *Salmonidæ*, and

then they press upwards the short and almost obsolete vertebral centra which form the tip of the spinal column, and into which the spinal marrow is not extended. This larger development of the hæmal processes elongates the upper lobe of the fin, and gives a very unsymmetrical form to the caudal of Sharks, Sturgeons, and Elephant fish. Fishes pos-

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Fig. 11.
Hemiscyllium trispeculare, Australian shark of the family of *Seylliidæ*.

sessing such a caudal are named by M. Agassiz "heterocercal;" and those with a symmetrical caudal fin he denominates "homocercal," including, however, in the latter group the existing fish wherein the obliqueness of the caudal vertebræ does not affect, in a decided way, the shape of the caudal fin, the *Salmonidæ*, for instance, being homocercals.

Among the palæozoic fishes the heterocercal fishes greatly predominate; all that have been found in the magnesian limestone, and in older strata, having the superior lobe of the tail prolonged. The only existing osseous fishes that are recognised by M. Agassiz as heterocercal belong to the genus *Lepidosteus*.

The size, number, and shape of the vertical fins depends on the development and grouping of the accessory and intercalary spines, the proper neural and hæmal spines of the endo-skeleton showing no direct indication of the existence or position of those fins; but it is convenient to notice them in connection with the vertebral column, as the systematic arrangements of ichthyologists have had much reference to the number, relative position, and condition of the rays of those fins, in regard of their being simple and spinous, or jointed and forked. We have already noticed the terms Malacopterygian and Acanthopterygian as derived from these varieties of structure. Species occur among the *Gobiidæ* and some other families of fish, in which there is much difficulty in deciding to which of the two groups they belong. In the Lancelet and Lamprey, the dorsal and caudal fins are simply cutaneous folds, with scarcely distinguishable soft fibres for rays. *Synbranchus gutturalis*, and *Channomuræna*, have nearly obsolete rays at the tip of the tail only; and in *Gymnomuræna* the folds as well as rays are wanting. The interneural and dermal spines seldom coincide in number with the neural spines. They are often more numerous, but more frequently less numerous. The sucking apparatus on the head of the Remora is an assemblage of peculiarly modified and connected dermal spines. Great development of the dermal spines often renders

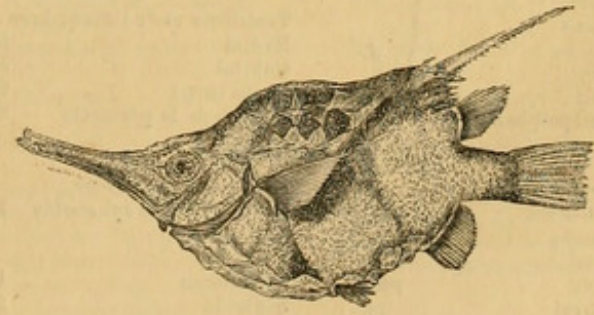


Fig. 12.
Centriscus humerosus of the *Fistularidæ*, representing in the Australian seas the Mediterranean "Snipe-fish."

them powerful weapons of defence, as in *Trachinus*. The *Chinæra*, *Cestracions*, Piked Dog-fish, and *Balistes*, are

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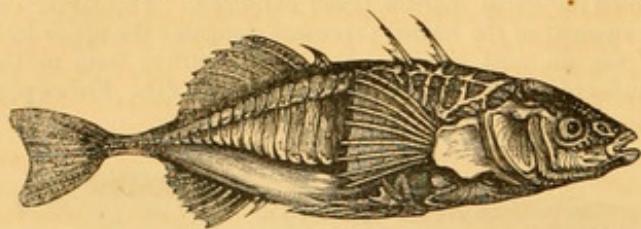


Fig. 13.

Gasterosteus insculptus, discovered by Sir Edward Belcher in the high latitude of 77°, at the northern outlet of Wellington Sound, when in search of Sir John Franklin.

tured bony spines in the ventrals as well as in the dorsals. In most *Siluridae* the pectorals are supported by a strong and dangerous spine. Many of the rays have detached serrated spines on the upper part of the tail; and in palæontology similar spines, named "Ichthyodorulites," are the sole indications remaining of the plagiostomes of for-

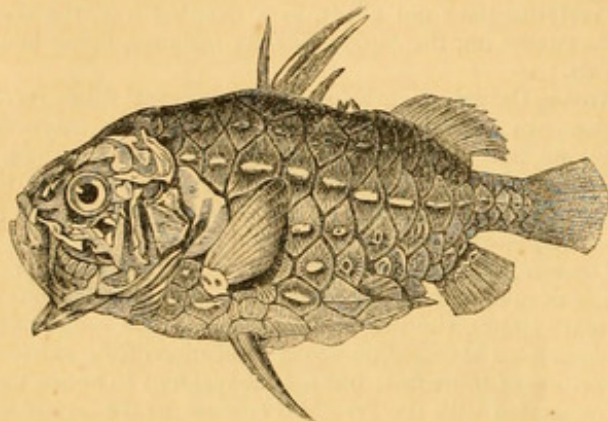


Fig. 14.

Monocentris Japonica.

mer epochs. The Siluroids and Trigger-fish (*Balistes*)

are remarkable among bony fishes for these dermal weapons.

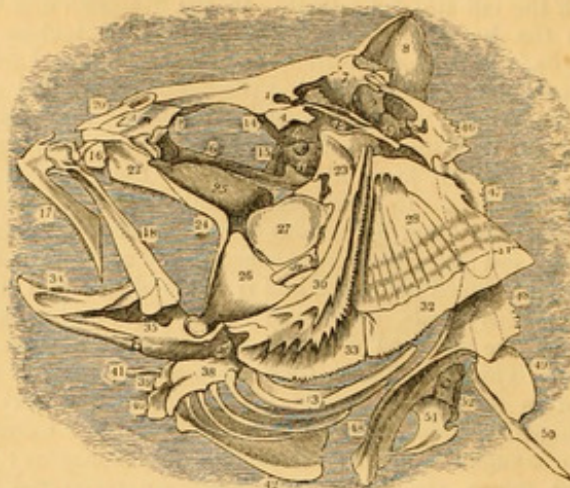


Fig. 15.

Skeleton of a Perch's Head.

That the skull¹ (fig. 15) consists of a series of four vertebrae modified for containing the cerebral enlargement of the anterior end of the nervous column, has been most fully demonstrated by Professor Owen. Each is divided into a *neural arch* with which the centrum and parapophyses are more immediately connected, and a *hæmal arch* with its appendages.

A. Beginning next the trunk, the following are the names of the neural arches in the order of their succession:—I. Epencephalic arch. II. Mesencephalic arch. III. Prosencephalic arch. IV. Rhinencephalic arch.

AA. The hæmal arches are,—1. Scapular or scapulo-coraoid. 2. Hyoid or stylo-hyoid. 3. Mandibular or tympano-mandibular. 4. Maxillary or palato-maxillary. The appendages of the hæmal arches are,—1st, The pectoral. 2d, The branchiostegal. 3d, The opercular. 4th, The pterygoid.

¹ For the sake of more clearly exhibiting the relations of the different members of the osteological system, and to furnish a key to figures, we here subjoin a TABLE of the names of the parts of the skeleton as fixed by Owen, with Cuvier's synonyms.

c. denotes centrum; n. neural arch; s. spine; par. parapophysis; pl. pleural arch; h. hæmal arch; hs. hæmal spine; d. diverging appendage.

The numbers after the French names have reference to figures 10, 15, 20, and 21.

ENDO-SKELETON.				FRONTAL VERTEBRA.			
OCCIPITAL VERTEBRA.				PRESPHENOID			
<i>Owen's Names.</i>				<i>Cuvier's Names.</i>			
Basi-occipital	c.	Basilaire	5.	Presphenoid	c.	Sphénoïde principale	5.
Exoccipital	n.	Occipital latéral	10.	Entosphenoid	n.	Aile orbitaire	14.
Supraoccipital	s.	Interpariétal	9.	Orbito-sphenoid	s.	Frontal principal	1.
Paroccipital	par.	Occipital externe	8.	Frontal	par.	Frontal postérieur	4.
Supra-scapula	pl.	Surscapulaire	46.	Post-frontal			
Scapula		Scapulaire	47.	Tympanic			
Coracoid	h.	Huméral	48.	Epitympanic	pl.	Temporal	23.
Clavicle				Mesotympanic		Symplectique	31.
Humerus	d.	Troisième os de l'avant bras		Pretympanic		Tympanal	27.
Ulna		Radial	52.	Hypotympanic		Jugal	26.
Radius		Cubital	51.	Mandible	Mâchoire inférieure		
Carpals		Os du carpe	64.	Articular	Articulaire	35.	
Metacarpo-phalanges		Rayons de la pectorale	65.	Surangular	Sûrangulaire		
PARIETAL VERTEBRA.				ANGULAR			
Basi-sphenoid	c.	Sphénoïde postérieur	6.	Angular	h.	Angulaire	36.
Alisphenoid	n.	Grande aile du sphénoïde	11.	Splénial	h.	Operculaire	37.
Columella				Dentary	hs.	Dentaire	34.
Parietal	s.	Pariétal	7.	Preopercular	d.	Pré-opercule	30.
Mastoid	par.	Mastoïdien	12.	Opercular		Operculaire	28.
Stylohyal	pl.	Styloïde	29.	Subopercular		Sous-opercule	32.
Epihyal	h.	Grandes pièces latérales	37. 38.	Interopercular	Inter-opercule	33.	
Cerato-hyal							
Basi-hyal	hs.	Petites pièces latérales	39. 40.	NASAL VERTEBRA.			
Glossohyal		Os lingual	41.	Vomer	c.	Vomer	16.
Urohyal		Queue de l'os hyoïde	42.	Pre-frontal	n.	Frontal antérieur	2.
Branchiostegal	d.	Rayon branchiostège	43.	Nasal	s.	Ethmoïde	3.
				Palatine	pl.	Palatin	22.
				Maxillary	h.	Maxillaire supérieur	18.
				Pre-maxillary	hs.	Inter-maxillaire	17.
				Entopterygoid	d.	Ptérygoïdien interne	25.
				Pterygoid		Transverse	24.

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B. The bones of the Splanchno-skeleton constitute in the skull,—*a.* The ear-capsule or petrosal and otolite. *b.* The eye-capsule or sclerotic and pedicle. *c.* The nose-capsule or ethmoid and turbinal. *d.* The branchial arches.

c. The bones of the Dermo-skeleton belonging to the skull are,—*a.* Supra-temporals. *β.* Supra-orbitals. *γ.* Sub-orbitals. *δ.* Labials.

A. I. The Epencephalic arch consists of the *basi-occipital*, on which there is an excavation similar to one on the first abdominal vertebra, and with which it is articulated through the intervention of a capsule filled with jelly. This articular cup varies from a deep conical excavation common to many fish, to the almost flat surface which it presents in the Holibut, and, what is extremely rare, to a convex surface as in *Fistularia*. In the Carp, the under surface of the basi-occipital forms a broad triangular plate, on which there is planted the large upper pharyngeal grinding tooth. This bone is the centrum of the arch. The ex-occipitals or neurapophyses are articulated one on each side to the basi-occipital, and, in most fishes, they expand on the upper surface of that bone, so as to meet and support the medullary column; but sometimes a space is left between them, as in the *Lepidosiren*, whose basi-occipital completes the *foramen magnum* of the skull. The *par-occipitals* form the upper lateral curve of the arch, and are wedged in between the ex-occipitals and the *supra-occipital*, which forms the key of the arch, and raises a strong compressed crest-like spine from the whole length of its mesial line; a transverse supra-occipital ridge coming from each side of the base of this spine runs outwards laterally to the external angles of the bone. The supra-occipital is separated from the frontals in the Salmonoid, Clupeoid, Cyprinoid, Murænid, and Salamandroid families; but, in the majority of fishes, it runs forward between the parietals to join the frontals. In *Lepidosteus*, it is itself divided by a median suture. In greatly compressed skulls, the occipital spine is usually very lofty; and, in *Ephippus*, its peripheral edge swells out like the crest of a helmet, whence the fish is named the Light-horseman. In depressed skulls, on the contrary, the spine is low and merely projects backwards, as in the Pike and Salmon; while in some it is wholly obsolete, as in the flat-headed *Remora*. In the unsymmetrical skulls of the *Pleuronectidæ*, it is pushed from its usual place by the par-occipitals, and one of its lateral plates is not developed. In

broad depressed skulls the *par-occipital* forms a strong crest, and exceeds the ex-occipital in size. In *Synodus*, *Callichthys*, and *Heterobranchus*, the par-occipital is visible only at the back part, not on the upper aspect of the skull. The outer projecting process supports the upper fork of the first piece of the scapular arch, sometimes, as in *Ephippus*, by a distinct articular cavity.

The members of the occipital vertebræ are the parts which are commonly most completely ossified, and in *Polypterus* they are ankylosed into one piece. Both the par-occipital and the ex-occipital are excavated for lodging the posterior and external semicircular canal of the enormous internal organ of hearing, and the acoustic capsule, or petrous bone, as it is named from its hardness, is intercalated between the par-occipitals and the ali-sphenoids. In the Carp, a chain of ossicles connects the air-bladder with the organ of hearing.

II. The Mesencephalic arch has for its centrum the *basi-sphenoid*, which is always connate with the pre-sphenoid (belonging to the next arch), and forms with it a long sub-triangular bone (basi-pre-sphenoid), usually split or forked posteriorly, more or less expanded beneath the cranial cavity, and then continued forwards, along the base of the inter-orbital space to near the fore part of the roof of the mouth, where it terminates by a cavity that receives the pointed end of the vomer. This end of the basi-pre-sphenoid is twisted up in the *Pleuronectidæ*. The longer and narrower the skull, the longer in general is the basi-pre-sphenoid. Rarely does any portion of it show on the floor of the cranial cavity, but in the Cod a small part supports the pituitary sac; in *Fistularia* a transverse ridge of it appears within the cranial cavity, and in some other fishes it sends a small process up on each side. The *ali-sphenoids* or neurapophyses of this arch are articulated firmly to the sides of the basi-sphenoid, their bases usually expanding over this bone so as to meet and form part of the floor of the cranial cavity. In some fishes, as in the perch and carp, these expanded plates of the bases are raised from the basi-sphenoid so as to form a sub-cranial canal which exists in the Salmonoids, Sparoids, Scomberoids, and is very remarkable in *Ephippus*, and most fishes that have lofty compressed skulls. It exists in some Clupeoids, but not in the Salamandroid fishes. In deep and compressed skulls the ali-sphenoids are narrow and

Ectopterygoid		
Malar		
Squamosal		
SPLANCHNO-SKELETON.		
CAPSULES OF ORGANS OF SENSE INTERCALATED WITH THE CRANIAL BONES.		
Petrosal } Acoustic	Rocher	13.
Otosteal } Acoustic		
Ethmoid and Ethmo-turbinal	Sphénoïde antérieur	15.
Turbinal	Nasal	20.
BRANCHIAL ARCHES.		
Hypo-branchial	Pièce interne de partie inférieure de l'arceau branchiale	57.
Cerato-branchial	Pièce externe de partie inférieure de l'arceau branchiale	58.
Epi-branchial	Partie supérieure de l'arceau branchiale	61.
Pharyngo-branchial	Os pharyngien supérieur	62.
DERMO-SKELETON.		
Supra-orbital scale-bone	Sur-orbitaire	
Supra-temporal scale-bone	Sur-temporal	72.
Sub-orbital scale-bones	Sous-orbitaires	19.
Lachrymal	Lachrymal	19.
Labial	Labial	
ENDO-AND EXO-SKELETON OF THE BODY AND TAIL.		
Abdominal vertebræ	Vertèbres abdominales	67. 68.
Caudal vertebræ	Vertèbres caudales	69.

Centrum	Corps du vertèbre	67. 68. 69.
Neurapophysis	Partie annulaire	
Neural spine	Apophyse épineuse	<i>c.</i>
Interneural spine	Interépineux	74.
Dermo-neural spine	Rayons dorsales	75.
Zygapophyses	Apophyses articulaires	
Parapophyses	Apophyses transverses	
Hæmal canal	Anneau inférieur	
Hæmal spine	Apophyse épineux inférieur	
Interhæmal spine	Interépineux	6.
Do., aggregated at base of caudal fin	Plaque triangulaire et verticale	70.
Dermo-hæmal spine	Rayon de l'anale et du caudal inférieur	78.
Spinous rays	Rayons épineux ou aiguilleux	75.
Soft-jointed or branching rays	Rayons articulés, mous ou branchus	71. 75-82.
Pleurapophysis or rib	Côte	72.
Epipleural spine	Appendice or stylet	73.
Ventral fins, being the hæmapophysis with diverging appendage of the last abdominal vertebra	Nageoires ventrales abdominales et subbranchiens.	
Pubic bone in fishes; the representatives of the femoral, tibial, and tarsal bones, are wanting	Un seul os représentant l'os innominé, la cuisse, la jambe, et le tarse	80.
Metatarso-phalangeal jointed rays	Rayons mous du nageoire ventrale	82.

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high plates, while in low and flat heads their longitudinal axis is the longest. In skulls of the ordinary form, they are sub-circular, and are perforated as in the Carp, or this perforation may be replaced by a deep anterior notch, as in the Cod. Its connections vary with its relative size, and, according as the petrosal, which interposes between it and the ex-occipital, is greater or smaller or wholly wanting. The *parietals* or spine of this arch are most commonly two in number. In the Cyprinoid and Salamandroid fishes, they unite above by a longitudinal suture (the sagittal); in the Cyprinoid *Catastomi* a mesial rectangular cartilaginous plate interposes between the ossified side plates; in the Salmonoids they soon coalesce; and in some Siluroids they coalesce with the supra-occipital as well as with each other. In the Pike, Perch, and Cod, and most osseous fishes, the parietals are separated from each other by an anterior prolongation of the supra-occipital. The *mastoids* or parapophyses of the parietal vertebra are interposed between the ali-sphenoids and parietals, and project outwards and backwards farther than the par-occipitals, forming the second strong transverse process at the side of the cranium. This process is developed from the outer margin of the bone. The inner side of the bone lodges part of one of the semi-circular canals. The great cavity named "otocrane," which lodges the proper acoustic capsule or petrosal, whether osseous or cartilaginous, is formed by the ex-occipital, par-occipital, ali-sphenoid, mastoid, and sometimes the parietal and supra-occipital.

III. The Prosencephalic or frontal arch is based on the *pre-sphenoid* already described in connection with the basi-sphenoid. The *orbito-sphenoids* or neurapophyses of the frontal vertebra are usually square, but sometimes semi-circular or semi-elliptic, as in the Cod; larger in the *Mala-copteri*, but very small usually in the *Acanthopteri*, and cartilaginous in the *Sclerogenida*. The olfactory nerves pass out of the skull by the superior interspace of the orbito-sphenoids, and the optic nerves by their inferior interspace or by a direct perforation. The *mid-frontal* bone completes this arch above, and always enters into the formation of the cranial cavity though its major part forms the roof of the orbits. It is single, and sends up a median crest in the Cod, the Ephippus, and some other fishes, but is more commonly divided along the median line. Each of the halves sends up its own crest in the Tunny. In the Salamandroid fishes, each frontal sends down a vertical plate to the sphenoid, thus forming a canal through which the olfactory nerves run. The side walls of this canal make a double bony partition between the orbits. The *post-frontals* or parapophyses of the frontal vertebra partly underlie the mastoids, and complete their prominent crest.

IV. The Rhinencephalic arch terminates the axis of the skull anteriorly, and protects the olfactory ganglions and nerves. The centrum of the nasal vertebra is named the *vomer*. Its posterior point is wedged into the under part of the pre-sphenoid; it expands and becomes thicker, anteriorly, where its lateral angles are articulated to the pre-frontals. Its upper surface supports the nasal bone, and its under surface, which enters into the composition of the roof of the mouth, is in many fishes dentiferous. The same is often the case with the palatine bones, which abut against it laterally, and also form part of the roof of the mouth. The presence or absence of these teeth has been made much use of for characterizing genera and large groups of the osseous fishes. In *Lepidosteus* the vomer is cleft by a median fissure. In *Polypterus* it is confluent with the basi-sphenoid. The *pre-frontals* or neurapophyses of the nasal vertebra defend and support the olfactory ganglions, bound the orbits anteriorly, give a surface of suspension to the palatine bones, and through them for the palato-maxillary arch; and they also give attachment to the large pre-orbital or lachrymal scale bone when this

exists. In the Cyprinoids and most Clupeoids the pre-frontals form part of the interorbital septum. In the *Con-geridae* we recognise the pre-frontals in the confluent parts of the nasal vertebra by the external groove conducting the olfactory nerves to the nasal capsules, and by the inferior process from which the palatine bone is suspended. In the *Muraenida* also the pre-frontals are plainly confluent with the nasal bone, and furnish the well-marked articular surfaces for the palato-maxillary bone. In the Cod the palatine arch is chiefly, but not wholly, suspended to the pre-frontals. The *nasal-bone* or spine of the most anterior arch of the skull is usually single, and terminates forwards in a thick obtuse extremity. In the Salmonoids and some other fishes, it is broad, but not deep; in *Istiophorus* it is long and narrow; in the *Discoboles* and *Lophobranchii* it is a short vertical compressed plate, and it is wanting in *Lophius* and *Diodon*, or merely membranous. It is articulated above and behind to the frontals and pre-frontals; and below, either directly or by cartilage, to the vomer. In the Flying Gurnard it has no immediate connection with the vomer; but this is a rare exception. In the Salamandroid fishes, the nasal is divided by a median suture. The horn-like projection from the forehead of *Naseus* is formed

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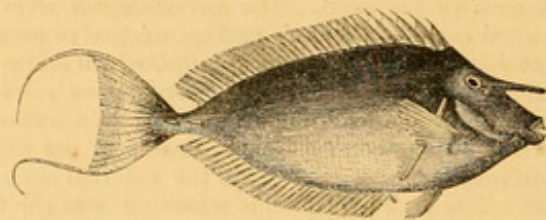


Fig. 16.

Naseus longicornis, one of the *Theutidæ*.

chiefly from the frontal bone, a small nasal being articulated beneath. This nasal is trifid anteriorly; its lateral divisions articulating with the pre-maxillaries, as in *Citharinus*. The *turbinal bone* or osseous capsule of the nose, belonging to the splanchno-skeleton, is situated at the side of, or above the nasal; the pre-maxillary and maxillary bones are usually attached to its extremity through the medium of cartilage. In the *Muraenida*, the normal elements of the nasal vertebra coalesce into a single bone. The spine of this vertebra or nasal bone forms the usual obtuse extremity beneath the skin of the upper part of the snout, and it is dentiferous, as in the *Lepidosiren*; it is intimately confluent anteriorly with the centrum or vomer, the limits being indicated by the interruption of the median series of vomerine and nasal teeth.

This completes a compendious view of the neural arches of the four cranial vertebræ which have for their primary function the protection of the ganglionic brain, in which the spinal chord ends anteriorly. From the complete osseous skull of a fish, there are many descending modifications, until we come to the vermiform Lancelet, which wants the cerebral expansion altogether; the gelatinous "chorda dorsalis" being terminated by a tapering end, invested by a membrane, without any addition of cartilaginous or osseous coverings.

B. *Sense capsules* of the splanchno-skeleton intercalated with the neural arches. Some of these have been already noticed. In the *Ammocetes*, cartilage is developed for the protection of the acoustic organ, in a skull, otherwise mostly fibro-membranous. (a.) The bones entering into the formation of the otocrane for the lodgement of the labyrinth have been named above; but it is the *petrosal* which is the bone specially designed to form the acoustic capsule, though in fishes it is less confined to that function than in the higher vertebrals in which it exclusively envelopes the labyrinth. Its ossification commences late in the osseous fishes. It is very small in the Cyprinoids, and in them Cuvier describes it as a dismemberment of the

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mastoid; but in the Perch, where it is more developed, he recognises it under its proper name. In the Cod it has a larger size, and the two otocranes are completely separated from each other.

b. The *optic capsule* or sclerotic investment of the eye is cartilaginous in the Chondropterygians and in semi-osseous fishes, but in most osseous fishes it is bony. An orbit for lodging the eye-ball is formed by the pre-sphenoid, orbito-sphenoid, frontal, post-frontal, pre-frontal and palatine bones; its wide outer opening is often circumscribed by the chain of sub-orbitals or scale-bones below, and less frequently by one or more supra-orbitals above. In the Shads, *Erythrinus*, *Citharinus*, *Hydrocyon*, *Cyprinus*, and many other *Malacopteri*, and in *Synbranchus*, the orbits are separated from one another by an osseous septum, but in general the septum is incomplete or wanting; in *Lepidosteus* and *Polypterus* it is double.

c. The *nose-capsule* is formed by the *ethmoidal* which enters into the walls of the cranium, and the *turbinal* which belongs to the nose, other bones, as the vomer and nasal, being accessories. The whole capsule is cartilaginous in cartilaginous and semi-osseous fishes, and the ethmoidal part continues so in many osseous fishes. The cartilaginous capsules and pituitary expansions are proportionally large in the Chondropterygii and Lepidosiren, communicating with each other in the latter by membranous slits; but in the higher fishes they form a pair. The *turbinals* in osseous fishes are generally thin, more or less elongated, scales situated at the sides of the nasal bone and ascending processes of the pre-maxillaries.

AA. The *inferior* or *hæmal* arches of the cranial vertebræ are essentially four in number in the osseous fishes, and in most of these have radiating appendages. A special visceral system of bony arches, called "branchial," also exists in fishes for the support and movement of the gills.

4. *Palato-maxillary arch*. Of this inverted arch, the palatine bones are the piers, and their points of suspension are their attachments to the pre-frontals, the vomerine, and nasal bones. The arch is completed by the maxillary and pre-maxillary bones, the symphysis of the latter forming its apex. The palatine or pleurapophysis of the nasal vertebra articulates at its peripheral extremity with the maxillary, to which it affords a more or less moveable joint. In the Parrot fishes and Diodons the articulation is analogous to that of the mandible below, with the tympanic pedicle. In the Salamandroid fishes it is a fixed suture. In *Mormyrus* these ends of the palatines meet and unite at the mesian line. In fig. 19, representing the jaws of *Alepisaurus*, the palatines are seen to be strongly armed, each of them having two pairs of tall lancet-shaped teeth, one pair nearly under the nostrils, the second pair not so tall, further back, and closely followed by ten much shorter ones. The *maxillary* or hæmapophysis of the nasal vertebra lies between the palatine and pre-maxillary. On the extent to which these two bones enter severally into the orifice of the mouth, and on their dentiferous or edentulous conditions, many divisions of fishes made by ichthyologists are mainly founded. In the Salmonoids the maxillary joins to the lower end of the pre-maxillary, forming,

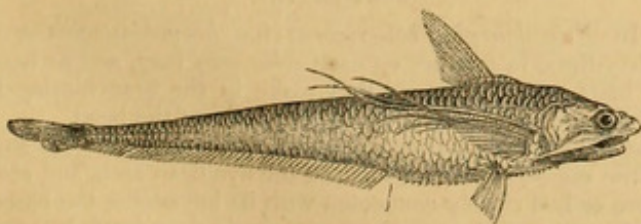


Fig. 17.

Coilia Playfairii, one of the *Clupeidæ* of the China seas.

together with it, the upper half of the border of the mouth,

and it supports teeth. The same form prevails with the Clupeoids. In *Thrissa* and *Coilia* of this family the pre-maxillary is very small, and the large dentiferous maxillary is prolonged beyond the corner of the mouth (fig. 17). In the *Plectognathi* the two bones coalesce. In *Lepidosteus* these bones also form a single dentiferous arch, but they are subdivided into many pieces, a condition which seems to have prevailed with the ancient Salamandroid fishes. It is dentiferous and largely developed in *Polypterus*, but very diminutive in the Siluroids, and wanting in the *Muraenidæ*.

The *pre-maxillary*, or the hæmal spine of the nasal vertebra, is more commonly directed transversely than longitudinally. Its nasal branch, or pedicle, is of unusual length in fishes with protractile snouts, such as the *Menidæ*, *Zeidæ*,

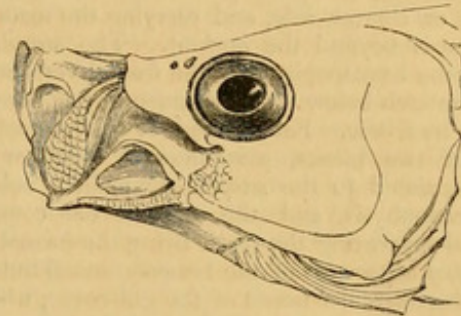


Fig. 18.

Emmelichthys nitidus (*Erythrichthys Schlegel*), from Western Australia.

Epibulus, *Emmelichthys*, and others. Commonly, its labial border is beset with teeth; and in many groups of fish it forms, with its fellow and the mandible, the whole margin of the mouth, the maxillaries in that case lying in folds of skin. This extension of the pre-maxillary is well shown in the *Alepisaurus*, a predaceous Sphyrænoïd; there it is

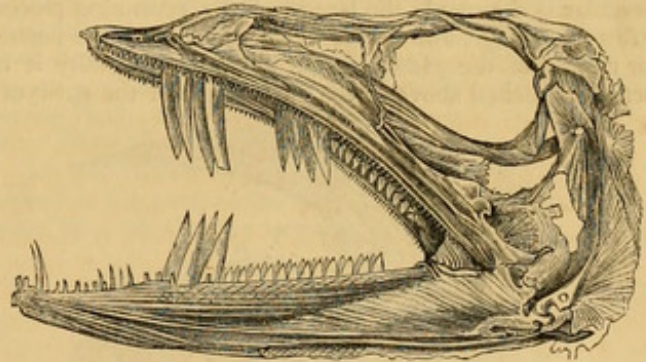


Fig. 19.

Alepisaurus, one of the *Sphyrænidæ*, a predaceous family, nearly allied to the Scomberoids. The upper border of the mouth is formed wholly by the pre-maxillaries, which are armed with small teeth. Valenciennes, who knew the fish only from a drawing, places it among the *Salmonidæ*.

closely set by a series of small teeth (fig. 19). The small bony piece above the maxillary in the Trout, Herring, and Pike, seems to belong to the series of mucous or scale bones.

The *diverging appendage* of the palato-maxillary arch consists of the pterygoid and entopterygoid bones, which are the less constant parts of the arch. They are connate with the palatine in most Salmonoids and Eels, while *Muraena* wants the entopterygoid, and its pterygoid is disconnected from the maxillary arch. Most fishes, however, have both bones.

3. The *tympano-mandibular arch* has the true inverted or hæmal character, its apex formed by the *epi-tympanics* or pleurapophyses of the frontal vertebra hanging downwards below the vertebral axis of the skull. In most fishes, its lower end is bifid, and supports two inverted arches, the mandibular and the hyoidean. The *meso-tympanic* is articulated above to the epi-tympanic and pre-opercular, anteriorly to the pre-tympanic, and by its lower end to the

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hypo-tympanic, reaching almost to the mandibular trochlea. It is the "symplectic" of Cuvier, and it is confluent in the Siluroid, Murænoid, and some other fishes with the epi-tympanic. The pre-tympanic "caisse" or "os tympanicum" of Cuvier, receives, in its posterior margin, the fore part of the meso-tympanic, and the upper and fore part of the hypo-tympanic. It is confluent with the latter in Conger and Muræna, and it does not join either of these bones in the *Lepidosteus*. The *hypo-tympanic* bears the convex articular trochlea for the lower jaw upon its inferior apex. The *Epibulus* presents a remarkable, much elongated, and slender modification of it, carrying the lower jaw at an unusual distance from the base of the skull, and allowing it to swing backwards and forwards on its long pedicle as on a pendulum. In the *Murænide* the tympanic pedicle is a strong triangular plate affixed to the cranium by its base or shorter side, and carrying the mandibular joint backwards beyond the occiput. The *mandible* or lower jaw is the hæmapophysis of the frontal vertebra, and completes the arch below by its ligamentous or bony symphysis with its fellow. Each branch or half consists most commonly of two pieces, sometimes of three or more, the one articulated to the suspensory pedicle being the proper hæmapophysis, and the extreme one completing the arch and supporting the teeth being the hæmal spine. The *diverging apparatus* of the tympano-mandibular arch consists of the opercular bones of the gill-cover, which, by its movements, opens and closes the branchial aperture on each side of the head, thereby regulating the currents through the branchial cavity. It may be considered as a kind of short and broad fin. The first or most anterior, and the chief medium of attachment of the appendage, is the *pre-opercular*, which commonly has a crescentic or angular form. In the Cod it is forked above, and in the *Sclerogenide* the enormously developed second suborbital scale bone crosses the cheek to be articulated to it. The opercular is commonly the largest of the remaining pieces of this appendage, and is chiefly connected with the posterior margin of the pre-opercular, but very generally it is partially attached above to the outer angle of the epi-tym-

a long slender fin ray, and the *sub-opercular*, which forms the posterior and lower angle of the gill-cover, carries out the resemblance to a fin by its radiated structure. All the framework of this fin has the form of rays in the Plagiostomes. The lowermost piece, called the inter-opercular, is articulated to the pre-opercular above, the sub-opercular and angle of the opercular behind, and usually to the back parts of the mandible in front. In conjunction with the pre-opercular, it is more elongated in the very long head of *Fistularia* than the other two pieces of the appendage. It is wanting in the *Siluri*, and the sub-opercular is wanting in the Shad. In *Muræna*, the small opercular bones are articulated only to the lower part of the tympanic pedicle. The smoothness or serratures of the posterior edges of these bones, more especially of the pre-opercular, and the numbers and situations of the spines which emanate from them, furnish characters to ichthyologists for the discrimination of many species and groups of species.

2. The *hyoidean arch* is suspended in osseous fishes, as we have already had occasion to say, to the mastoid, through the medium of a fork of the epi-tympanic bone; and its bony arch is completed by the two small, cubical *basihyals*. The anterior part of the arch is formed by the *stylohyal*, *epi-hyal*, and *cerato-hyal*, the first-named being joined at its upper end by ligament to the *epi-tympanic*, and the others descending from it in succession. The cerato-hyal is the longest and largest, and supports the diverging appendix of the hyoidean arch named *branchiostegals* or gill-cover rays, and on which the membrane that closes the branchial chamber is extended. The number of these rays varies greatly. They are only three, and these comparatively broad and flat in the Carps, while in *Elops saurus* they amount to more than thirty. They are of very great length in the Angler, and spread out the gill membrane like a great bag on each side of the head.

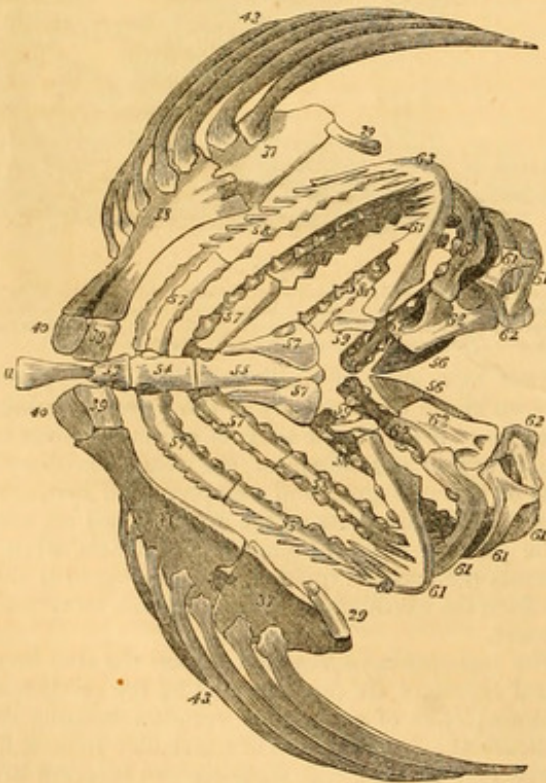


Fig. 20.
Hyoid bone of the Perch.

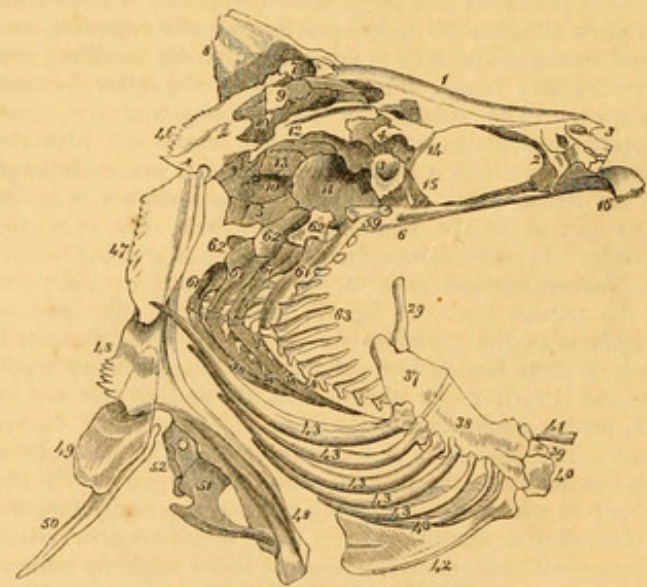


Fig. 21.
Gills of the Perch.

In *Pisodonophis cancrivorus* the *branchiostegals* are thirty-three in number on each side, very long, and as fine as hairs, and the curves they make in the branchiostegal membrane are different on the two sides of the head.

d. The *branchial arches*, which appertain to the system of the visceral skeleton, succeed the hyoidean arch, and are more or less closely connected with its key-stone, the *basihyals*. Six of these arches are usually developed in embryo, and five are usually permanent, four of them supporting the gills, and the fifth circumscribing the opening of the gullet and beset with teeth. This last is called the *pharyn-*

panic. In the *Lophius*, its posterior margin is coated by

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geal arch, the rest *branchial arches*. The arches adhere by their lower extremities to a chain of ossicles, and curving as they ascend, nearly meet at the base of the cranium, to which they are attached by ligamentous and cellular tissue. Each of the first three branchial arches, independent of the basal key bones, or *basi-branchials*, consists of three or four pieces, which have a certain elastic or flexible movement on each other. The lowest of these pieces is the short *hypo-branchial*; the next, the long *cerato-branchial*, is grooved on the outside, and supports the dentigerous processes, or tubercles, named *rakers*. Above this is an *epi-branchial* similarly formed. To it, in the second and third arches, the short, broad, dentiferous epi-branchial is commonly attached. The fourth arch consists of the cerato-branchial, the epi-branchial, and the pharyngo-branchial pieces. The fifth arch usually consists simply of the cerato-branchial element, but in *Anabas* it supports a pharyngo-branchial. This last-named bone is often expanded, and more or less dentiferous: it is termed by Cuvier "the inferior pharyngeal bone," and the upper dentiferous portions of the arches are called the superior pharyngeal bones." In *Cottus*, these superior bones are blended into one piece. A peculiar development of the epi-branchial and pharyngo-branchials of the first two or three arches, serves the office, in a group of fishes, the *Labyrinthibranchii*, of retaining a supply of water for moistening the gills when the fishes are temporarily out of their proper element.

1. *Scapular arch*. This inverted cranial arch is attached to the par-occipital; or to that bone and the mastoid; or to the same bone and the petrosal, as in the Cod; or to the par-occipital and basi-occipital, being essentially the hæmal arch of the occipital bone, to which it is constantly attached wholly or in part. In the Eels it is feebly developed, and only loosely suspended behind the skull; and in the Plagiostomes it is removed further back to a distance from its proper vertebra. Its superior piece is the *supra-scapula*, then follows the *scapula*, and the arch is completed below by the union of the frequently very strong and firm *coracoid* with its fellow. The coracoids defend and support the heart, and give attachment to the diaphragm, which separates the pericardial and abdominal cavities.

The scapular arch usually supports a *diverging appendage* on each side, constituting the pectoral fin. The pectoral fin rays are analogous to the fingers of the higher animals, the lowest ray, when the fin is laid back to the side of the fish, answering to the thumb. The bones which support these rays are homologues of the bones of the fore extremities of the higher vertebrals, and have been named accordingly. In the Cod tribe, and most other fishes, there is, however, no separate representative of the *humerus*. The *radius* is of enormous size in the *Lampris* and in *Flying-fish*. It is ankylosed to the ulna in *Silurus* for the firmer support of the pectoral spine, and in *Lophius*, both radius and ulna are extremely small, and connate with the coracoid. The *carpals*, usually four or five, but sometimes only two, progressively increase in length from the ulna to the radial side. In the Wolf-fish they are broad flat bones. The *metacarpals* and *phalangeals* are in the Cod twenty in number, all soft-jointed, and sometimes bifurcate at the distal end.

In the osseous fishes the pectoral fins present a series of modifications. In the *Acanthopterygii* the ulnar ray is a hard unjointed spine. In the Gurnards, Choridactyles, and several other genera of *Sclerogenida*, the three lower rays are detached and free, and there is reason to believe that these rays are used like fingers as organs of touch when

the animal swims close to the sandy bottom of the sea. The pectoral fins are very largely developed in the *Exocoætus*; it is also large in *Dactylopterus*, *Trigla*, and *Priotonotus*, as well as in several other forms of the *Sclerogenida*.

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In the Cod and Carp there is a single styliform bone, named the *epi-coracoid*, because it is attached to the upper end of the coracoid. In the Perch, and most other fishes, it consists of two pieces. In *Centriscus scolopax*, *Argyreiosus vomer* and *Siganus*, it is joined by its lower end to its fellow, thus completing an inverted arch behind the scapular one. The epi-coracoids are absent or are very slender spines in the Wolf-fish, Mullet, Goby, Stickleback, *Remora*, *Cepola*, *Uranoscopus*, the Blennies, Siluroids, and Apodal fishes. The apodal Sandlance, however, possesses the epi-coracoids.

Ventral fins. The rays of the ventral fins are supported by two bones, which are named *pubic bones*, and represent the lower part of an inverted hæmal arch. In no fish is this incomplete pelvic arch directly attached to the vertebral column. In all fossil fishes belonging to deposits anterior to the chalk, the ventrals are placed towards the posterior end of the abdomen, and hence, and from the consideration of the position of the rudiment of the ventral in the embryo fish, it may be inferred that these pubic bones are the hæmapophyses of the last abdominal vertebra. In Acanthopteri the anterior ray of the ventral may be spinous.

In the *Malacopteri* all the ventral rays are soft, multi-articulate, and bifurcate. The normal position of the ventral hæmapophysis is under its proper vertebra, but the relative length of the pubic bones in different fishes, places them under the abdomen, or pectoral fins, or gills; hence Linnaeus's division of the fishes into abdominal, thoracic, and jugular, and, when the ventrals are wanting, apodal. Cuvier substituted the term subrachial for thoracic and jugular. The ventrals are better developed in the Plagiostomes than in other fishes, and connected with this fin, in the male *Plagiostomes* and *Chimerae*, there is the peculiar intromittent organ of generation named the "clasper."

In the *Gobies* (fig. 22) and *Gonorrhynchus*, the ventrals are united to each other by a membrane; and in *Cyclopterus*, *Gobiesox*, and



Fig. 22.
United ventrals of *Gobius ommaturus*, a Chinese fish.

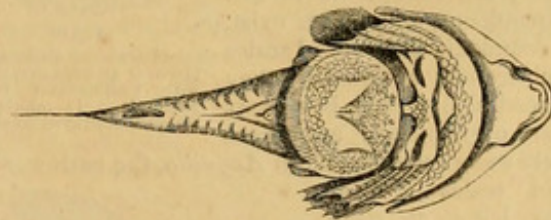


Fig. 23.
Lepadogaster puniceus, a Discobole or Cyclopteroid. A sucking apparatus is formed round the basis of the ventrals.

Lepadogaster (fig. 23), they so united as to form a suctional foot, by which these fish can attach themselves to a rock.

We have allotted more space to the skeleton of fishes than our limits will permit us to devote to the rest of the ichthyic structure, because the soft parts and dermal system cannot be properly apprehended or referred to without a competent knowledge of the bony or cartilaginous endoskeleton by which they are sustained.¹

¹ In adopting Professor Owen's osteological system, we have thought it proper, to avoid mistake, to use his own words as often as we could; but as our extracts from his elaborate and exhaustive work are very compendious, and not always in the order he pursued in his lectures, they are not marked by inverted commas as quotations.

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c. *Dermal or Exo-skeleton.* To this system the scales belong, each being secreted, like a tooth, in a depression or pocket of the skin, to which it adheres under the cuticle. They are very generally imbricated with the posterior end extruded and free, but the skin usually extends over the surface of the anterior end to a greater or less extent; or the scale may be entirely imbedded beneath the cuticle. Professor Agassiz considered the form of the scales to bear so strong a relation to the rest of the ichthyic structure and the general economy of a fish, that he founded upon it his primary divisions of the class, of which he characterized four. The fish of his Cycloid order have scales composed of concentric layers of horn

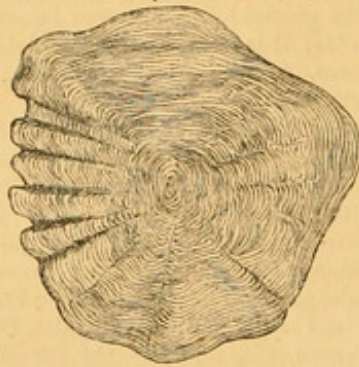


Fig. 24.

A Cycloid scale of *Lampanyetes* (or *Mycetophum*) *resplendens*, one of the nocturnal *Scopelinae* of the great group of *Salmonidae*.

scales (fig. 28); in others the teeth are more persistent, though the earliest, which are the nearest to the centre of the disk, are generally the smallest. There are some

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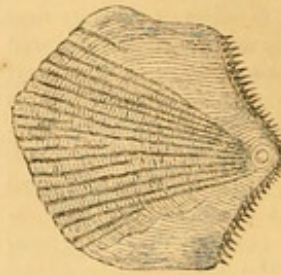


Fig. 28.

Fig. 28. Ctenoid scale of *Gobius ommaturus*.

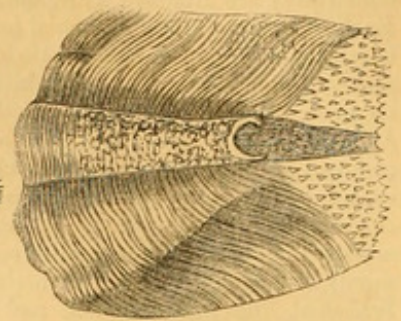


Fig. 29.

... 29. Ctenoid scale of *Psettus argenteus*, a *Chatodontoid*.

scaleless groups associated with Ctenoids. Scales of this and the preceding order have most commonly grooves radiating from the centre of the disk over that part which remains in the cuticular pouch, and crenatures on the basal

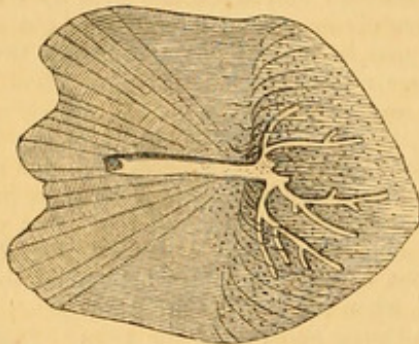


Fig. 25.

Scale of a *Labroid*.

or bone, without spinous margins, and not covered by enamel. He believed that a close relationship existed between the absence of pungent teeth on the scales, and the want of spinous rays in the fins, and that this order has a considerable correspondence with the *Malacopterygii* of former ichthyologists. The *Cyclo-Labridae*, however, and many *Gobiidae*, are exceptions to this correspondence, and others exist. Most commonly the Cycloid scales are imbricated; occasionally they are placed side by side, in contact but not overlapping; sometimes they are more remote; and in *Anguilla*, the narrow, oblong cycloid scales are in groups lying at right angles to each other, so as to produce a kind of lattice-work under the cuticle. Some genera of fishes with smooth scaleless skins come into this order. The Ctenoid order of fish have horny or unenamelled bony scales, with spinous teeth on the posterior edges of the layers like a comb (figs. 27, 28, 29, and 31). As the scales grow their spinules wear off, and in some species we observe no more than a single series on the posterior edge of the last formed layer of the



Fig. 26.

Cycloid scale of *Gadopsis marmoratus*, an *Acanthopterygian* with rudimentary thoracic pectorals. It inhabits the rivers of Southern Australia.

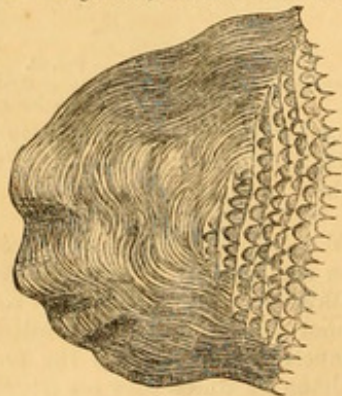


Fig. 27.

Ctenoid scale of *Scatophagus multifasciatus*, one of the *Squammipennes* or *Chatodontidae* from the Australian seas.



Fig. 30.

Scale from the head of *Macrourus Australis*.

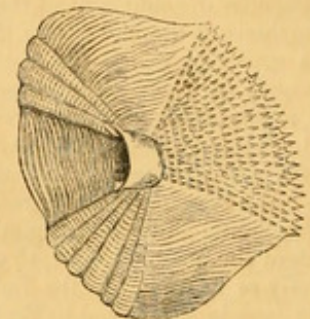


Fig. 31.

Ctenoid scale of *Lethrinus cynocheilus*, one of the Norfolk Island *Sparidae*.

edge corresponding with the number of grooves. In both orders, also, the most common circumscription of the scale is circular or subcircular; occasionally they are irregular or oblique; and the scales in one part of the fish differ from

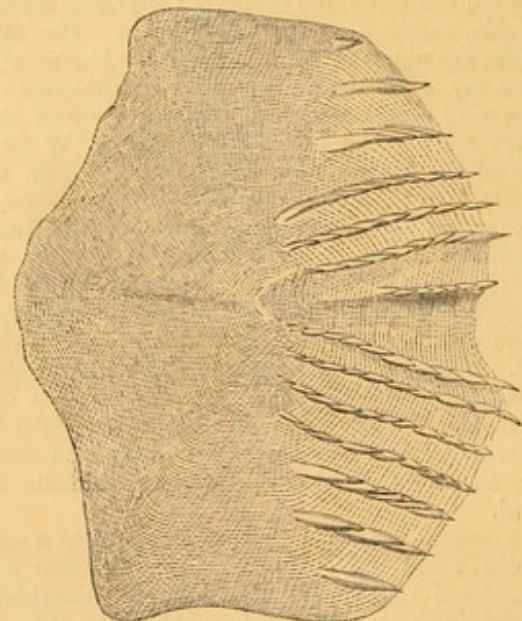


Fig. 32.

Scale from the lateral line of *Macrourus Australis*.

those in another, in outline, and more frequently in size. In some Labroids the largest scales are on the base of the caudal fin, but in most of the osseous fishes the largest lie towards the middle of the sides of the body. The Ctenoid scales are mostly imbricated.

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In Ganoid fishes the plates or scales are covered by a

the head to the caudal fin, or even through the latter, called

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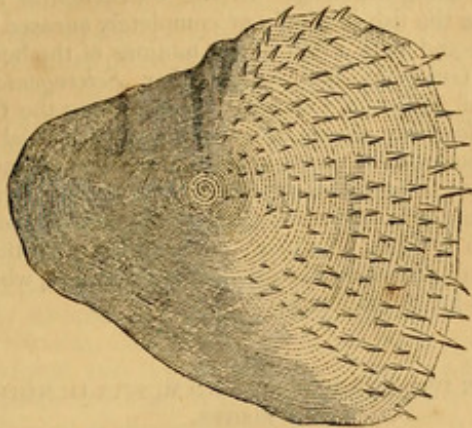


Fig. 33.

Scales of *Macrourus calorhynchus*.

thick coat of enamel, and are sometimes of considerable dimensions; and in many of the extinct species which compose the bulk of this order the enamelled plate is rhomboidal, with a hook at its anterior angle, which assists in retaining it in its place. The recent species included by Agassiz in this order do not form a natural group.

Fishes of the Placoid order have the skin covered with irregular plates of hard bone, varying greatly in shape and size. In the Rays and Monk fish they form large, rough, or spinous tubercles; and in the Dog-fish, fine-grained shagreen. As formed by Agassiz, the order corresponds with the *Cartilaginei* or *Chondropterygii* of authors, and includes species with smooth skins. For the arrangement of fossil

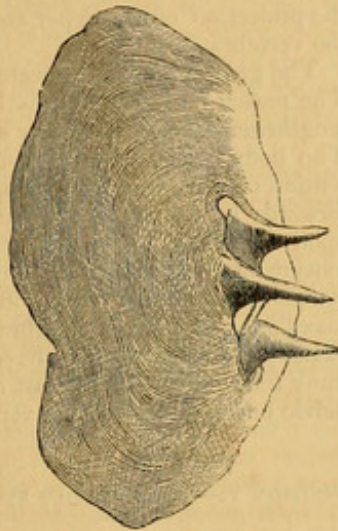


Fig. 34.

Scale of *Macrourus trachyrhynchus*.



Fig. 35.

Placoid scales of *Aleuterus trossulus*, one of the *Balistidae*, from Australia.

fish these divisions were well devised, but, as may be expected, a system based on the variable characters of a

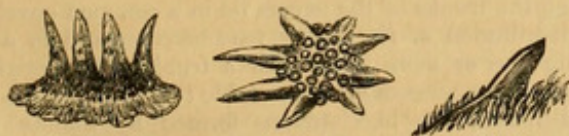


Fig. 36.

Scales from different parts of the body of *Aleuterus variabilis*.

portion of the dermal skeleton fails in defining natural groups. Used in conjunction, however, with the other parts of the structure, Agassiz's discoveries are of great importance for the purpose of classification.

Along the side of an osseous fish, there is a line running from



Fig. 37.

Ctenoid scales from the lateral line at the base of the caudal fin of *Caranx papapistes*, a *Scomberoid* from North Australia.

the lateral line. It is nearer the back in some fishes than in

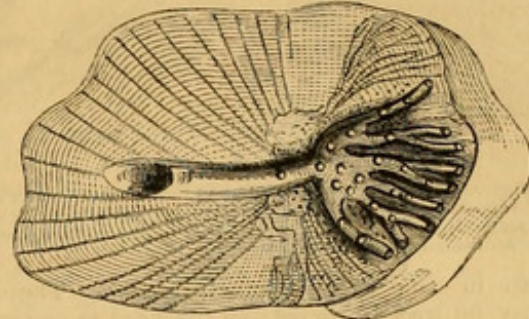


Fig. 38.

Cycloid scale from the lateral line of *Labrus laticlavus*, an Australian Cyclo-Labroid.

others; very generally it runs at mid-height, sometimes it ceases a long way before the caudal fin; and in *Chirus* there are several lateral lines, the upper one coasting the back, and the lower one the edge of the belly. This line is muciferous, being connected with a series of glands. In the *Anguil-*

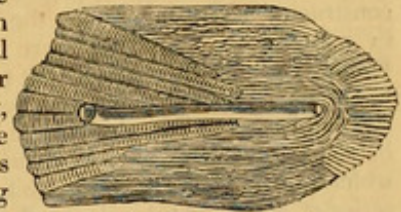


Fig. 39.

Cycloid scale from the lateral line of *Odax lineatus*, a genus closely allied to *Scarus*.

lae, the mucous ossicles lying like the scales under the cuticle are scarcely visible, and in many scaleless vermiform apodals the line is still less conspicuous; but in these slimy fishes the whole skin is densely studded with glands and their ducts. The scales that cover this line, or lie in immediate contact with it, above and below, are constructed with a tubular arch along their middle, or a simple perforation in the disk, or with a mere notch on the edge for the exit of the mucoduct (figs. 25, 29, 32, 38, 39, 40, 41, 43, and 44). The scales are sometimes larger than the ordinary ones in the same fish, occasionally they are smaller, and sometimes they

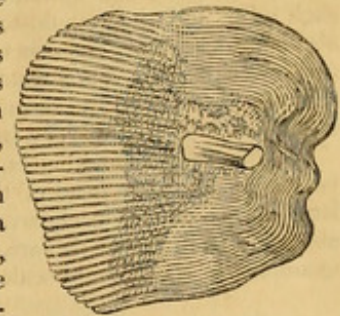


Fig. 40.

Cycloid scale from the lateral line of *Lutodeira salmonca*, one of the *Gonorynchidae* from Torres Straits and Polynesia.

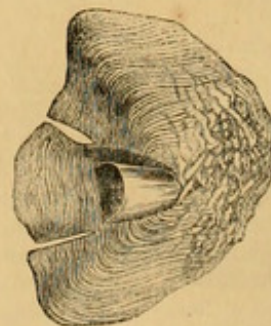


Fig. 41.

A cycloid scale from the lateral line of *Saurus undosquamis*, one of the North Australian *Scopelinae*.

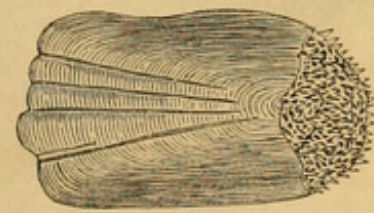


Fig. 42.

Ctenoid scale of *Platycephalus cirrhanasus*, one of the *Sclerogenidae* of Botany Bay.

are the only ones, the rest of the body being naked. Very

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frequently they have strange irregular forms (fig. 44), and

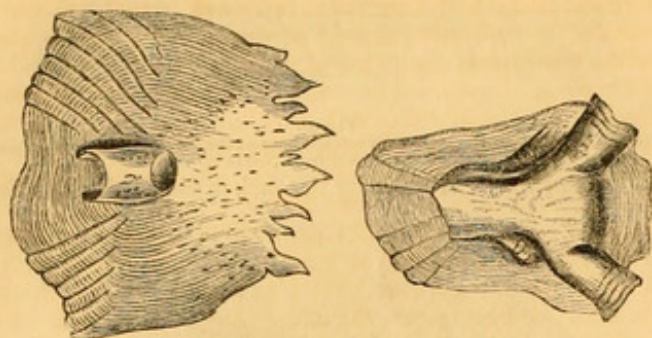


Fig. 43.

Fig. 43. Figured Cycloid scale from the lateral line of *Hamerocartes acanthorhynchus*, a Gobioid inhabiting the seas of New Zealand.

... 44. Scale from the lateral line of *Trigla pleuracanthica*, one of the Australian *Scelerozenidae*.

they are in some cases peculiarly armed. The lateral line may be traced forwards on the head to one or more little bones named *supra-temporals*, and thence over the cheek along the *sub-orbital* series of bones to the first and usually largest of the series, named the *pre-orbital*, as may be well observed in fig. 8, page 207. All these bones are constructed so as to protect the muciferous canals, and in many fishes they are mere osseous pipes. In the *Gadidae* and in *Macrourus*, the pre-orbital and following bones of the chain are largely developed and fold down, forming large semi-canals. These bones are strongly armed in some *Acanthopteri*, particularly the *Scelerozenidae*, in which the second of the sub-orbital chain emits a spine or series of spines or tubercles, and is prolonged to articulate with the pre-opercular. The marginal serratures of the pre-orbital are conspicuous in *Mugil*, and furnish characters for other genera of *Acanthopteri*. The *supra-orbitals*, though less constant than the sub-orbitals, belong to the same system. The Carp has one above each orbit, and the *Lepidosteus* three. The *turbinals* are also considered by Professor Owen to appertain to the dermal system. They are wanting, together with the sub-orbitals, in many of the serpentiform apodals; but the turbinals exist, though of very small size, in the Conger.

Of the other dermal bones of fishes our notice must be very cursory. The head of the Sturgeon is protected by large dermal plates closely arranged, and the rows continued along the trunk of the fish are, as we have mentioned above, examples of the Placoid scales of Agassiz. The sternum,

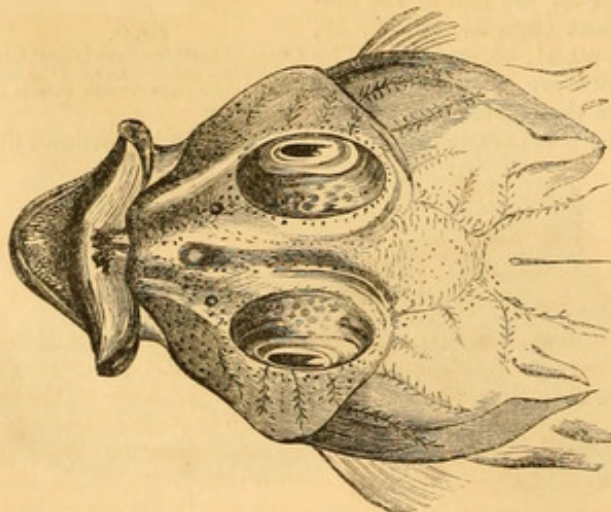


Fig. 45.

Head of *Bovichthys variegatus*, one of the *Uranoscopidae* from Sydney, to show the branching mucoducts.

as it has been called, of the Herring, is formed of a series

of acutely bent dermal bones, and the Dory has two rows of plates along the belly. In the *Ostracionidae* and *Syngnathidae* the fish is wholly or completely encased in scales, so connected as to admit of few motions of the body. And in the Gurnards, and many other *Scelerozenidae*, some genera of *Siluridae*, the great *Sudis* among the *Clupeidae*, and *Polypterus* among the *Ganoids*, the cranial and humeral bones of the endo-skeleton present hard, shagreened surfaces exteriorly, in which the soft epidermis is not perceptible, and the resemblance to the dermal plates of the Sturgeon is close. In many other fishes, also, the cranial bones emit processes from their outer surfaces, which serve as canals for the mucoducts.

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SECTION IV.—THE MUSCLES AND MUSCULAR MOTIONS OF FISHES.

The spinal column, composed of numerous articulations united by cartilages which permit of certain movements, curves with great facility from side to side; but the vertical motion is much more restricted, chiefly in consequence of the projection of the upper and under spinous processes of the vertebræ.

The great organ of movement in all fishes is the tail. The muscles by which it is brought into play extend in lengthened masses on either side of the vertebral column. The body being rendered specifically lighter by the distention of the swim-bladder when that exists, is impelled forwards by the rapid flexure of the tail acting laterally upon the water. The head of fishes exercises but slight movement, independent of the rest of the body; but the tympano-mandibular arch, often the maxillary and premaxillaries, the hyoid and branchial apparatus, and occasionally the scapular arch, have more or less motion. The finny terminations of the last named appendage and of the pelvic bones, as well as the vertical fins, are seldom at rest.

SECTION V.—THE NERVOUS SYSTEM AND SENSES OF FISHES.

The spinal chord, which terminates anteriorly in an enlargement named the brain, consists of a dorsal and ventral pair of columns, the former having for its function the receiving of impressions made on the peripheral surfaces of the body by external objects, and the latter, that of directing the voluntary muscular movements,—they are the nervous centres of *animal life*. Each consists of an intimate aggregation of nervine matter named ganglions. From the sensorial and motor columns on each side of the chord, nervous filaments, more or less in number, proceed, and being invested by a common membrane, pass out between the vertebræ to all parts of the body; one on each side between every pair of vertebræ, the number of vertebræ being in fact regulated primarily by the number of pairs of spinal nerves. It would be correct to say that the nerves of motion arise from the motor column, and that the nerves of sensation terminate in the sensorial one. For, though the trunks of the nerves lie in a common envelope, the distribution of the former may be compared to a tree having one or more roots, with a trunk giving origin to numerous branches, and innumerable twigs; while the sensorial nerves are like streams formed by minute rills, uniting in a river that terminates by one or by several mouths. To serve the involuntary muscles, as the heart and arterial system, and also to supply the viscera that perform the functions of digestion, assimilation, secretion, or to preside over *organic life* there is a separate system of ganglia and network of nerves that has been named the *sympathetic*. Under this general description the nervous systems of all the vertebrals may be comprehended; but in the higher classes, the development is much more full than in fishes,

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and among fishes the Lancelet offers the simplest nervous system of the whole series of vertebrated animals.

The spinal chord, or the nervous columns, for which, independent of its protecting investments, the term *myelon* has been well devised by Professor Owen, is extremely short in those fishes whose lumpish shape originates in the abbreviation and coalescence of the posterior vertebræ. In *Orthogoriscus* and *Lampris*, the whole myelon appears to be a minute ganglionic process of the brain. In *Tetrodon* and *Diodon* it is also very short, or about a twentieth of the length of the fish; but the rest of the neural canal is in them occupied by a bundle of caudal nerves, usually named, from their resemblance to the tail of a horse, *cauda equina*. *Lophius* has a myelon which reaches the twelfth vertebra; but its pointed end is concealed by a long *cauda equina*. In most fishes there is no *cauda equina*, and the myelon runs to the end of the neural canal.

In fishes the brain consists of a few ganglionic masses, which vary in number in different groups of species, and, as has been mentioned, are wholly wanting in the lowest form of the class. It is proportionally larger in the young fish, and Professor Owen states that, on an average, its weight is only a three-thousandth part of that of the whole fish. Carus estimated the brain of the Burbot (*Lota*) as forming the seven hundred and twentieth part of the entire weight; and that of the Pike has been found to be the thirteen hundred and fifth part.

We mean to mention only the more constant or important encephalic masses, and even these in a very cursory way. The myelon, on expanding into the brain, assumes the name of "encephalon," which is protected by the occipital neural arch of the skull. In proceeding from the spinal column onwards towards the nose, the first rounded masses that we observe in the encephalon are not constantly present in fishes, nor do they exist in any other class of vertebrals. They are called "vagal lobes," and are largely developed in the *Cyprinidæ*, and enormously in the Torpedo, Narcine, and other electric Rays. In these they supply the large electric nerves. They are also large in *Gymnotus*, which, however, does not receive its electric nerves from these organs. The medulla oblongata, and cerebellum, are more constant parts of the occipital division of the brain. Fishes that possess much muscular energy, and take their prey by the velocity of their movements, have the largest cerebellum; and the other extreme of its size is found in the feeble Myxine or Glutinous Hag which passes its parasitic existence buried in the flesh of other fishes. It is also a mere fold in *Polypterus*, and is very small in the sedentary *Discoboli*, whose ventral fins are employed as suckers to attach the fish to the rocks. Among osseous fishes the cerebellum attains the largest size in the warmer-blooded, impetuous Tunny; and in the cartilaginous Sharks it is still more largely developed. The next division of the brain, the "mesencephalon," protected by the neural arch of the parietal vertebra, is usually larger than the other divisions in osseous fishes. To it belong the two optic lobes, whose function is denoted by their name. They are hollow in most fishes, and are often larger than the cerebellum, as in *Polypterus* and *Lepidosiren*, of equal size with that organ in Eels, and smaller in the Sharks and in *Amblyopsis*. Their existence at all in this fish, which is blind, and in the Myxine, which is equally destitute of sight, shows that they have some other function than merely communicating with the optic nerves. The "prosencephalon," inclosed in the neural arch of the frontal vertebra, corresponds to the cerebral hemispheres of the higher vertebrals. It is smallest in the Myxines, equal to the cerebellum in the Perch, and exceeds in size that of the Stickleback, Gurnard, *Lepidosteus*, *Lucioperca*, *Amblyopsis*, and *Raia*. In *Polypterus* and *Lepidosiren* it surpasses all the rest of the brain.

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The fourth and last division of the brain, protected by the nasal neural arch, consists of two lobes, named "rhinencephala" or "olfactory lobes," as they send forwards the nerves that supply the organ of smell.

Organ of Vision.—The position, direction, and dimensions of the eyes of fishes vary greatly. In some they have an upward aspect, and are often very close upon each other; in others they are lateral, and so wide apart as to be even directed slightly downwards. But of all anomalies, one of the most extraordinary which their position presents, is that of the *Pleuronectes* (such as Turbot, Flounders, Soles, &c.), in which the two eyes are placed, as it were, the one above the other, and both upon the same side of the head. In certain species of the Eels and *Siluri*, they are so small as to be scarcely visible; while in other groups, such as *Priacanthus*, *Pomatomus*, and *Orthogoriscus*, they surpass in proportional diameter whatever is known of the same organs in the higher classes. Some ichthyologists have remarked that fishes which habitually descend to great depths in the ocean have large eyes; and in the internal parasites and in fishes which live in subterranean waters, we have examples of the most rudimentary form of the organ of vision. In the Glutinous Hag, and in the *Amblyopsis spelæus*, the eye is merely a minute black fold of skin on which a cerebral nerve terminates. In *Apterichthys cæcus*, the eye-ball, still rudimentary, is covered by the skin. It may be said in general that the eye of fishes is large, and that its pupil especially is broad and open; a character probably connected with the necessity of collecting whatever devious rays of light may penetrate the obscure depth of waters. Fishes have no true eyelids. The skin always passes over the eye, to which it is slightly adherent; and it is for the most part sufficiently transparent for the passage of the solar rays. In some species, such as Eels, it passes over without the slightest fold or duplication. In others, as the well-known Mackerel and Herring, it forms an adipose fold both before and behind; but these folds are fixed, and being unprovided with muscles, have no mobility. Sharks have one, somewhat more moveable, on the inferior margin of the orbit. The globe of the eye itself is very slightly moveable, although, like that of man, it is furnished with six muscles. Perhaps the most singular eye presented by the class of fishes is that of *Anableps*, which has two corneæ, separated by an opaque line, and two pupils pierced in the same iris, so that one might deem it double; but there is only one retina, and a single vitreous and crystalline humour.

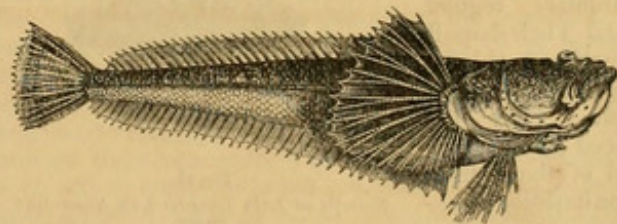


Fig. 46.

Uranoscopus macropygus, an Acanthopterygian fish in which the only spinous ray is one in front of the ventral fin. The points of the pubic bones are also spinous, and the undeveloped interspinous bones of the first dorsal lie beneath the skin. The eye-ball is retractile to beneath the edge of the orbit.

In *Uranoscopus macropygus* and others of that genus, the eyes can be elevated and depressed at the will of the fish, on a cylindrical stem, above or below the plane of the flat dorsal aspect of the head on which it is situated; and in the ferocious *Zygæna*, the eyes are stilted out from the sides of the head on cartilaginous expansions of the skull. Fishes, in the range of their vision and acuteness of sight, are very far inferior to birds, and inferior generally to reptiles and beasts, yet, at the same time, it is evident that they perceive their prey from a considerable distance; and the angler, who knows either how rapidly they seize, or how

cautiously they avoid his lure, and with what discrimination they sometimes prefer one colour or kind of artificial fly to another, must be impressed with the belief that the vision, at least of certain species, is by no means devoid of clearness and precision.

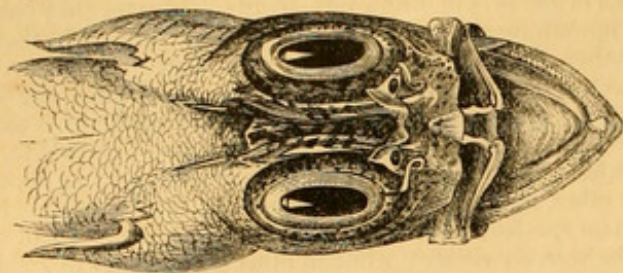


Fig. 47.

Shows the large eyes of *Sebastes percooides*, one of the *Sclerogenidae* or *Triglidae*, a family whose home is at the bottom of the sea, and have very commonly the lower rays of the pectoral fins detached and organized as feelers.

We shall not repeat here the notices that we have already had occasion to take of the *organ of hearing*. In Sharks, a canal extends from the interior organ of hearing to the hinder part of the head, where it is closed by the skin, and in the rays there is a very minute external orifice to the canal, closely approximated on the dorsal aspect of the head to its fellow. In osseous fishes there is no such mechanism, and the sonorous vibrations are conveyed to the labyrinth through the solid parts; but in the Carp and certain Siluroids, the air-bladder would appear to be accessory to the acoustic organ, as it is connected with it by a chain of ossicles. The general structure of the organ of hearing in fishes is doubtless specially adapted for the sensation of the sonorous undulations of the element in which they live.

A few lines may now be devoted to the consideration of the *sense of smell*. The nostrils of fishes are not so placed as to be traversed by the respiratory medium in its course to the organs of respiration. They consist merely of two openings, situate on the muzzle, and lined by the pituitary membrane, which is raised in extremely regular folds. Their shape is sometimes oblong, sometimes round or oval. They are placed either at the end of the muzzle or on its sides; sometimes on its superior face, and even occasionally, as in Skates (fig. 48), and Sharks, on its under surface near the angle of the mouth. In the Lamprey they are approximate on the top of the head, and open by one common orifice (fig. 49). In the great ma-

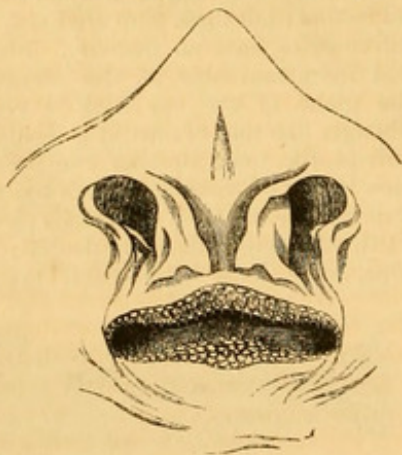


Fig. 48.

Nostrils of *Raia Lemprieri*, an Australian Skate.

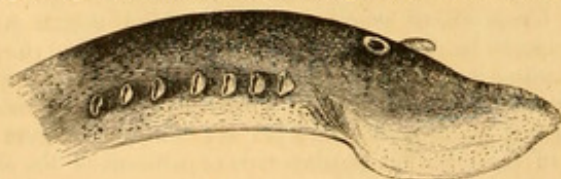


Fig. 49.

Head of *Petromyzon mordax*, showing the single nostril tube and seven branchial orifices.

majority of fishes each nostril opens by two orifices, the one posterior to the other, and in some cases at a considerable

distance. These are what are called double nostrils, an inaccurate term, in as far as each pair of holes leads only to a single cavity. The margins of the anterior orifice are often tubular, as in the Eel, and sometimes a single side of the tubular margin is prolonged into a tentacular appendage, as in several *Siluri*. In the genus *Lophius* the nostrils are borne upon a little pedicle, so as somewhat to resemble mushrooms. Various other modifications are observable in different genera, although not necessary to be here narrated.

It is certain that fishes possess the faculty of perceiving odours; that various scents attract or repel them; and there is no reason to doubt that the seat of that perception lies in the nostrils. It may be reasonably conjectured that its strength depends mainly on the degree of development produced by the number and extent of the interior folds of the pituitary membrane.

The essential character of the organ of smell in fishes is that the pituitary sac has one or more external openings not communicating with the mouth or fauces except in the *Dermopteri*, and in these the naso-palatine canal is not traversed by the water in its course to the gills. In some *Synbranchidae*, the posterior nasal aperture is situate on the white parts, within the edge of the lip, in this respect agreeing with the *Lepidosiren*. Long debates on the conflicting claims of the latter to be ranked as a fish or a reptile, have turned on the position of the posterior nostril. *Tetrodon naritus* is an exception to the general rule of double nostrils, in having merely a single wide opening, coextensive with the dimensions of the pituitary sac, but bordered by membrane. In other Tetrodons the sac is closed by a thin membrane, in which there are two small openings close to each other. The *Chromidae* also, and the Ctenoid *Labridae*, have but one opening to each sac; and in some few fishes there is a barbel merely, without an aperture, in place of a nostril.

In regard to the *sense of taste* in fishes, it is evident that as, with few exceptions, they swallow their food rapidly and

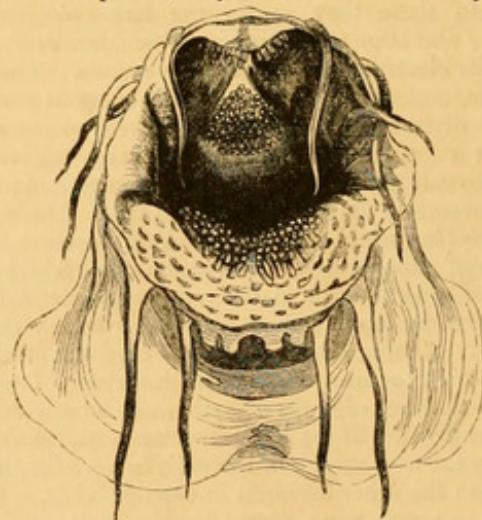


Fig. 50.

Mouth of *Plotodus megastomus*, one of the *Siluridae*. This fish feeds at the bottom, and the barbels developed round the mouth are organs of touch. Teeth are seated on the inner lips and move with them.

without mastication, their perception of that faculty must be in noways acute. The same may be inferred from the fact of their tongue being almost immovable, often entirely osseous, or beset with teeth or dental plates, and from its receiving very slender nerves, and these but few in number. Even those species of which the jaws are so armed as to enable them to cut and bruise their aliment, cannot long retain the latter in their mouths, on account of the position and the play of the respiratory organs. No salivary glands discharge their moisture on the organs of taste. The tongue itself is not seldom entirely wanting; and even when it

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exists in its most distinct and apparently fleshy state, it consists merely of a ligamentous or cellular substance, applied on the surface of the lingual bone. It is never furnished with muscles capable of producing any movement of extension or retraction, as in quadrupeds.

Fishes cannot be said to be more highly favoured in respect to the *organs of touch* than those of taste. The faculty is greatly deadened over the general surface by the coating of scales, and in the particular members by the inflexibility of the rays. It is chiefly confined to the lips, and even these parts in many species are themselves as hard and insensible as bone. Certain soft and delicate appendages called *barbels*, possessed by many species, such as the Cod and Loach, are supposed to enjoy a more delicate perception of the sense of touch; and among the *Sclerogenida* there are many species that have one or more rays of the pectoral detached from the membrane, so as to become truly delicate, flexible fingers, not for prehension but for touch. The common Gurnard has been seen in a clear sea swimming along near a sandy bottom, and exploring it with these special organs of touch. It is by means of the *dermis* that that peculiar matter, so remarkable for its silvery metallic lustre, and which bestows so much of brilliancy upon the class, is secreted beneath the scales. It is composed of small polished plates resembling burnished silver, and capable of being removed by washing, either from the skin itself, or from the inferior surface of the scales. It is this substance that is used in the formation of false pearls. It is also secreted by many species in the thickness of the peritoneum, and in the envelopes supplied by that part to particular viscera, especially the swimming bladder.

It thus appears that the external senses of fishes convey to them few lively or distinct impressions; and by whatever scenes in nature they are surrounded, their perceptions are probably indistinct and dull. Their sexual emotions, cold as their blood, indicate only individual wants. Few species pair, or enjoy any connubial gratification, for the males seek the eggs rather than the females which deposit them, and neither sex ever recognises its offspring. At least the exceptions to these general laws are extremely few, and when they occur they are of the lowest animal description. A pair of Congers are so dead to external impressions at the time of sexual congress, and so automatically, as it were, engaged, that they have been taken by the hand together out of the water. Sharks and

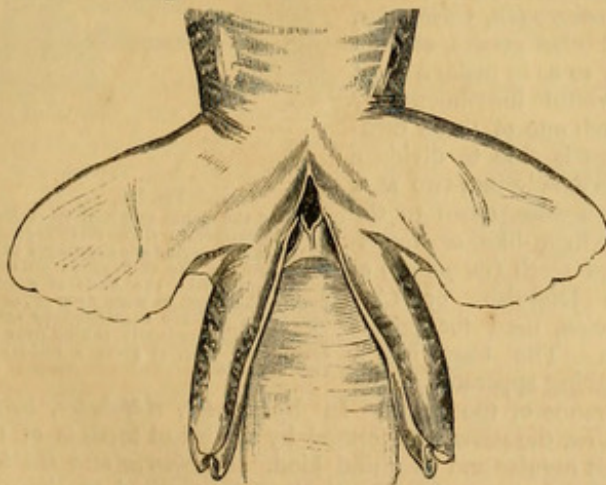


Fig. 51.

Pectoral fins and claspers, or intromittent organs of the male *Hemiseyllum trispiculare*.

Rays have special organs that make some approach to those of the two higher classes of vertebrals. We have no means of knowing much of the loves of a Dog-fish or Skate, but the prevailing economy of fishes may be said in all these respects to be exactly the reverse of that of birds. These

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gay creatures of the sky have the power of surveying distinctly at a glance an immeasurable extent of horizon; their acute perception of hearing appreciates all sounds, and every intonation; and their glad voices are exquisitely skilled in their production. Though their bills be hard, and their bodies covered by down and feathers, they are by no means deficient in the sense of touch. They enjoy all the delights of conjugal and parental affection, and perform their incumbent duties with devotedness and courage; they cherish and defend their offspring, and will sometimes die in their defence; and of all the wonderful labours of instinctive art, none is so beautiful as the formation of their mossy dwellings. With what deep and continuous affection does the female brood over her cherished treasures! how unwearied is the gallant male in his tender assiduities, and in the rich outpouring of that varied song by which he seeks to soothe her sedentary task! The same principle of attachment and discrimination is even made available in a state of domestication by the skill of all-engrossing man. A bird acquires a knowledge of its master, and submits to and obeys that master's will; and the proud falcon, which in its natural state

“Doth dally with the wind, and scorn the sun,”

will wheel in airy circles over a well-trained dog, or stoop its boldest flight at some familiar urchin's call. Other species will even imitate man's noblest faculty, the power of speech,—and it is thus with somewhat doubtful feelings that we deny to them the gift of reason.

But the silent dweller in the deep knows few attachments, expresses no language, cherishes no affections. Constructing no dwelling, he merely shelters himself from danger among the cavernous rocks of the ocean, or beneath the murky shade of the overhanging banks of rivers; and the cravings of hunger seem alone to exercise a frequent or influential action over his monotonous movements. We must not, however, suppose that the life of fishes is not one of enjoyment, for we know that the great Creator “careth for *all* his creatures;” and it ought perhaps rather to be said that we cannot appreciate the nature of their feelings, than that they are in any way fore-doomed to a negation of pleasure. Assuredly, however, the hand of nature has been most prodigal in bestowing on their external aspect every variety of adornment. Their special forms are infinite, their proportions often most elegant, their colours lively and diversified, and nothing seems wanting in them to excite the admiration of mankind. Indeed it almost appears as if this prodigality of beauty was intended solely for such an end. The brightness of metallic splendour, the sparkling brilliancy of precious gems, the milder effulgence of the hues of flowers, all combine to signalize fishes as among the most beautiful objects of creation. When newly withdrawn from their native element, or still gliding submerged in its liquid coolness, their colours, fixed or iridescent, are seen mingling in streaks or bands, or broader flashes, always elegant and symmetrical; sometimes richly contrasted, sometimes gradually softened into each other; and in all cases harmonizing with a chaste fulness of effect, which Titian or Rubens might envy, but could never equal. For what reason, then, it has been asked, has all this adornment been so lavishly bestowed on creatures which can scarcely perceive each other amid the dim and perpetual twilight of the deep? Shakspeare has already said that there are “more things in *heaven and earth* than are dreamt of in our philosophy;” and we fear it is no answer to the foregoing question to add, that the same observation applies with even greater truth to the “*waters beneath the earth.*”

SECTION VI.—THE NUTRITION, MANDUCATION, AND DEGLUTITION OF FISHES.

The nutritive functions of fishes follow the same order

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of progression as those of the other vertebrated classes; they seize, and some divide, their food with their teeth; they digest it in the stomach, from whence it passes into the intestinal canal, where it receives a supply of bile from the liver, and frequently a liquid similar to that of the pancreas; the nutritive juices, absorbed by vessels analogous to lacteals, and probably taken up in part also directly by the veins, are mingled with the venous blood which is flowing towards the heart, from whence it is pushed to the branchiæ, in which, coming into contact with the water, it is converted into arterial blood, and then proceeds to the nourishment of the whole body. As in other animals, also, certain properties are carried off from the blood by transpiration, the secreting power of the kidneys, &c.

Fishes in general are extremely voracious, and the rule of "eat or be eaten" applies to them with unusual force. They are almost constantly engaged in the pursuit and capture of their prey; their degree of power in these respects depending of course on the dimensions of the mouth and throat, and the strength of the teeth and jaws. If the teeth are sharp and hooked, they are capable of securing the slenderest and most agile animals; if they are broad and strong, they are able to bruise the hardest aliment; if they are feeble or entirely wanting, they are only serviceable in procuring some inert or unresisting prey. Fishes indeed show but little choice in the selection of their food, and their digestive powers are so strong and rapid as to suffice to dissolve very speedily all kinds of animal substances. They greedily swallow other fishes, notwithstanding the sharp spines or bony ridges with which they may be armed; they attack and devour crabs and shell-fish, gulping them entire if they cannot otherwise attain their object; they do not object occasionally to swallow the young even of their own species, and the more powerful kinds carry their warfare into other kingdoms of nature, and revel on rats, reptiles, and young ducklings, to say nothing of the ferocious Shark, which not seldom makes a meal even of the lord of the creation. The species which live chiefly on vegetable substances are few in number.

The growth of fishes depends greatly on the nature and supply of food, and different individuals of the same species exhibit a great disparity in their respective dimensions. They grow less rapidly in small ponds or shallow streams, than in large lakes and deep rivers.¹ The growth itself seems to continue for a great length of time, and we can scarcely set bounds to, certainly we know not with precision, the utmost range of the specific size of fishes. Even among species in no way remarkable for their dimensions, we ever and anon meet with ancient individuals, favourably situated, which vastly exceed the ordinary weight and measurement of their kind.

The *teeth* of fishes are more variable in form, structure, number, and position, than those of any other class of animals. They are depressed prisms of three, four, five, or six sides in *Myletes*, *Myliobates* or *Scarus*. More generally they are round and tapering, varying in length and thickness from the "short obtuse cone," to the "long conical," "subulate," "acicular forms," even to such fineness as to be named "ciliiform." Their points may be curved, reflexed,

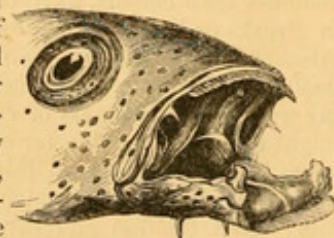


Fig. 52.
Petrosicirtes Bankieri.

and bent at right angles, and their bases may be fixed or moveable. In some *Gobiidæ* their forms and free motion have caused them to be compared to the keys of a piano. When acicular or ciliiform teeth are arranged so closely as to resemble the pile of velvet, they are said to be "villiform" (*en velours*); and when coarser and straight, or with their points bent back, they are "card-like," or "cardiform," or they may be rasp-like or carduliform (*en râpe ou en cardes*). The *Chatodontidæ* are named from their seti-

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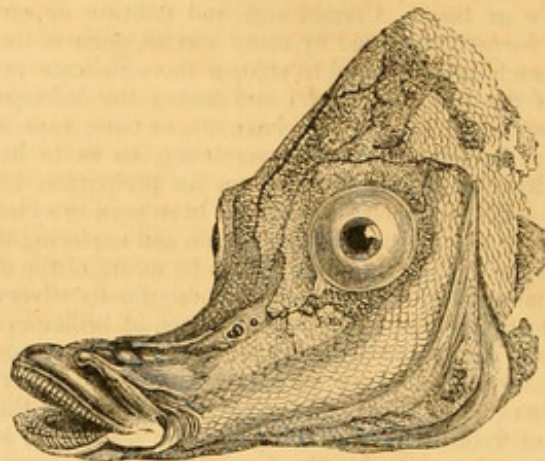


Fig. 53.

Head of *Histiopertus recurvirostris*, one of the *Squamipennes* or *Chatodontidæ*. The teeth, as in the true *Chatodonts*, are closely set, but they are stouter than the "villiform" teeth, and even than those usually named "setiform," having a resemblance to the cylindrical blunt fibres of whalebone in a scrubbing brush, hence they may be termed coarsely "brush-like" (*en brosses*). They are somewhat thicker than the strong hairs of an elephant.

form teeth. In the *Sphyræna* we have examples of teeth exactly resembling the blade of a surgeon's lancet (*vide* fig. 19), and in Sharks the teeth have a variety of forms, from the long triædral dagger or spike-nail of *Oxyrhina* and *Odontaspis*, to the serrated or lobed cutting teeth of *Galeocerdo*, *Carcharodon*, *Cacharias*, and other genera, set in a row so as to make a most powerful instrument, by which one of these creatures is able to divide a man's body into two at a single bite, down to the pavement-like or tessellated teeth (*en pavés*) of the Dog-fish, or *Cestracion*, used for crushing. The Carp has a crushing apparatus at the entrance of the gullet. In *Myliobates*, *Aëtobates*, *Rhinoptera*, the pavement formed by the broad teeth is of the most regular and beautiful kind. In *Scarus* and *Hoplenathus* or *Scarodon*, the teeth are so united to the premaxillaries and mandible as to form but a single tooth in each jaw, while in *Calliodon*, the union of the teeth

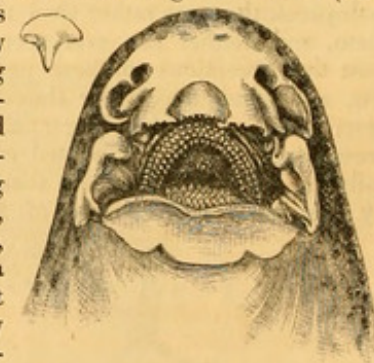


Fig. 54.

Orifices of the mouth and nostrils of *Hemiscyllium trispeculare*. The teeth are seated in the skin covering the cartilages of the jaws, and, as the skin grows outwards (peripheral) like the nails of a man's fingers, the teeth as worn drop off, or desquamate, and are succeeded by others from within, gradually rolling over the cartilages. Fig. 11 gives a full-length view of this fish.

¹ The writer of this treatise kept a minnow little more than half an inch long in a glass tumbler for a period of two years, during which time there was no perceptible increase in its dimensions. Had it continued in its native stream, subjected to the fattening influence of a continuous flow of water, and a consequent increase in the quantity and variety of its natural food, its cubic dimensions would probably have been twenty times greater; yet it must have attained, prior to the lapse of a couple of years, to the usual period of the adult state. (J. W.)

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with the bone is less complete, and their edges rise as such. The Lampreys have rows of teeth on the lips, as above the general surface. In *Diodon*, we have the same kind of single tooth in each jaw, or rather confluence of teeth and jaw. In *Tetrodon*, the dentiferous jaws are divided by a mesial suture so as to present two compound teeth above and as many below.

In the *Plagiostomes*, the teeth are limited to the *maxillary* and *mandibular* bones, while in the genus *Cyprinus* teeth are wanting in the jaws, but, as mentioned above, these fish have grinding teeth on the pharyngeals and basi-occipital. In the *Catastomi* of the Cyprinoid family, the pharyngeal teeth are arranged on a crescentic bone like the teeth of a curved comb, the points being thickened for grinding. In *Scarus*, besides

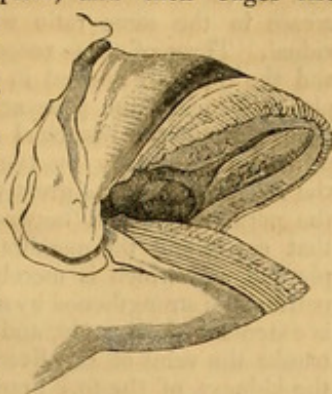


Fig. 55.

Jaws of *Hoplegnathus* (*Scarodon* Schlegel). The upper jaw is constituted by the pre-maxillaries coalescent into a single bone, and having the teeth so intimately incorporated with their substance as to make a solid, smooth, gorget-shaped bone; the forms of the teeth, however, faintly showing. The same is the case with the maxillary, the symphyseal line being obliterated as completely as in the human under jaw.

the solidly aggregated jaw-

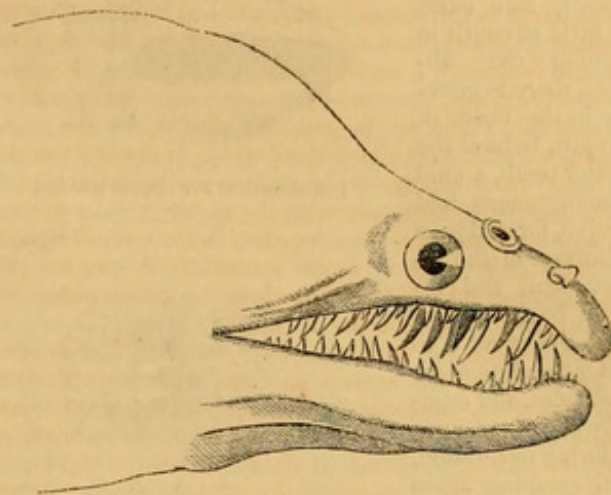


Fig. 58.

Jaws of *Enchelynassa Bleekeri*, one of the *Murænidae*. In this genus, teeth stand round the edge of the nasal bone and down its mesial line; two small ones exist on the vomer; two rows on the palatine bones and mandible. The hinder nostril is funnel-shaped.

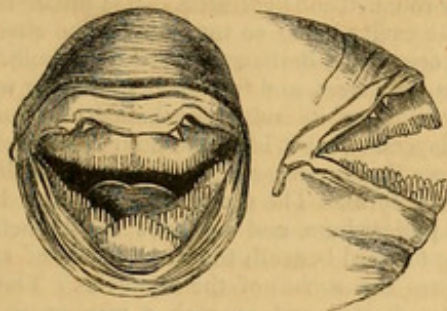


Fig. 56.

Teeth of *Calliodon chlorolepis*, a Searoid fish from Hong Kong. In this genus the teeth are less intimately united to the jaw-bones than in *Scarus* and *Hoplegnathus*. In the upper jaw the teeth consist of narrow chisel-shaped denticles, so grouped as to indicate four teeth with curved crenated edges on each pre maxillary and limb of the dentary piece of the maxillary. In the latter the four teeth stand out more distinctly, the one next the medial line being so intimately coalescent with its fellow as to form merely one tooth of the same shape as the others, and seated in front of the symphysis. So considered, it is a pairless median tooth, followed on each side towards the corner of the mouth by three others. There are also two small subulate canines or buck-teeth on each pre-maxillary. The fish is the "Sealy King-fisher" of the Chinese, who give it this name because it has bright celandine-green, orange, and yellow colours.

teeth above mentioned, there are also pharyngeal grinders. In *Crenidens*, thin tricuspid teeth placed in many close rows on the jaws, serve to cut the tender fuci on which these fishes feed. In passing through the whole series of fishes, we find teeth on the nasal bone, as in *Muraena*, where they stand in a row round the edge of the bone, and in one down the longitudinal mesial line; on the pre-maxillary, the maxillary, the palatines, the vomer, the hyoid-bones, the branchial arches, and especially on their processes, named "rakers." Teeth occur on the maxillary only when it enters into the composition of the orifice of the mouth, as in the *Clupeidae* and *Salmonidae*. In *Pristis*, of the Ray tribe, the flat snout, greatly prolonged, and well ossified, is set on each side by a series of very strong nail-shaped teeth, whence its name of Saw-fish among sailors, though it is in reality a weapon that wounds by repeated blows, not by cutting longitudinally like a saw. This snout forms a dangerous sword in the hands of the Polynesians who use it

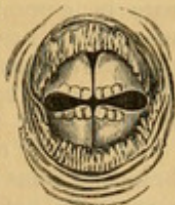


Fig. 57.

Teeth of *Tetrodon bimaculatus* of the *Ostracionidae* family of *Plectognaths*, similar to those of *Scarus* and *Hoplegnathus*, but the mesial symphysis of both jaws remaining non-coalescent, four teeth are formed, as the generic name denotes.

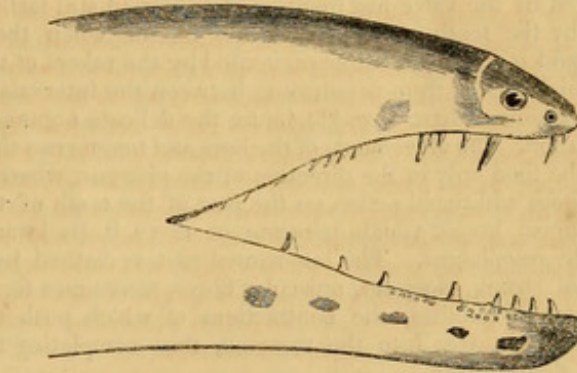


Fig. 59.

Jaws of *Brachysomophis horridus*, one of the *Ophisuridae*, which have one row of teeth round the margin of the nasal, one row down the mesial line of that bone, and one on the vomer; a row on the mandible, and two rows on the palatines.

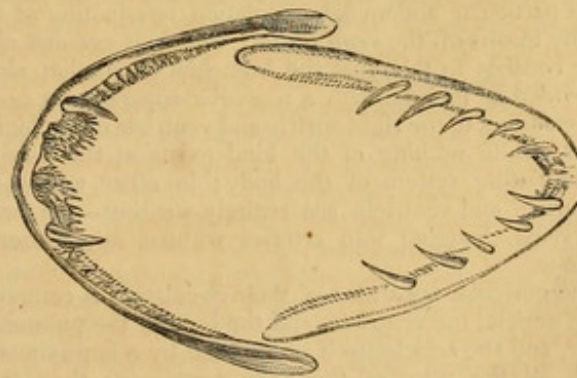


Fig. 60.

Jaws of *Plectropoma dentex*.

well as strong pharyngeals. Commonly the teeth do not cross the symphysis of the jaw, there being in most cases a line of division between the pre-maxillaries or at the union of the limbs of the mandible. Instances to the contrary have already been mentioned in *Scarus*, *Hoplegnathus*, and *Diodon*. In *Notidamus*, *Scymnus*, and *Myliobates*, among the *Plagiostomi*, we have also examples of this departure from the dental type of the higher animals.

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In the majority of osseous fishes, besides the lips, which, having no peculiar muscles, can exert but little strength in retaining the aliments, there is generally in the inside of each jaw, behind the anterior teeth, a kind of membranous fold or valve, formed by a replication of the interior skin, and directed backwards, of which the effect is to hinder the alimentary substances, and especially the water gulped during respiration, from escaping again by the mouth. This structure does not, as formerly supposed, constitute a character

restricted to the genus *Zeus*, but exists in an infinity of fishes. The food seized by the teeth of the jaws, and detained by the valve just mentioned, is carried still farther back by the teeth of the palate and tongue when these exist, and is at the same time prevented by the rakers of the branchiæ from penetrating between the intervals of the branchiæ, where it might injure the delicate organs of respiration. The movements of the jaws and tongue can thus send the food only in the direction of the pharynx, where it undergoes additional action on the part of the teeth of the pharyngeal bones, which triturate or carry it backwards into the œsophagus. The last-named part is clothed by a layer of strong, close-set, muscular fibres, sometimes forming various bundles, the contractions of which push the alimentary matter into the stomach, thus completing the act of deglutition.¹

SECTION VII.—THE CIRCULATION OF FISHES.

Fishes, in common with warm-blooded animals, are provided with a complete circulation for the body, and with another equally complete for the organs of respiration, and with a particular abdominal circulation terminating at the liver by means of the *vena portæ*; but their peculiar character consists in this, that the branchial circulation alone is provided at its base with a muscular apparatus or heart, corresponding to the right auricle and ventricle of the higher classes, while nothing of the kind exists at the base of the circulating system of the body; in other words, the left auricle and ventricle are entirely wanting—the branchial veins changing into arteries without any muscular envelope.

The muscular apparatus of their circulation is composed of the auricle, the ventricle, and the bulb of the pulmonary artery, and the auricle itself is preceded by a large sinus, in which all the veins of the body terminate; thus there are in a single series four cavities separated by constrictions, into which the blood must flow in its progress from the body to the branchiæ. Their size is small in propor-

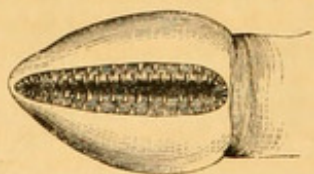


Fig. 61.

Labial teeth of *Petromyzon mordax*.

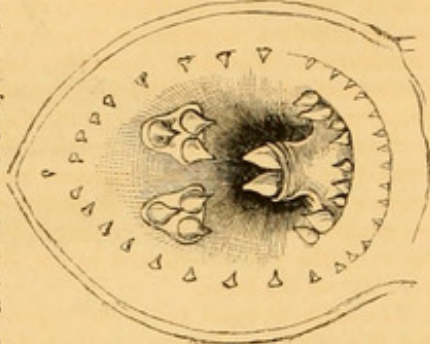


Fig. 62.

Pharyngeal teeth of *Petromyzon mordax*.

tion to the dimensions of the body, and does not increase in the same ratio with the growth of the individual. Three of these receptacles, the auricle, the heart, and the bulb, are lodged in a pericardium, which is itself placed beneath the pharyngeal bones, between the inferior parts of the branchial arches, and for the most part protected externally by the scapular arch. Except in the *Plagiostomes*, the great venous sinus is not placed in the pericardium, but between the posterior partition of that cavity and the membrane which represents the diaphragm, and which is merely the anterior portion of the peritoneum strengthened by aponeurotic fibres. This sinus is extended transversely, and receives by several different trunks the veins of the liver, of the generative organs, of the kidneys, of the fins, branchiæ, and throat; and finally those of the head, which themselves partly pass by a sinus at the back of the cranium. The first-mentioned sinus sends the whole of this blood by a single orifice of its anterior convexity into the auricle, which receives it through the opening of its anterior portion. Two thin membranous valvules protect this communication, and are turned towards the auricle. The latter organ is placed in the pericardium, in front of the great sinus, and above the ventricle, that is, on its dorsal aspect. The ventricle presents very various and often remarkable configurations. In osseous fishes it is usually of a tetrahedral form,—in the cartilaginous kinds more frequently rounded and depressed. It is situate beneath the auricle, the cavity being so turned as to be almost vertical next that organ, and horizontal towards the bulb. Its coats are extremely robust, and furnished internally with powerful fleshy columns, its substance being composed of two different layers. But it is in the bulb of the branchial artery that we find the most vigorous fibres, usually disposed in a circular form. The prolongation of this bulb issues from the pericardium, and becomes the branchial artery, advancing forward beneath the single chain of small bones which unites the arches of the branchiæ. The branchial artery soon divides, and in such a manner as to send a branch to each branchia. These branches pass along a hollow groove on the convexity of each branchial arch, and more external than the vein which follows the same track, but in an opposite direction. To the arch are attached a great number of leaflets, parallel to each other, usually terminated in a forked point, and sometimes deeply divided. The principal branch which passes along the groove of the arch gives a smaller branch to each of the leaflets; and this branch, after being twice bifurcated, furnishes an infinity of lesser branchlets, which meander over the surface of each leaflet, till they finally terminate in extremely minute veins. These little vessels meet on each side in a branchial vein, which proceeds along the internal margin of the lateral lobe of the leaflet, and the two veins open into the trunk of the great vein of the branchia.

On passing out of the dorsal side of the branchiæ, the branchial veins assume the structure and functions of arteries; even before their arrival at this point, the anterior have already sent several branches to different portions of the head; and it is necessary to remark, that the heart and several parts situate in the chest receive their blood from a branchial vein, by means of an offset issuing from near its source, and consequently anterior to its exit from the branchiæ. Nevertheless, it is only by the re-union of the

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¹ The various notices (as already intimated) of the internal structure of fishes contained in the article COMPARATIVE ANATOMY of this work (vol. iii.) absolve us from the necessity of presenting any details regarding the form and constitution of the intestinal canal, and of certain other important interior organs of the class. The forms of the stomach, whether "siphonal" or "cæcal," the *pancreatic apparatus* passing from slender cæcal appendages to the intestinal canal, which secrete a proper fluid but do not admit the food, gradually increasing in complexity to the pancreatic conglomerate gland of the sturgeon, are parts of structure which the ichthyologist is required always to pay attention to; and also to the extension of the inner coats of the intestine by valvular folds, producing a more extensive secreting surface, and delaying the passage of the food. The two forms of spiral valves in the lower gut of sharks, and in some of the osseous apodals, require special notice.

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trunks proceeding from the four branchiæ that the great artery is formed which carries the blood to the viscera and all the parts of the trunk, and which is by consequence the representative of the aorta of the Mammalia,—but of an aorta which possesses neither auricle nor ventricle at its base. Thus, according to Cuvier's views, the left cavities of the heart of quadrupeds do not exist in fishes, but are replaced by a simple vascular apparatus, situate above the branchiæ, in like manner as the right cavities are placed beneath them.

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of deep-sea Mediterranean fishes. Dr Davy¹ in the air-bladder of fresh-run Salmon found a trace of carbonic acid, and 10 per cent. of oxygen, the remainder of the air being nitrogen. Humboldt found 4 per cent. oxygen, and 96 per cent. nitrogen, in the air-bladder of *Gymnotus*. That the air-bladder is homologous with the lungs of the higher animals, is the opinion of the best physiologist of the present day. These in their embryo state have gills, the lungs being developed when needed. In fishes the gills are persistent, while the air-bladder is simple and embryonic, having chiefly a mechanical function to perform. In the Salamandroid *Ganoidei*, however, various *Siluroids*, and *Protopteri*, the air-bladder shows some pulmoniform complications. The *Lepidosiren* of the Gambia remains buried in the mud during the dry season, and its respiration is performed by pulmonary air-bladders, which have short, wide tracheæ, kept open by cartilaginous orifices; and all the oxygenation of the blood required during the torpid condition of the fish is effected in the blood-vessels ramified over the air-bladders.

SECTION VIII.—THE RESPIRATION OF FISHES.

It is by an almost infinite subdivision of the vessels over the surface of the branchiæ or gills, that the blood of fishes becomes subjected to the influence of the circum-ambient water, which is made to flow incessantly between the branchiæ by the movement of the jaws, and of the opercular and hyoidean apparatus. This mode of respiration is as necessary to fishes as the direct respiration of air is to other animals. If the air is expelled by ebullition from the water, fishes cannot live; and many species are obliged to rise frequently to the surface for the purpose of breathing atmospheric air. It is easy to suffocate various kinds, by keeping them beneath the surface, inclosed in a gauze net. The absorption of oxygen, however, is comparatively small among these aquatics, for it has been calculated that a man consumes fifty thousand times more than is required by a Tench. When fishes are deprived of water, they perish not so much for want of oxygen, as because their branchiæ become dry, and unable to perform their functions duly. Hence the species of which the branchial orifice is small, as the Eel, or those which possess receptacles for moisture, like *Anabas* and *Ophicephalus*, long survive exposure; while such as have their gills greatly cleft and open, as the Herring, expire almost instantly when withdrawn from their moist abode. Some fishes, as *Amphipnous cuchia*, and *Saccolabrus singio*, have a pulmoniform sac for supplying air to the gills.

The more obvious use of this organ seems to be to maintain the fish in equilibrium, or to lighten or increase its relative weight, so as to cause an ascension or a sinking, in proportion as the bladder is compressed or expanded. This is probably effected by the contraction or dilatation of the ribs. At all events it is certain, that when the air-bladder bursts, the fish remains at the bottom, usually turning up its belly, and exhibiting other irregularities in its locomotion. Another curious effect is observable in regard to fishes which have been suddenly brought from a great depth by means of a long fishing line, and which having no time either to compress or partially empty the organ in question, the air which it contains being no longer pressed by the heavy weight of water, either expands so as to burst the bladder, or by its dilation forces the stomach and œsophagus into the fish's mouth. When the air-bladder is pierced artificially, the fish almost immediately turns upon its back, and sinks to the bottom.

SECTION IX.—THE AIR-BLADDER OF FISHES.

One of the most remarkable and characteristic organs of fishes is the air or swim-bladder. In many genera it has no opening or external communication, and in these the air which it contains must be the result of secretion. It is composed of an extremely fine internal tunic, of another of a thicker texture and peculiar fibrous structure, remarkable for producing the finest kind of isinglass, and is inclosed within the general coating with which the peritoneum invests the other viscera. It is sometimes simple, as in Perch, sometimes furnished with more or less numerous appendages, as in some of the Haddock tribe, or branched, as in certain *Sciencæ*. Occasionally we find it divided, as it were, into two or more parts, by a constriction, as in the genus *Cyprinus*, many of the *Siluridæ*, and others. It is chiefly among the abdominal fishes that we find it communicating by a tube with the intestinal canal, and either directly with the œsophagus, as in *Cyprinus*, or with the base of the stomach, as in the Herring. That of the Sturgeon opens into the former portion by means of a large orifice. Professor Owen states generally that the contents of the air-bladder consist in most fresh-water fishes of nitrogen, with a very small quantity of oxygen and a trace of carbonic acid; but that in the air-bladder of sea-fishes living at great depths, oxygen predominates. Biot found as much as 87 per cent. of oxygen in the air-bladder

Though of the highest importance in the structure of such species as possess it (and these are by far the greater number), yet the air-bladder is not indispensable in the general economy of the class of fishes.² In some fishes it is no bigger than a pea; in several genera (*e.g.*, *Pleuronectes*) it is entirely wanting, and the species in such cases generally remain at the bottom, and, swimming obliquely on one side, propel themselves forward by a nearly vertical motion of the tail. In such cases both eyes are on the same side, and the whole structure of the fish, especially the skeleton of the head, presents an unsymmetrical aspect of a very extraordinary kind.³ In many cartilaginous fishes, such as Rays (commonly called Skates), the absence of the swimming bladder seems compensated by the enormous size of the pectoral fins, which, of all the external organs, are probably the most efficient in raising the body, as the caudal extremity is the power chiefly employed during an onward course. The Lamprey, which has neither swimming bladder nor pectoral fins, dwells in the mud. Flat fishes being unprovided with swimming bladders, are supposed for that reason to raise themselves with difficulty to the surface; and they do not appear to strike the water laterally like other fishes, but swim rather after the manner of the *Cetacea*, by a motion alternately up and down. In all the other animals of this class the chief organ of progressive motion is the tail, or prolongation of the body, terminated by a caudal fin, the position of which, unlike that of the great aquatic mammalia called whales, is vertical. The reason of the difference is obviously this: a true fish, pos-

¹ Transactions of the Royal Society of Edinburgh, xxi., p. 245, 1855.

² De Aure et Auditu, &c.

³ In several insects of the genus *Blatta* we have observed a want of symmetry both in the size and markings of the elytra. We do not mean an accidental variation of one side, but an evidently pre-ordained disparity of form and colour.

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sessing the power of extracting air from water by means of its gills, does not (except at rare intervals) require to mount to the surface for the performance of the vital act of respiration; but all cetaceous animals being furnished with lungs, which cannot perform their functions except through an immediate communication with the atmosphere, require their bodies to be terminated by a horizontal expansion, the action of which is the most efficient for an ascending course. It is, however, difficult to account for the fact that so considerable an organ as the swimming-bladder should have been denied to so many species, not only of the more indolent kinds, which dwell composedly at the bottom of the waters, but to many others which yield to none of their class in the ease and velocity of their movements. Its presence or absence does not even accord with the other conditions of organization; for while it is wanting in the common Mackerel, it is found to occur in a closely allied species, the *Scomber pneumatophorus* of Laroche. Weber

has pointed out a remarkable connection between the air-bladder and the acoustic organs in the head.

We have already alluded to a singular peculiarity connected with the organization of certain fishes—we mean the power of conveying electrical shocks. In Torpedos, the apparatus consists of two organs, built up of membranous tubes filled with mucous matter, divided by transverse chambers closely set together, like the cells of honeycomb, and disposed in two groups placed on each side of the head. They receive enormous branches of nerves from the fifth and eighth pair. In the *Gymnotus* the electric organs are four, and occupy the under surface of the body throughout its entire extent to a considerable thickness. It is composed of parallel plates separated by thin layers of mucilage. The effect of this natural galvanic pile will be detailed in the course of the systematic portion of this article, when we shall have occasion to mention the electric fishes in their proper place.

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CLASSIFICATION OF FISHES.

A "natural arrangement" of fishes or of any other class of animals implies an accurate knowledge of their whole structure, internal as well as external, by which they can be grouped in the order of their affinities, placing those species together which agree with one another in the greatest number of important characters. Naturalists have generally come to the conclusion that the series of species is not a linear one; some have one portion of their frames, some another, specially organized for the part the species has to play in the system of nature; and so the affinities branch off in several directions. The nervous system being that by which an animal has perception of external objects, and directs its motions accordingly, and which presides moreover over those operations of organic life that are not obedient to the will, would be one important basis of classification, but its various modifications of structure in fishes are still too imperfectly known, and the labour and skill necessary for the elucidation and discrimination of its parts and their functions are such that, practically, it has hitherto been as yet but little referred to in the arrangements of the systematic ichthyologist. The same is true in a greater or less degree of the other parts of the organism employed in nutrition, respiration and circulation, secretion, generation, and development; most of the arrangements of fishes that have hitherto appeared being based on the organs of locomotion and the external integument, the latter the most variable certainly that could have been chosen, but at the same time the least important. We have scaly, partially scaly, and scaleless species in the same genus of some particular groups. Agassiz has been labouring assiduously on embryonic development as a basis of arrangement; but as far as we know, has not yet published a system founded on his researches in this direction. All attempts at classification of fishes which have hitherto been given to the world, violate more or less anatomical affinities; the best on the whole that has been proposed, is that of Professor Johannes Müller, which we shall follow, adopting the modifications of Professor Owen. It would be a great help to the memory were the divisions of the class of equal rank to approach to equality also in the number of species that they embrace, but this cannot be; though most probably the disparity in the size of the groups would be considerably lessened were we acquainted with all the species secluded in the depths of the sea, and still unknown, as well as with the forms of the extinct fishes. The *Salamandroid* Ganoids which abounded in variety and number in another epoch of the earth's history, have only a few existing representatives; and of the palæozoic fishes with soft skins that are less likely to be preserved than the strongly cuirassed Ga-

noids, we know absolutely nothing, not even that such were then created.

In his arrangement of fishes, Müller finds characters which he considers to be of the highest importance in the vascular system. The heart of fishes is a venous or branchial one, consisting of an auricle in which the veins terminate, and a ventricle for transmitting that venous blood to the gills where it is aerated and whence it circulates through the body without the intervention of a special propelling organ like the systematic side of the heart of a higher animal; but merely through the general contractile power of the arteries. In most fishes there is a thick muscular swelling of the commencement of the arterial system close to the ventricle, and which, in fact, may be called a third chamber of the heart. The blood is prevented from regurgitating into the ventricle on the contraction of the bulb by valves; and the number of these valves, and the presence or absence of the thick muscular coat of the bulb, furnish characters of groups so constant, that Müller says he is acquainted with no others, either anatomical or zoological, which equal them in certainty. The *Plagiostomi*, or cartilaginous fishes, as restricted by the removal of several groups that were included among them by the older ichthyologists, have *three or more longitudinal rows of valves* within the muscular bulb. A still *greater number of valves* are present in the bulb of the existing Ganoids; but in the large group formed by the osseous fishes after the Ganoids have been removed from them, *two opposite valves* are placed at the origin of the bulb, and no more. This great group Müller names *Teleostei*, or perfect osseous fishes; and he includes in it the six following orders mentioned in the subjoined table,—*Acanthopteri*, *Anacanthini*, *Pharyngognathi*, *Physostomi*, *Plectognathi*, and *Lophobranchii*. The *Cyclostomes* of Cuvier, or the Suckers, want the *bulbus arteriosus*, or thickened muscular tunic, but have *two valves* at the origin of the branchial vessel like the *Teleostei*; while the Lancelet (*Amphioxus*) wants the *heart* itself, the circulation being carried on by the muscularity of the entire vascular system. This fish, therefore, he considers as the type of a sub-class which he names *Leptocardii*. Another sub-class, termed *Dipnoi*, includes fishes which have scales, with both lungs and gills. In all, he makes six sub-classes of fish—1. *Teleostei*; 2. *Dipnoi*; 3. *Ganoidei*; 4. *Elasmobranchii*; 5. *Marsipobranchii* or *Cyclostomi*; 6. *Leptocardii*. In the subjoined modification of his arrangement by Professor Owen, these sub-classes are not preserved, the class being sub-divided into nine orders, and again into sub-orders. A few changes have been made by us in the termination of the names of

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respiration. The intestine proceeding from the œsophageal bag is slender, almost straight, and terminates at the anus, about one-fourth of the whole length of the fish from the point of its tail. In its motions, the Lancelet is lively and active, and shelters itself quickly from observation among the gravel. In 1853 Sundeval distinguished two American species of *Amphioxus* or *Branchiostoma*, the *B. caribæum* from the West Indies, and *elongatum* from Peru; but Professor Peters on comparing the species found that *caribæum* was identical with the European one. Dr Gray has described a Borneo specimen as a distinct species, so that the genus probably is not so poor in species as was at first supposed.

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CLASS OF FISHES.

ORDER I.—DERMOPTEROUS FISHES.

SUB-ORDER I.—PHARYNGOBRANCHS.

This order is named from the cutaneous vertical fins, in which the mucoid rays are extremely soft and delicate, or altogether imperceptible, and from the want of pectoral or ventral members. The first two sub-orders are founded on the different developments of the respiratory organs. In the first the pharynx itself is organized for respiration, and two processes having the function of gills project freely into the cavity of the mouth; the water necessary for respiration flowing over them by the same canal which carries the food; there being no lateral gill-openings through the skin. Of this sub-order the best known representative is the *Amphioxus lanceolatus* of Yarrell (*Branchiostoma lubricum*, Costa), which was first made known to the world as a *Limax* or Slug by Pallas, who received it from the Cornish coast. Recently Mr Couch rediscovered it on the same shores, and Mr Yarrell has described it in his excellent work on British Fishes, according to its true affinities as a fish, though its want of a head was puzzling. Its structure has since been investigated by Ratke, Johannes Müller, Owen, Goodsir, Swan, and other first-rate comparative anatomists,—many specimens having been procured among the gravel and rocks of the sea-beaches in the south of England, also in the Irish Channel, on the Norway coast, and in the Mediterranean. The longitudinal slit forming the orifice of its mouth, resembles, to the unassisted eye, that of a Lamprey, its jointed labial feelers looking like moveable teeth. It is a thin semi-transparent creature about an inch and a half long, without jaws, but having a large buccal cavity into which the short vascular processes that perform the function of gills project freely, without cartilaginous supports or lateral attachments. The buccal cavity communicates by a small pharyngeal opening with a wide barrel-shaped œsophagus, which occupies more than a fourth of the whole length of the fish, and whose interior surface is ciliated throughout, and organized to assist in respiration. Vessels that ramify over its vertical ciliated bands communicate with the dorsal and ventral portions of the vascular trunk that carries on the circulation, without the intervention of a central propelling organ. There is, however, beneath the posterior end of the expanded œsophagus a small widening of the circumferential vessel which pulsates rythmically, and which Professor Owen considers to be a rudimental representation of the branchial heart of the Myxinoids, the next order of fishes in point of organization. The peculiarity of shape which distinguishes the Lancelet from all other fishes, arises from all its nerves of the senses devolving from the myelon or spinal marrow, without the production of a ganglionic brain, and consequently, without the necessary expansion of the protecting integuments which make the head, and in animals more advanced in the scale, provide sockets for the sense capsules. The only cartilaginous part of this fish is a jointed hæmal arch which extends from the anterior end of the spinal chord on the ventral aspect to the orifice of the pharynx, and serves to support the oral filaments. It represents the labial arch of the higher Myxinoids. Though this little creature wants jaws, it has, as we have just mentioned, a large buccal cavity which, as in other fishes, admits not only food, but also aerated water, to the respiratory organs, and an enormous œsophagus having the double function of deglutition and

CLASS.—PISCES.

ORDER I.—DERMOPTERI.

Vermiform, abrachial and apodal; endo-skeleton unossified; exoskeleton and vertical fins muco-dermoid; no pancreas; no air-bladder. The development of the skull in the Dermopterous fishes is arrested at more or less embryonic stages, but in each genus it proceeds in a specific direction; thus, in the Lancelet, evolving an articulated labial arch and its numerous filaments; and in the Myxinoids and Lampreys forming a more complex system of lateral and labial cartilages; or modifying the palatine, maxillary, and hyoid rudiments in relation to the suctorial function of the mouth. The olfactory organ, which is double in all other fishes, is single in this order; and the eye is rudimentary, being merely a small fold of skin coated with a speck of dark pigment. It is probable that this point is sensitive to light, as the lowest member of the order, the Lancelet, quickly secludes itself among gravel when exposed to light. In *Ammocetes* and the Myxinoides the cartilaginous capsules of the acoustic organs retain the embryonic position of projecting spheres at the base of the cranium; these are less prominent in the Lampreys; in the Plagiostomes they are imbedded in the walls of the cartilaginous skull; and in the bony fishes they are walled up by ossification. The oral filaments and soft integuments of the anterior end of the Lancelet and Myxines receive many nervous twigs from the fifth pair; and touch seems to be the most important sense in these low vertebrals.

SUB-ORDER I.—PHARYNGOBRANCHII.

Cirrhostomi, aliorum. Gills free, pharyngeal; no heart. A single genus of few species.

FAMILY I.—AMPHIOXIDÆ.

GENUS I. AMPHIOXUS, Yarrell. (*Branchiostoma*, Owen.) Respiratory processes projecting from above the pharynx into the large cavity of the mouth. Interior mucous coat of the widely dilated œsophagus organized for aerating the blood. Mouth edentate, furnished with exterior labial barbels.

SUB-ORDER II.—SUCKERS.

Genus *Heptatrema*, Dum. (*Bdellostoma*, Müll. Act. Berol, 1838.) A single species is known, the *Petromyzon cirrhatus* of Forster, who discovered it in Queen Charlotte's Sound, on Cook's second voyage. It has since received the appellations of *Heptatremus Dombeyi* and *Bdellostoma Forsteri*. It is a lively, active fish, inhabits rocky bottoms, lies in wait for fishes on which to prey, and was frequently taken by our voyagers adhering to pieces of fish which had been let down into the sea as bait. It has the power of emitting an immense quantity of mucus from all parts of its skin. The New Zealanders roast and eat it.

Myxine, Linn. (*Gasterobranchus*, Bloch.) The species best known, *Myxine glutinosa*, Linn., or Glutinous Hag, was classed by Linnæus with the *Vermes*. The mouth is a membranous ring, with a single tooth on its superior part; while the strong teeth of the tongue are arranged in two rows on each side, so as to give to these animals the appearance of having lateral jaws, like insects or *Nereides*; but their tongue performs the office of a piston in exhausting the mouth so as to enable them to adhere to other

Classification—Der-
mopteri.

bodies, like the Lamprey. The lips are furnished with eight cirrhi, and above is a spout-hole communicating with the mouth; the body is nearly cylindrical, and terminates in a fin which surrounds the tail. The intestine is simple, wide, and straight, as viewed externally, but it is plaited within; the liver has two lobes; the eggs grow to a considerable size. When taken and confined in a large glass jar, a single fish will pour so much mucus from its lateral pores as to give the water the appearance of jelly.

Ammocetes. Body cylindrical, with numerous annular lines around it, that give it much the appearance of a worm. It lives in the mud of rivers. Mouth incapable of adhering by suction to other bodies; fins very shallow; tail sharp at the tip. The only species is *P. branchialis*, Shaw (the *Pride* of Pennant), which grows to six or eight inches long, and is as thick as a goose-quill. It inhabits the rivers of Oxfordshire, and occurs in various parts of the European continent.

Petromyzon, Dum., or Lamprey. The tongue, acting like a piston in the circular mouth, is capable of vigorous motion, and is an essential part of the mechanism by which the fish is enabled to attach itself firmly to stones, or to fasten itself to the larger fishes, which it is thus enabled to suck and devour at its leisure. The dorsal fin is farther forward than the anus, and a second unites with the tail. The European species are,—*P. marinus*, the Greater Lamprey, which grows to the length of more than three feet. It is considered as a delicate food, and is caught as it ascends rivers in the end of winter and spring. Colour yellowish, marbled with brown. First dorsal fin very distinct from the second. This fish is common in the Severn, and in the mouths of many European rivers. Its supposed *hermaphroditism* is mentioned by Sir Everard Home.—*P. fluviatilis*, the Lampern, or Nine-eyed Eel. Length from twelve to eighteen inches; olive back, silvery below; first dorsal distinct from the second. Two thick teeth, separate, in the top of the maxillary ring. Ascends rivers from the sea; swarms in the Thames, Severn, and Dee. Vast quantities taken in England are sold to the Dutch for the Turbot fishery. It abounds in the rivers on the southern side of the Baltic. Both these animals are very tenacious of life, and will live many days out of water.—*P. planeri*. About ten inches long; greatly resembles the preceding; but the two dorsal fins are united. It is also an European river fish. Figs. 61, 62 show the dentition of *Petromyzon mordax*, an Australian species; the lips and their teeth being shaved off in the latter to show the pharyngeal teeth.



Fig. 63.

Fig. 49 represents the lateral gill-openings of the same species, and fig. 63 the entire fish.

SUB-ORDER II.—MARSIPOBRANCHII.

Cyclostomi, Dum., Cuv. Gills fixed, bursiform, inoperculate, receiving the respiratory streams by apertures usually numerous and lateral, distinct from the mouth; a heart.

These are vermiform fishes whose vertical fins are folds of skin surrounding the tail, and the rays scarcely to be perceived in any part, being soft and rudimental. They are the first in the ascending series of fishes in which the anterior end of the myelon has that ganglionic development which constitutes the brain in fishes, and which have a cartilaginous cranium for its protection. In *Ammocetes* the persistent cranial cartilage resembles the first appearance of the cartilages in the embryo of the higher fishes. In the Myxinoids the neural and hæmal canals of the spinal column are formed of layers of the sheath of the gelatinous dorsal chord; the neural canal extending along the whole upper part of the chord, and the hæmal canal being confined to the tail. In the *Petromyzons* cartilaginous plates are developed in the fibrous sheath, which is

the first indication of neural arches. A cartilaginous barrel-shaped basket, homologous with the branchial skeleton of osseous fishes, is provided for the support of the gills and the canals leading to them. This cartilaginous frame-work is termed by Cuvier *cotes branchiales*; and he observes, that though it is much developed in the Cyclostomes, it is scarcely perceptible in the Rays and Sharks. There are no other ribs in this order. The Marsipobranchs, however, resemble the Plagiostomes in having an undivided cephalic cartilage, a spout-hole in the head, and a spiral valve in the intestine. In all other respects they differ from them, and especially in the complete absence of gill-arches, want of jaws, in the total absence of a muscular tunic to the *bulbus artenosus*, and in the arterial valves beyond the branchial opening of the ventricle being only two; they differ further in the genital organs of the one sex having no oviduct, and in the other no seminal duct.

The gills of Lampreys and Myxines are little bags, each of which has its proper artery; and its proper orifice in the pharynx through which the water flows in to pass out on the dermal side by another hole. These purse-shaped bags are called fixed lungs, in contradistinction to the gills of osseous fishes, whose exterior edges are free and pectinated; but Professor Owen has observed that if one side of one of the sacs were adherent to the adjacent side of another, and then each bag slit open and detached from the outer integument, a gill would be formed receiving its blood from two arterial branches, and resembling, were it pectinated, the gill of an osseous fish. The genera have been characterized by the number of the exterior gill-openings.

The teeth in the Marsipobranchs are composed of indurated albuminous matter, and when macerated, flake off in successive hollow cones. Agassiz, from investigations into the embryology of fishes, thinks that the Marsipobranchs are not a proper order of fishes, but merely embryonic forms of the more developed Sharks and Rays from which they ought not to be dissevered in our systems.

FAMILY I.—AMMOCETIDÆ.

GENUS I. AMMOCETES, Dum. Mouth semicircular, edentate, the posterior lip being transverse, cirrhatid within; gill-bags seven, each with an external lateral aperture, and receiving streams of water from the œsophagus without a separate trachea. Olfactory organ single, opening in the median line of the dorsal surface of the head, whence a narrow canal, strengthened by cartilaginous rings, runs to the bottom of the skull, and terminates by a valvular opening in front of the occipital cartilage. The pituitary lining is plaited longitudinally.

Agassiz describes a new species, *A. borealis*.

FAMILY II.—MYXINIDÆ.

Internal branchial openings œsophageal and equal in number to the branchial sacs; external ones as many, lateral; or only one common to all the gills of a side, and then situated on the ventral aspect; four barbels on the snout, and two on each side of the mouth which is circular; one tooth on the roof of the mouth, two rows on the tongue. Eye as lowly organized as in the Lancelet. Naso-palatine tube having a valve at its opening on the roof of the mouth.

GENUS I. MYXINE, Lin. (*Gastrobranchus*, Bloch.) Saccular gill-bags, six on each side, receiving the streams of water from the œsophagus by as many short tubes. The efferent tubes empty the water into a common lateral canal which terminates on the ventral aspect of the fish at the end of the first third of its length. Between this aperture and its fellow of the other side, there is a larger opening rather to the left of the mesial line, which admits the water into the œsophagus.

GENUS II. HEPTATREMA. Seven lateral branchial apertures. At the extremity of the snout a depressed opening of a canal leading to the gills. Four rostral cirrhi; as many labial ones. Eyes white lateral points.

FAMILY III.—PETROMYZONTIDÆ.

Branchial organ of each side divided by transverse partitions into seven fixed chambers, which receive the water from a median canal, distinct from the œsophagus, by as many round holes, and permit it to flow out by an equal number of lateral cutaneous orifices; the median canal lies beneath the œsophagus, opens anteriorly into the fauces by a doubly valvular orifice, communicates with the gill-chambers to the right and left, and is closed at the posterior end. Nostril single; tubular on the top of the head, leading to a globular nasal sac from a tube that descends to the base of the skull and the membrane of the palate, which closes it, leaving no perforation there. Cuvier compares this tube to a trachea. Mouth variously armed with teeth.

GENUS I. PETROMYZON, auctorum.

Dr Gray has recently proposed a new arrangement of the Lampreys.

Classification—Der-
mopteri.

Classification—*Dermopteri*.

(a.) SUB-FAMILY.—PETROMYZONINA.

(With distinct teeth and eyes.)

GENUS I. PETROMYZON. Two conical upper pharyngeal teeth close together; a single crescentic under one; numerous conical labial teeth, two fringed lingual ones. *P. marinus*, and four other species.

GENUS II. LAMPETRA. Upper and under pharyngeal teeth transversely crescentic; labial teeth in two rows on the border of the lips; more interior lateral teeth bigger, irregularly twice or thrice notched; lingual teeth pectinate. *P. fluviatilis*, *planeri*, and two other species.

GENUS III. GEOTRIA. Upper and under pharyngeal teeth transversely crescentic, the upper one-lobed; labial teeth numerous, remote, pointed, the interior ones the biggest; lingual teeth long, conical, curved. One species. *G. australis*.

GENUS IV. VELASIA. Upper and under pharyngeal teeth transversely crescentic; the upper bilobate; labial teeth narrow, truncate, the interior ones the biggest; lingual teeth rather long, curved. *V. chilensis*.

GENUS V. CARAGOLA. Two upper, three-lobed, pharyngeal teeth, widely apart; under one crescentic, nine-lobed; labial teeth four-bundled; lingual teeth flat. *C. lapicida*.

GENUS VI. MORDACIA. Two upper pharyngeal teeth; the lateral ones trilobate; nine under conical ones in a curved row; labial teeth conical, in a single series on the margin of the lip; lingual teeth long, conical, curved. *P. mordax*.

(b.) SUB-FAMILY.—AMMOCETINA.

(Without teeth and with obscure eyes.)

GENUS VII. AMMOCETES. Five species.

SUB-ORDER III.—RIBBON APODALS.

These delicate, semi-transparent, and scaleless fishes are inhabitants of all the oceans, and the species are probably numerous, though it is only in localities where much attention is paid to fish that they are likely to be noticed. They are many, and of considerable variety of form in the Mediterranean, and one species is occasionally taken by keen naturalists on the English coasts. Several have been described that inhabit the Indian seas; and on Sir James Clark Ross's antarctic voyage one specimen was obtained in a high southern latitude. The absence of ossification in the skeleton, the gelatinous condition of the sheath of the spinal marrow, which, in the form of a "chorda dorsalis," reaches into the base of the skull; and the persistence of the primordial cartilaginous cranium are reasons for placing these fishes with the *Dermopteri*.

SUB-ORDER III.—APODES LEMNISCATI.

Ribbon-shaped, extremely compressed fishes. Gills free, suboperculate; no air-bladder. Skeleton cartilaginous; no scales. Blood colourless; no spleen.

FAMILY I.—LEPTOCEPHALIDÆ, Bon.

Helmichthyidæ, Köll. Small, greatly compressed, blade-shaped, apodal, diaphanous fishes, totally destitute of scales, with a lateral line formed by the intersection of the muscular layers; some have, some want teeth; and the pectoral fins are also present in some species, and wanting in others. The anus is placed on the ventral edge of the fish, before or behind the middle, and the simple straight gut runs near the ventral edge of the fish. Their skeleton is very incomplete and cartilaginous, and the myelon is obscurely visible through it. In most, the anal and dorsal, uniting at the end of the tail, form a pointed or blunt, but very seldom a forked caudal, in which the rays are generally discoverable.

GENUS I. ESUNCULUS, Kaup. *Leptocephali* with small pectorals and a forked caudal. One species, Italy.

GENUS II. HYPRORUS, Köll. Jaws straight, much elongated, with merely traces of dentition. Hinder nostrils before or over the eyes; muciferous pores along the jaws and round the eye. Body elevated and gibbous at the occiput; tail pointed. Pectorals minute; rudimentary anus before the middle; caudal not distinct from the other vertical fins. One species, Messina.

GENUS III. OXYSTOMUS, Rafin. (*Tilurus*, Köll.) Distinguished from *Leptocephalus* by the rayless, cutaneous dorsal fin commencing at the occiput, and by the upper and under transverse muscular bands not making an angular interruption or break anteriorly at their intersection; no anal fin; anus far back, near

where the tail is attenuated into a longish filament. Head small; mandible a trifle longer; pointed teeth on both jaws; gill-openings furnished with distinct opercula, and squeezed together on the throat. Three species.

GENUS IV. LEPTOCEPHALUS, Lin. (*Helmichthys*, Rafin.) Distinguished from *Oxytomus* by none of the species having the tail so prolonged into a hair-like point, and by the muscular bands making a distinct angular intersection anteriorly. Some species have, others want teeth; there are species in which the teeth can be seen only through a microscope, and others whose pointed teeth are distinctly visible to the naked eye. Most have small pectorals, but some show not even a trace of these fins. At the end of the gut there is an anal opening as fine as a hair, which gives exit to the fluid excrement. Eighteen species.

GENUS V. CHEILOBRANCHUS, Rich. Form compressed; body linear-lanceolate. Head very small; snout obtuse; jaws equal. Mouth small; teeth uniserial, acute, becoming blunt with age, closely ranged so as to form an incisorial series; lips loose. Anus before the middle; dorsal and anal mere cutaneous folds without rays or interneural bones; a single interneural at the point of the tail, which supports seven or nine jointed rays; caudal united with the cutaneous dorsal and anal; muscular layers forming chevrons, which have the apex of the angle on the lateral line, and directed forwards, as in *Leptocephalus*; abrachial and apodal. Gill-opening under the throat, a small transverse slit, common to the two sides, without a division in the middle; the edge of the membrane free; a cutaneous fold, ending on each side in a minute lobe, forms the posterior edge of the opening, and seems to be capable of acting like a valve, with the aid of an interior membranous fold; brachiostegals three; a minute genital papilla; a single pancreatic caecum was observed; the intestine appeared to be straight, with a stomachal dilatation. The skin is smooth, but minutely pitted, as if from microscopical sunken scales. Vertebrae 73, ossified. Two species—one obtained at Penguin Island, in Lat. 72. S.

Classification—*Dermopteri*.

ORDER II.—MALACOPTEROUS FISHES.

SUB-ORDER I.—SERPENTIFORM APODALS.

In the Lancelets, the only representatives as yet known of the order of *Dermopteri*, we have seen that the skeleton is membranous, that the spinal nervous chord is continued to the anterior end of the fish without expansion, and that in conformity with this simplicity of the nervous centre, the head cannot be distinguished from the body, and may be said to be wanting,—the only part of the face that is developed being the mouth and oral filaments. In the Suckers the skeleton rises from the soft membranous condition of that of the *Ammocete*, to the production of a tendinous spinal chord filled with gelatine, and partially encompassed by cartilage; teeth exist on the palate and lips, though as yet seated only in the soft parts, and formed of indurated mucoid matter; while the jaws are wanting. The group we have now to speak of consists of fishes with a well ossified skeleton, and a head that is at once recognised as such, but with the bones of the face less fully developed than in osseous fishes more highly organized. A single bone represents the nasal, ethmoid, and vomer, or it may be said that these three bones have coalesced into one, which is firm and strong. The pre-maxillaries and the maxillary are wanting, the palatines coming in contact with the lips to form the lateral portions of the upper jaw, which are opposed to the mandible,—the teeth which arm these bones standing in reverse order with regard to one another; for instance, when they are biserial, and the inner row is the tallest on the palatines, the outer row of the mandibulars is the tallest, and is opposed to the lower rank of the palatines. In the mammals a similar reversal of the sides of the molar teeth may be noticed in comparing the upper and lower jaws.

This sub-order does not embrace all the fish that want ventral fins, there being many examples of such in other groups, but it may be viewed as presenting an analogy to the *Cetaeci* among mammals. Neither does the vermiform type belong exclusively to these Apodals; we shall find it manifested repeatedly in other parts of the series of fishes.

The table in small type gives the technical characters

Classification—*Malacopteri.*

of the various divisions and sub-divisions of the order, and our limits will not permit us to do more than to notice a few of the species that inhabit the British waters, or that are otherwise interesting from some particulars in their history or economy.

In this order the forms of the teeth vary greatly. In a few species they are mere grinding machines, in the majority, long, slender, and sharp for the retention of their prey; in others, they are variously lobed, fine-edged, cutting instruments. On these different kinds of dentition, the genera and minor groups are, in many instances, founded. The arrangement of the entire sub-order is that of Dr J. Kaup of Darmstadt, from whose catalogue, written for the British Museum, we have borrowed it.



Fig. 64.
Muræna pavonina.

The *Muræna Helena*, or *Roman Muræna*, abounds in the Mediterranean, and was introduced by the luxurious Romans of antiquity, in crystal vases, to the table before being cooked, that the guests might admire its variegated skin. This fish is very voracious, and feeds on all sorts of animal matter. The Romans fed them in ponds, and Pliny has recorded the atrocities of Vedius Pollio, who used to punish his offending slaves by throwing them alive to his *Muræna*. We have seen this fish repeatedly taken at Gibraltar, between three and four feet in length. The skin is beautifully marbled with yellow sub-angular markings on a rich brown ground. When captured in nets it lives long out of the water, and is capable of biting very severely, from the sharpness of its numerous teeth.

A Murry is noticed in the narrative of *Cook's Third Voyage to the Pacific* in these words:—"Amongst these were some large eels, beautifully spotted, which, when followed, would raise themselves out of the water, and endeavour, with open mouth, to bite their pursuers."

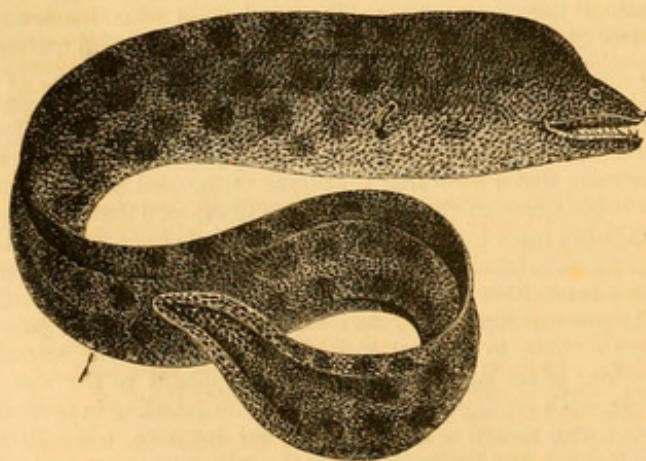


Fig. 65.
Sidera pantherina.

The *Anguillidæ* are a family whose members exhibit little variety of form, and it contains only a single genus. From the common Eel, however, most of our ideas respecting the Apodals have originated. *Anguilla vulgaris*. We have observed these fish in considerable numbers leaving fresh-water lakes in the night time, and frequenting meadows, seemingly for the purpose of preying on slugs and snails. They easily move on the land, with a motion resembling that of snakes. The Eel grows to the size of two

or three feet, and is sometimes said to reach five or six feet in length. It abounds in many European rivers. Eels are caught in immense numbers in the rivers emptying themselves into the Baltic; and they form a considerable article of trade. Two thousand are stated to have been caught at one sweep in Jutland; and in the Garonne 60,000 were taken in one day by a single net.

"That Eels migrate towards brackish water," observes Mr Jesse, "in order to deposit their roe, I have but little doubt, for the following reasons. From the month of November until the end of January, provided the frost is not very serious, Eels migrate towards the sea. The Thames fishermen are so aware of this fact, that they invariably set their pots or baskets with their mouths up stream during those months, while later in the spring and summer they are set down stream. The best time, however, for taking Eels, is during their passage towards the sea. The Eel-traps, also, which are set in three different streams near Hampton Court (the contents of which, at different times, I have had opportunities of examining), have invariably been supplied with Eels sufficiently large to be breeders, during the months I have mentioned. This migratory disposition is not shown by small Eels; and it may therefore be assumed that they remain nearly stationary till they are old enough to have spawn. I have also ascertained that Eels are taken in greater or lesser numbers during the months of November or December, all the way down the river to the brackish water. From thence the young Eels migrate, as soon as they are sufficiently large and strong to encounter the several currents of the river, and make their way to the different contributory streams. I have also been able to trace the procession of young Eels, or, as it is called here, the *Eel-fair*, from the neighbourhood of Blackfriar's Bridge, as far up the river as Chertsey, although they probably make their way as far, or farther than Oxford. So strong, indeed, is their migratory disposition, that it is well known few things will prevent their progress, as, even at the locks at Teddington and Hampton, the young Eels have been seen to ascend the large posts of the flood-gates, in order to make their way, when the gates have been shut longer than usual. Those which die stick to the posts; others, which get a little higher, meet with the same fate, until at last a sufficient layer of them is formed to enable the rest to overcome the difficulty of the passage. A curious instance of the means which young Eels will have recourse to, in order to perform their migrations, is annually proved in the neighbourhood of Bristol. Near that city there is a large pond, immediately adjoining which is a stream. On the bank between these two waters a large tree grows, the branches of which hang into the pond. By means of these branches, the young Eels ascend into the tree, and from thence let themselves drop into the stream below, thus migrating to far distant waters, where they increase in size, and become useful and beneficial to man. A friend of mine, who was a casual witness of this circumstance, informed me that the tree appeared to be quite alive with these little animals. The rapid and unsteady motion of the boughs did not appear to impede their progress."

"All authors agree," adds Mr Yarrell, "that Eels are extremely averse to cold. There are no Eels in the Arctic regions, none in the rivers of Siberia, the Wolga, the Danube, or any of its tributary streams. It is said there are no Eels in the Caspian or Black Seas, but they abound in the Mediterranean; and M. Risso has described eight species in his work on the *Natural History of the Environs of Nice*. There is no doubt, also, that fishes in general, and Eels more particularly, are able to appreciate even minute alterations of temperature in the water they inhabit. The brackish water they seek to remain in during the colder months of the year, is of a higher temperature than that of the pure fresh water of the river, or that of the sea.

Classification—*Malacopteri.*

Classification—Malacopteri. It is a well-known law in chemistry, that when two fluids of different densities come in contact, the temperature of the mixture is elevated for a time, in proportion to the difference in density of the two fluids, from the mutual penetration and condensation. Such a mixture is constantly taking place in rivers that run into the sea, and the temperature of the mixed water is accordingly elevated." As Eels are well known to breed in ponds, it may be inferred that their descent to the brackish water, though customary, is not indispensable. They sometimes attain a great size. The species (or variety) called the *Sharp-nosed Silver Eel* has been taken near Cambridge of the weight of twenty-seven pounds.

Classification—Malacopteri. Like *Amphipnous* and *Ophisternon*, the exterior gill-opening is angular, and below the outer integument there is a membranous partition between the gills. One species, *M. javanicus*.

Classification—Malacopteri.

ORDER II.—MALACOPTERI.

Physostomi, Müll. Endo-skeleton ossified; exo-skeleton, in most as Cycloid, in a few as Ganoid scales. Fins supported by rays, all, save the first, sometimes in the dorsal or pectoral, soft or jointed abdominal or apodal. Gills free, operculate; a swim-bladder and air-duct.

SUB-ORDER I.—APODES ANGUIFORMES.

Malacopterygii apodes (partim), Cuv. Elongated fish more or less approaching to vermiform, covered with a thick slimy skin; the majority scaleless, but in some genera small scales are imbedded in the skin. No developed ribs in the skeleton. Stomach caecal. Pancreatic caecal appendage to the intestine wanting. The greater number have a swimming-bladder, which is often very curiously formed, but never double. Fin rays simple, not jointed.

SECTION A.—*Phaneromycteres*.

Labial olfactory organ opening by the posterior nostril on some part of the head above the mouth, so as to be exposed.

FAMILY I.—SYNBRANCHIDÆ, Kaup.

Uni-aperturida, auct. Both gill-openings enveloped by a border of the common integument, so as to present externally only a single medial orifice. Pectorals and other fins wanting, or almost obsolete. Species few, confined to the seas of Asia and South America.

GENUS I. AMPHIPNOUS, Müll. (*Unibranchapertura*, Hamilt. Buch.; *Synbranchus*, Cuv.; *Ophichthys et Pneumabanchus*, McClell.) A membranaceous partition separates the branchial efferent tubes, and is continued to the verge of the common orifice. Four gills, the third one having short fringes; the fourth, a membrane with merely faint notches on its extremity. Vomerine teeth strong, in two rows, eight in each, standing well apart; palatine teeth small and thin, a little larger on the point of the bone; mandibular teeth pluriserial at the symphysis, uniserial towards the corner of the mouth. On the occiput there is a sac which can be filled with air, and is connected with the gills. Fine scales form a multitude of elevated longitudinal lines on the body. The only trace of a fin is a slight one on the thin tapering end of the tail. One species, *A. cuchia*.

GENUS II. OPHISTERNON. (*Unibranchapertura*, Lacép.; *Ophisternon*, McClell.; *Synbranchus*, Cant. and Bleek.) Four fringed branchial arches, which discharge the water that has passed over them by two tubes divided by a thin partition, inclosed by the skin of the throat so as to form one transverse oval opening. No air-bag on the occiput, and no swim-bladder. Branchiostegals six, bony. Posterior apertures of the nostrils between the eyes; anterior nostrils minute, one on each side of the snout. Teeth fine, blunt on the upper jaw, almost setaceous, crowded into a triangle on each side of the symphysis; vomerine teeth larger, in a single series; mandibular ones somewhat bigger still, and truncated. One species, *O. bengalensis*.

GENUS III. SYNBRANCHUS, Bloch. Have all the characters of *Ophisternon*, but the four fringed gills are not separated under the throat by a partition, and the solitary gill-opening does not make the angular inflection that it does in *Monopterus*, *Ophisternon*, and *Amphipnous*. Hinder nostrils opening above the eyes, and capable of being shut by a cutaneous flap. Two species, one Indian, the other South American.

GENUS IV. MONOPTERUS, Lacép. Three gills only. No occipital air-bags. No protruding nasal teeth; the palatine teeth meet in an angle with the vomerine ones anteriorly, and are there pluriserial, but diminish to two and one row towards the corner of the mouth; vomerine teeth triserial anteriorly, uniserial posteriorly; ranged in two bands, which meet in an acute angle anteriorly, and

diverge posteriorly. Like *Amphipnous* and *Ophisternon*, the exterior gill-opening is angular, and below the outer integument there is a membranous partition between the gills. One species, *M. javanicus*.

FAMILY II.—MURÆNIDÆ, Kaup.

In most of the genera no pectorals. Gill-openings lateral. Skin smooth and slippery, without scales. Mostly or wholly marine fishes.

(a.) SUB-FAMILY.—MURÆNINÆ.

Uniserial teeth on nearly all the dentiferous bones of the mouth. GENUS I. MURÆNA, Kaup. Uniserial nasal teeth, three on the mesial line. Twenty-four species. Figure 64 represents *Muræna pavonina*.

GENUS II. SIDERA, Kaup. Only one short conical tooth on the mesial line; biserial, low, granular teeth on the vomer, the rows coalescing in a point posteriorly; opening of the jaws not wide. Skin spotted. Two species. Figure 65 represents *Sidera pantherina*.

(b.) SUB-FAMILY.—THYRSODEINÆ.

Within the outer palatine teeth, a second row that varies much in the number of teeth which compose it.

GENUS III. ENCHELYNASSA, Kaup. Fore nostrils short, infundibuliform, and capable of being closed by a cutaneous tag of its hinder border; hinder nostril longish, oval, surrounded by an elevated cutaneous border, and nearly as large as the eye. Rictus of the jaws gaping in the middle, owing to the length of the teeth; nasal teeth, five long ones anteriorly, followed by three or four smaller ones; in the second row three long moveable teeth standing near the corner of the eye; nineteen greater and smaller palatine teeth, with six more acicular ones in an interior row; on the mesial line of the nasal, three long moveable teeth; on the vomer, two short conical ones; mandibular teeth, twenty-two small ones in the exterior row, and five long ones in an interior row. One species. The teeth are shown by figure 58.

GENUS IV. EURYMICTERA, Kaup. Fore-nostril tube projecting outwards beyond the lip; lips expanding on the upper and under jaws; hinder nostril over the eye, and encompassed by an infundibuliform border. Nasal teeth eleven, with five small intercalary ones in the posterior part of the row; palatines thirty in the outer row, five larger ones forming an inner row; from seven to ten on the vomer, the extreme ones minute; mandibulars twenty-seven of a side, with five bigger ones near the symphysis in a second row. Body slim. Jaws deeply cleft. Dorsal fin commencing at the occiput. One species.

GENUS V. ENCHELYCORE, Kaup. Jaws incapable of shutting close from the length of the teeth; hinder nostril strikingly large, longer than broad, and situated before the eye; fore nostril-tube so unusually short that it does not pass over the edge of the lip, and it has no lid; eye in the middle of the length of the snout; the thin outstretched upper jaw curves upwards. Twenty-four slender teeth, some of them elongated, forming the outer row on the nasal bone; eight moveable latter ones in a second row; three on the mesial line; eighteen outer palatines; three moveable bigger ones making an inner row; about fifteen small, pointed vomerines, and thirty-seven fine mandibular ones, with two bigger moveable ones at the symphysis. One species.

GENUS VI. THYRSOIDEA, Kaup. *Muræna* in the construction of the fore and hinder nostrils, and presenting no prominent character whereby they may be distinguished from the *Muræna* proper, except that they possess a more or less complete second or inner row of pointed palatine teeth.

The numerous species (33) may be grouped according to the number of rows of their vomerine and palatine, and by the patterns which the colours of their bodies assume;—some are reticulated, others spotted, others again of one uniform colour in the upper, or both above and below.

GENUS VII. LIMAMURÆNA, Kaup. Abbreviated *Thyrsoideina*, whose hind nostril-tubes project still more than those of *Muræna helena*. Ten or twelve nasal teeth, with some scarcely perceptible ones at their bases: three on the mesial line; palatine teeth biserial, but the inner row of six generally defective, sometimes altogether wanting; four to six vomerine teeth; mandibulars uniserial, nine of them taller than the fourteen others.

Head elongated; snout pointed; front nostril-tubes projecting over the edge of the lip; hinder ones a little exceeding the diameter of the eye in length. Dorsal fin commencing at the occiput. One species.

GENUS VIII. POLYURANODON, Kaup. *Thyrsoideina*, with three rows of acute teeth on the palatine bones; fourteen uniserial nasal teeth; five or six uniserial vomerine teeth, mandibulars quadriserial anteriorly, biserial towards the corner of the mouth. One species.

Classification—*Malacopteri.*

GENUS IX. CHANNOMURENA, Rich. (*Ichthyophis seu Nettastoma*, Rich., olim.) Nostrils like *Muraena*; face short and depressed, but the gape of the mouth extremely wide and long. Body cylindrical, without any vestige of the fold of the skin which contains the dorsal rays in *Muraena*. Tail compressed and thinner at the tip, where a few caudal rays are faintly perceptible. Teeth slenderly subulate, in broad, dense, coarsely villiform plates. One species. It is represented by figure 6.

GENUS X. MURENOBLENNA, Lacép. (*Ichthyophis*, Less., Rich. partim.) Finless, like *Gymnomuraena*, but differing wholly in the teeth, which are slenderly subulate, rather tall, and thin set. Vomerines irregularly biserial; nasals, palatines and mandibulars triserial.

GENUS XI. PŒCILOPHIS, Kaup. *Muraena*, with blunt or more conical teeth; vomerines round, pavement-like. Hinder nostrils fringed; front ones shortly tubular, not projecting over the lip. Dorsal and anal fins not distinctly perceptible, and the species are therefore to be distinguished from *Gymnomuraena* by the numerous rows of vomerine teeth. Six species, most of which are much spotted.

GENUS XII. GYMNOMURENA, Lacép. Destitute of fins; blunt, pavement-like teeth on the border and mesial line of the nasal bone, crowded into a space shaped like the sole of a shoe. Palatine bones rudimentary, supporting small teeth in two or three rows. Body elongated, crossed by white bands. Two species.

GENUS XIII. APHALMICHTHYS, Kaup. Resembling *Moringua*, but destitute of fins except at the point of the tail, where there is a trace of rays. Eyes covered by the skin. Lower jaw thick and projecting beyond the snout. Nostrils short and tubular, the posterior ones capable of being shut. Tail nearly equally thick throughout. Eleven teeth in the upper jaw, the seven nasals being the longest; five vomerines in one row; ten or twelve mandibulars. One species.

GENUS XIV. UROPTERYGIUS, Rüpp. Both jaws furnished with two rows of fine teeth; the teeth in the outer row being short, with reflexed points, those of the inner ones straighter and twice as high; vomerine teeth uniserial, recurved. The only fin is the caudal, seated on the dilating tip of the tail. One species.

GENUS XV. APTERICHTHYS, Dum. (*Cæcilia*, Lacép.; *Sphagebranchus*, Bloch, Cuv.) No fins. Snout lengthened beyond the mandible; gill-openings near to one another, as in *Sphagebranchus*; anterior and posterior nostrils tubular. Body much elongated; tail slender. Teeth acicular and curved, and uniserial on all the dentiferous bones. One species.

GENUS XVI. PRYMNOTHONUS, Rich. Founded on a pencil drawing of Dr Hooker's; has an acute snout, projecting a little beyond the mandible. Acute subulate uniserial teeth, not closely set. Anal aperture near the head, a long even anal with some rays shown posteriorly united to a radiated caudal; a short dorsal fold also united to the caudal. Gill-openings lateral, a small hole in the axilla of what seems to be a small pectoral. No specimen of this form has reached England. It appears to belong to this place.

GENUS XVII. MORINGUA, Gray. Greatly elongated *Muraena*, with the mandible longer than the snout. Teeth distinct, acute, and recurved; vomerines uniserial. The dorsal and anal fins commence posterior to the anus, and disappear in the middle of their length, reappearing and becoming higher than before at the end of the tail. Three species.

FAMILY III.—ANGUILLIDÆ.

Teeth card-like or villiform. Gill-openings lateral. Pectoral fins conspicuous; anal and dorsal fins encompassing the tip of the tail, the former beginning generally at a considerable distance from the head; longish oval cycloid scales lying embedded in transverse and oblique groups in the skin, so as to resemble lattice-work. No species have as yet been detected that want the pectoral fins, like the abrachial genera among the *Muraenida* and *Synbranchida*. The *Anguillida* are wholly or mostly anadromous fishes, some of them remaining always in fresh water.

GENUS I. ANGUILLA. Forty-five species.

FAMILY IV.—CONGERIDÆ, Kaup.

A dorsal fin reaching up to the occiput; a naked, scaleless skin; and, for the most part, a very long tail running to a point. Pectorals in some present, in others wanting; a cartilage in the lips.

GENUS I. MURENESOX, McClell. Snout elongated like that of a Gavial, whereof the dilated spoon-shaped nasal bone overpasses the mandible; the thin lips do not cover the front teeth. Fore nostrils opening by short tubes near the narrowing of the nasal bone; hinder ones often pretty remote from them, placed beneath the eyes. The large eyes placed nearly over the middle of the jaws. Dorsal fin extending forwards to the base of the pectorals; vomer elevated with a furrow in which the bigger teeth stand, and are accompanied by a row of small blunt ones. Sun-

dry rows of teeth on the palatine and mandibular bones; the longest teeth are on the nasal bone and fore part of the mandible.

Classification—*Malacopteri.*
GENUS II. CONGER, Cuv. Anterior nostrils opening by short tubes close to the end of the snout; posterior ones before the large eyes. Palatine and vomerine teeth slender, but having chisel-shaped crowns, and arranged in so close a series as to produce an incisorial edge. Nine species.

GENUS III. CONGERMURENA, Kaup. Posterior nostril a short longitudinal slit before and above the large eye, which is over the corner of the mouth. Teeth flatly rounded in a multitude of rows. Species three.

GENUS IV. UROCONGER, Kaup. Anterior nostril not tubular; posterior ones close before the eye like a small slit. A row of slit-like pores on the border of the upper lip. Tail much elongated, slender towards the end, and tapering to an acute point. Teeth (like those of *Myrus*) very fine, and disposed in two or three rows; nasal and palatine teeth in two rows; front upper jaw teeth boring through the lips; pectoral small and elongated. Gill-openings very large, as compared with those of other genera in this family. One species.

SECTION B.—*Cryptomycteres.*

The olfactory canal, running from the front nostril backwards through the soft parts to the side of the mouth, opens by the posterior nostril in the white integument within the border of the lip; in this respect resembling *Lepidosiren*.

FAMILY V.—OPHISURIDÆ, Kaup.

(a.) SUB-FAMILY.—OPHISURINÆ.

Tail ending in a conical point, that separates the ends of the vertical fins; no caudal fin.

GENUS I. LEIURANUS, Bleek. No vomerine teeth; uniserial palatine teeth ranged in a crescent; mandibulars also uniserial; upper jaw elongated like that of a shark; mandible extraordinarily short and round. Fore nostrils under the projecting snout; hinder ones in the lip beneath the eye, which is nearer the corner of the mouth than to the point of the snout. Pectoral fins scarcely perceptible. Point of the tail spinous. One species.

GENUS II. CENTRUROPHIS, Kaup. Vomerine teeth uniserial or sometimes sub-biserial; nasal teeth beyond the point of the mandible. Pectoral fins pretty well developed. Six species.

GENUS III. PŒCILOPHIS, Kaup. Three nasal teeth, not implanted out of reach of the mandible; three on the mesial line, the foremost two smaller and side by side. Eleven palatine teeth in a crescent, whose point touches the last of the mesial nasals; eleven vomerines; nineteen mandibulars; teeth generally pointed, short, and recurved. No cuticular processes on the upper lip. Head roundish. Pectoral fins very short; dorsal commencing opposite their bases. One species.

GENUS IV. MICRODONOPHIS, Kaup. Very small pointed teeth, biserial on the nasal and on the symphyseal extremity of the mandible. Fins much developed. One species.

GENUS V. CŒCILOPHIS, Kaup. Biserial teeth near the symphysis of the mandible, and not elsewhere. Pectoral fins developed and longer than the rictus of the mouth. Fore nostrils shortly tubular, with a short tag on their under border. Dorsal fin commencing over the points of the pectorals. One species.

GENUS VI. OPHISURUS, Kaup. Head small; snout slender and elongated, its point passing beyond the mandible; gape of the mouth very wide; eyes near the corner of the mouth; fore nostril in the middle between the eye and end of the snout, indistinct and without a tube; and the hinder one rather on the outside of the thin lip. The pectoral fin is about half as long as the mouth.

Nasal teeth, five on the border of the bone, and nine longer ones on the mesial line; thirteen short and pointed ones on the vomer; palatine teeth uniserial, anteriorly, becoming biserial under the eye. One species.

GENUS VII. HERPETOICHTHYS, Kaup. Jaws nearly of equal length; snout bluntish; gape wide; eyes approximating to the snout; head depressed, so that the eyes are rather more on the dorsal than lateral aspect; front nostril-tubes at the end of the snout, and the hinder ones at the commencement of the outer row of palatine teeth; between the two there is a small cutaneous flap on the border of the lip. Pectoral fins pretty short. Six nasal teeth; from nine to thirteen vomerine ones. Three species.

GENUS VIII. BRACHYSOMOPHIS, Kaup. Eye placed at the end of the first fifth part of the length of the jaws, or one of its own diameters from the tip of the snout; fore nostril-tube extraordinarily short; the hinder one a short tube on the inner side of the lip under the eye; gill-openings very large, and approximated to one another. Pectoral fins comparatively small. Border of the lips warty. One species, *B. horridus*, whose jaws are represented by figure 59.

Classification—Malacopteri.

Classification—Malacopteri.

GENUS IX. ELAPSOPSIS, Kaup. Gape of the mouth short; snout elongated, obtuse, stretching beyond the mandible; the short nasal tube wider at its external orifice than at its commencement; eye approximating to the corner of the mouth. Pectoral very small but distinctly visible. Body about equal in length to the tail. Nasal teeth reflex, four in each row, with an odd one in front; vomerine teeth irregularly uniserial; palatine teeth uniserial anteriorly, becoming biserial and sub-triserial. One species.

GENUS X. MYSTRIOPHIS, Kaup. Snout spoon-shaped, its extremity being dilated; fore nasal-tube rudimentary, and in the middle of the rostral expansion; eyes over the middle of the jaws, and though the long head is depressed, they are more lateral than dorsal in their aspect; gill-openings large and near one another. Two species.

GENUS XI. MURÆNOPSIS, Lesueur. Head oval; snout not much elongated; hinder nostril rather on the outside of the thin lip. Pectoral as long, or somewhat longer than the long, straight rictus of the jaws. Teeth all of equal length. Three species.

GENUS XII. ECHIOPSIS, Kaup. Face short; eyes high-placed; fore nostril-tubes short; jaws deeply cleft. Pectoral fins pretty short, about half the length of the oral rictus. Nasal teeth seven; three on the mesial line being the tallest; two rows of vomerines uniting at their posterior termination, biserial palatines, interior row composed of the smallest teeth; two rows on the mandible, the outer row being the tallest. One species.

GENUS XIII. SCYTALOPHIS, Kaup. Teeth all nearly of a size, divergent; anterior nostril-tube distinctly visible. Pectoral pretty well developed. All the teeth biserial except the nasals. Two species.

GENUS XIV. LEPTORHINOPHIS, Kaup. Snout pointed; tubes of the anterior nostrils dependant; posterior nostrils situated before the eyes on the border of the lips; eyes over the middle of the oral rictus. Pectorals developed; anal and dorsal fin becoming higher near their terminations. Two species.

GENUS XV. PISOODONOPHIS, Kaup. Teeth all shortly conical, more or less blunt; anterior nostril-tube projecting; eye approximating to the corner of the mouth. Pectoral more or less fully developed. Eighteen species, some of them all of one colour, others spotted or banded. Eighteen species.

SUB-ORDER II.—APODALS WITH ARTICULATED FIN RAYS.

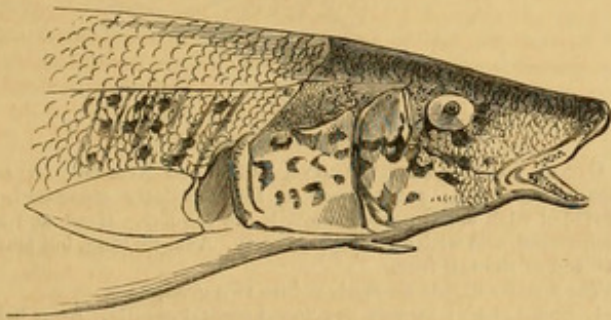


Fig. 66.
Rhamphichthys Mülleri.

The GYMNOTIDÆ are apodals, but cannot be associated with the Eels in the sub-order of Serpentine Apodals, owing to the considerable differences of their organization. Their jaws are complete, they are furnished with ribs, and their fin rays are jointed or branched, in which respect they differ from the preceding sub-order, the chief point of agreement being the want of ventral fins. The *Gymnotidæ* want also the dorsal; but one of the genera has a curious long ray, which commonly lies in a furrow along the top of the rounded back, glued down by mucus. It is named by German ichthyologists "peitsche," or "the whip," and is considered by Dr Kaup to be a representative of the adipose fin on the tail of the *Salmonidæ*. One of the most curious parts of their structure is the forward position of the vent, which in most of the *Rhamphichthi* is before the eye; and in these the anal begins between the gill plates, and extends along the ventral edge of the fish, while the rounded back is destitute of a fin. Examples of a similar forward position of the anus occurs in some other families, but they are very scarce. The *Gymnotidæ* inhabit the rivers and fresh-

water lagoons of the warmer parts of South America, Guiana, Surinam, Cayenne, Demerara, Guyaquil, Ecuador,

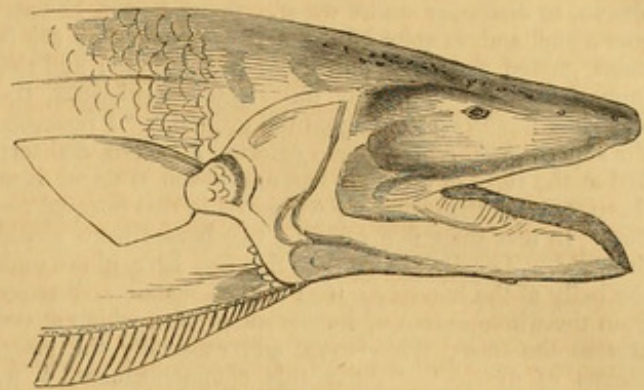


Fig. 67.
Sternarchus Bonapartii.

New Granada, and Brazils. The best known species is *Gymnotus electricus*, or the Electric Eel. This animal has been well described by Dr Garden of Charlestown, by John Hunter, and by Humboldt. It is remarkable for the violence of its electric shocks, which are often so powerful as to stupify a man or a horse. The researches of Hunter detected an electric organ in the posterior part of this fish consisting of four longitudinal fasciculi, which occupy one-half the thickness of the part in which they occur, and about one-third of the whole animal. The larger pair lie above, the smaller below. Each fasciculus is composed of flat partitions or septa, with transverse divisions between them. The outer edge of the septa appear in nearly parallel lines in the direction of the longitudinal axis of the body, and consist of thin membranes, which are easily torn; they serve the same purpose as the columns in the analogous organ of the Torpedo, making the walls or abutments for the perpendicular and transverse dissepiments, which are exceedingly numerous, and so closely aggregated as to seem almost in contact. The minute prismatic cells, intercepted between these two sorts of plates, contain a gelatinous matter; the septa are about one-thirtieth of an inch from each other, and one inch in length contains a series of 240 cells, giving an enormous surface to the electric organs. The whole apparatus is abundantly supplied with nerves from the myelon; and these nerves are seen coming out in pairs from between the vertebræ. In their course they give out branches to the muscles of the back, and to the skin of the animal. In the *Gymnote*, as in the *Torpedo*, the nerves supplying the electric organs are much larger than those bestowed on any part for the purposes of sensation or movement. Hunter thinks, however, that these nerves are more considerable in point of size in the *Torpedo* than in the *Gymnote*. These organs are attached loosely to the muscles of the back which lie between the larger fasciculi, and they are immediately connected with the skin by a loose cellular texture. Humboldt has given a very interesting and lively description of the mode of capturing the electric *Gymnote*, as practised in South America, near the town of Calabozo.

These fish abound in the stagnant pools of that vicinity. The Indians are well aware of the danger of encountering the *Gymnote* when its powers are unexhausted. They therefore collect twenty or thirty wild horses, force them into the pools, and when the fish have exhausted their electric batteries on the poor horses, they are laid hold of without difficulty. The horses at first exhibit much agitation and terror; they are prevented leaving the pool by an inclosing band of Indians, who goad them with bamboos whenever they attempt to escape. "The Eels," says Humboldt, "stunned and confused by the noise of the horses, defended themselves by reiterated discharges of their electric batteries. For some time they seemed likely to gain

Classification—Malacopteri.

the victory over the horses and mules; these were seen in every direction, stunned by the frequency and force of the shocks, to disappear under water. Some horses, however, rose again, and, in spite of the active vigilance of the Indians, gained the shore, exhausted with fatigue; and their limbs being benumbed by the electric explosions, they stretched themselves out upon the ground." "I remember the superb picture of a horse entering a cavern, and terrified at the sight of a lion. The expression of terror is not there stronger than what we witnessed in this unequal conflict. In less than five minutes two horses were already drowned. The Eel, more than five feet long, glides under the belly of the horse or mule; it then makes a discharge from the whole extent of its electric organs, which at once attacks the heart, the viscera, and especially the gastric plexus of nerves." "After this commencement, I was afraid that the sport might end very tragically. But the Indians assured us that the fishing would soon be finished, and that nothing is to be dreaded but the first assault of the *Gymnotus*. In fact, whether the galvanic electricity is accumulated in repose, or the electric organ ceases to perform its functions when fatigued by too long-continued use, the Eels, after a time, resemble discharged batteries. Their muscular motion is still equally active, but they no longer have the power of giving energetic shocks. When the combat had lasted a quarter of an hour, the mules and horses appeared less affrighted; they no longer bristled up the mane, and the eye was less expressive of suffering and of terror. They no longer were seen to fall backwards; and the Gymnotes, swimming with the body half out of the water, and now flying from the horses instead of attacking them, began themselves in their turn to approach the shore."

The electric Gymnote is by no means fierce or voracious; but its electric organs are the instruments by which it procures its prey, and defends itself against alligators and other enemies. It has been several times brought alive to Europe, and some experiments have been made on its electricity, which is conducted and insulated by the same substances as common galvanism. So common is the *Gymnotus* in some parts of South America, that, in the neighbourhood of Uritucu, a route at one time much frequented has been entirely abandoned, in consequence of the necessity of fording a stream, in which many mules were killed every year by these subaqueous electric shocks.

The genus *Sternarchus* of Schneider was so denominated from the anus being near the sternum. The *Gymnarchus niloticus* is named in Arabic "Del e far."

SUB-ORDER II.—APODES ARTHROPTERYGII.

Dr Kaup, for the reason stated in the text, has separated *Gymnotus* from the Serpentiniform Apodals, and associated it with *Sternarchus* and its allies, forming a group placed by him next the *Malacopteri abdominales*, but the want of ventrals necessitates its separation as a sub-order.

FAMILY I.—GYMNOTIDÆ.

Eel-like, the back round, and without fins; pectorals; largely developed anal fin, extending either to the point of the tail, or leaving the extremity free; with or without teeth on the pre-maxillaries, mandible, and palatines; no teeth on the vomer; scapular arch attached to the head; from the fifth vertebra onwards distinct ribs encompass the belly, and in many species are perceptible through the skin; stomach cæcal; pancreatic cæca; ovisacs pouch-shaped, and their outlets different from those of the Eels; vent and the genital papilla behind it on the coracoid bone, or still farther forward towards the middle of the mandible.

The small fore-bladder under the second, third, and fourth vertebrae is pyriform or heart-shaped, and is double; the outer one being thick, white, and easily torn; the inner one transparent, filled with a gelatinous fluid, and swimming loose in the outer one. This bladder is attached to the acoustic bones of the skull, and is connected by a fine chord with the simple posterior or ordinary swim-bladder, which chord divides, and with its fellow is attached to the stomach. The anterior double-bladder closely resembles

that of the *Catostomi* (which is followed by two or three ordinary swim-bladders), belongs to the organ of hearing, and corresponds to the membranous labyrinth of the higher mollusks.

Classification—Malacopteri.

GENUS I. *GYMNOTUS*, Linn. *Skin entirely soft, and destitute of scales. Only one species is known, which resembles Carapus in the conformation of the head, position of the nostrils, and dentition; but the anal fin reaches the point of the tail. Head oval, flatly depressed; mouth not opening quite as far as under the eyes, furnished with broad lips of equal length; fore nostril a small tube in a bell-shaped superficial depression above and towards the end of the lateral lip; hinder nostril distant about the diameter of the eye from the first one, behind and above it. Longitudinal and transverse rows of pores in cup-shaped depressions on the top of the head; also a row on the mandible; lateral line indicated by a row of distant pores.*

About fifty pointed teeth on the upper jaw, and sixty on the under one; a second row behind the middle of the upper ones of about six teeth; along the symphysis of the mandible two short rows, each with two toothlets. Vomer, roof of the mouth, and tongue furnished with lateral, projecting, dentated membranous edgings. Vent before the gill-openings; behind it a small orifice and a small, slender papilla. Pectorals and anal fin enveloped in a thick skin which conceals the rays. One species.

GENUS II. *CARAPUS*, Müll. and Trosch. (*Carapus*, Cuv. partim.) *Broad, depressed, flattish snout; a row of pointed teeth; scales. No caudal fin. Fore nostril a short tube in a notch near the corner of the mouth; hinder one before the eye, open and distinct; eyes shining through the skin; five broad, flat branchiostegals; anal fin extending almost to the end of the tail; under lip longer than the upper one. Scales of the back and lateral line of equal size. Two species.*

GENUS III. *STERNOPYGUS*, Müll. and Trosch. *Card-like teeth in numerous rows; small mouth. Body and head compressed; head short; small jaws; occasionally traces of card-like palatine teeth. Tail slenderly prolonged, without a caudal fin. Scales of the lateral line mostly larger than the others.*

This genus has the aspect of a *Fierasfer*. Four species.

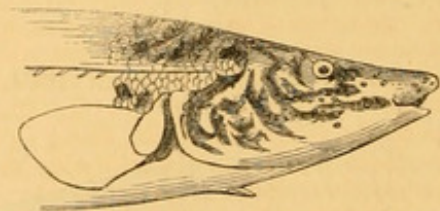


Fig. 68.

Rhamphichthys Artedi.

GENUS IV. *RHAMPHICHTHYS*, Müll. and Trosch. *A small mouth; no teeth; snout more or less tubularly elongated, and provided with small pores; nostrils not tubular. Head and body compressed, and with an exception scaly. Anal fin long, but leaving the end of the tail free.*

The species divide themselves into two groups:—

1. Snout short; largely developed genital papilla. Anus behind the third part of the head; and anal fin commencing at the point of the pectoral. Two species.

2. Anus under or before the eye, and the anal commencing before the gill-opening. Seven species.

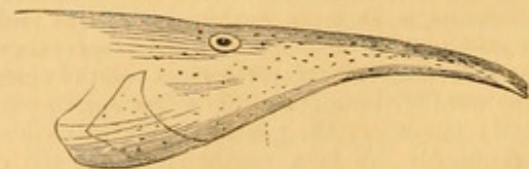


Fig. 69.

Sternarchus oxyrinchus.

GENUS V. *STERNARCHUS*, Schneid. *Having a small normally formed caudal fin. A crowd of teeth on the pre-maxillaries, and two rows of recurved ones on the mandible; no tooth on the symphysis. Head and body laterally compressed, the former naked, the latter scaly. In the middle of the dorsal surface of the tail an elastic ray, which, in the living fish, lies in a furrow and is kept firmly there by the dermal mucus (this ray is homologous with the fleshy fin of the Salmonidæ); anus before or under the eye; eye shining through without a lid. Nostrils like small pores. Four branchiostegals in the gill membrane. Three species.*

Classification—Malacopteri.

Classification—Malacopteri.

SUB-ORDER III.—MALACOPTEROUS ABDOMINALS.

CLUPEOIDS OR HERRING FAMILY.

The species of this family are so numerous, and many of them are so much alike, that much confusion prevailed respecting those described by the older authors and the many nominal ones recently introduced into our lists by modern ichthyologists who were not in circumstances that enabled them to profit by the examination of specimens preserved in rich museums. M. Valenciennes has thrown a flood of light into the darkness that previously existed; and it is on his labours that we almost solely rely in our notices of the families described in the *Histoire des Poissons*, subsequent to the death of his illustrious predecessor, Baron Cuvier. He has made use of the varieties of definition, so great in this family, to characterize his groups; also of the position of the ventrals and of the length of the anal. The comparative length of the mandible has also been taken into consideration by him; in most it projects beyond the snout; a second group is characterized by the snout, owing to the elongation of the nasal, projecting beyond the premaxillaries; which, then, instead of crossing the upper edge of the orifice of the mouth transversely, descend on the sides. In some, the maxillary is prolonged far beyond the corner of the mouth. There are diversities also in the fins: in certain species the anal and caudal are united; and in some, a greater or smaller number of the rays of the pectoral are prolonged into slender-jointed filaments; others again have the anal and caudal united, while the form of the mouth varies. We can notice only a few of the species of this family.

Clupea harengus, Lin. (The Herring.) The investigation of the habits of this fish has not received that attention which its importance as an article of food to the inhabitants of this country demands; and there are several circumstances respecting its economy which still require farther examination. It is generally believed that the Herring inhabits, in winter, the depths of the Arctic Ocean, or other seas in northern latitudes, and that during the rest of the year it makes migrations southwards. In summer and autumn it appears on the north and west coasts of Europe in immense shoals, and about the same season it arrives at some parts of the coast of America and Asia. It has been supposed that those coming from the north divide into two detachments, one of which proceeds along Newfoundland to America, the other along Norway to the south of Europe; and that one subdivision of this second detachment goes up the Baltic, while the other proceeds along Great Britain, Ireland, Germany, and France, as far as the western coast of Spain.

This is the description of the annual migrations of the Herring given by Pennant; but some doubts have been entertained as to its accuracy, from the circumstances,—1st, That while in some places the Herrings do not make their appearance for years, in others they are taken in abundance all the year round; and, 2d, That they have never been observed on their return northwards. Other naturalists suppose that they come merely from the deep into shallow water during the spawning season, and that in so doing they do not make any very lengthened journeys. In truth, we are not as yet furnished with sufficient data to decide the question; but, in the meantime, we do not feel inclined entirely to reject the generally received opinion, that the Herrings migrate from north to south in summer and autumn.

In migrating, the Herrings proceed in vast troops,—so great, indeed, that the sea is sometimes covered with them for miles, and that they have even been known to be stranded or crushed in immense quantities in confined bays, or when thrown by the wind or by currents upon

the shore. The shoals are said to be generally preceded sometimes for days, by one or two males. The largest generally go first, to act in some measure as guides; and as they proceed onwards, immense numbers fall an easy and unresisting prey to rapacious birds, or to their own not less rapacious kindred of the sea.

It is generally believed that the Herrings captured far north are larger, fatter, and of a better quality than those of the south; and for this reason, in the month of July, our fishermen go out to meet the shoals as far as Orkney and Shetland. The greatest number are taken on the coasts of Norway and Sweden, in the first of which countries it is said that about 400 millions are taken in one year, and sometimes 20 millions in a single fishery. The inhabitants in the neighbourhood of Gothenburg, in Sweden, take as many as 700 millions in a year. Herrings are fished also in great quantity in this country, Germany, France, Holland, the United States, and Kamtschatka.

The average size of the Herring is stated to be about ten inches. According to Dr Knox, the females are considerably larger than the males; the largest female he found on the east coast of Scotland measuring eleven inches, the largest male nine inches and a half. It does not appear to be precisely known at what age they attain their full size.

Considerable doubt has at all times prevailed regarding the food of the Herring. They were generally stated to live on small crabs and fishes, and on a minute crustaceous animal named by Fabricius *Astacus harengum*. But this was chiefly matter of supposition; for most practical fishermen described the stomach of the fish when in good state as quite empty, or, at most, as containing a little brownish mucus; and it has appeared difficult to reconcile the fact, that it is when the stomach appears thus empty that the fish is in its best condition, viz., fullest, with the finest flavour, and most capable of keeping,—with the notion, that when it appears upon our coasts it has quitted its natural feeding ground, and has been longer and longer in a state of starvation the more southern the latitude in which it is found. Dr Knox's interesting observation, that the principal food of the Salmon and Vendace consisted of minute crustaceous animals, led him to examine carefully with the microscope the brownish matter contained in the alleged empty stomachs of the Herring; and he then formed the opinion, that this matter consisted of the debris of a very minute entomostracous animal.

It is well known that the Herrings caught upon the east coast of Scotland are much inferior to those taken on the west coast, and more particularly to those of Loch Fine, and other lochs of Argyleshire. Dr Knox states that the Herrings taken near the Firth of Forth in July are foul, or are engaged in spawning, while those of the west coast, in the same season, have the organs of reproduction very slightly developed; and he conjectures that that species of crustaceous animal which forms their appropriate and most favourite food may exist abundantly in the bays on the west coast of Scotland, and either not at all, or not in sufficient quantities, along our eastern coasts. It appears to be chiefly after these fishes have been absent for some time from their proper feeding places that they eat marine worms and small fishes; and when so feeding, they lose much of their flavour, and run rapidly into putrefaction after being captured. The time of spawning seems to vary considerably, both in the same and in different districts; so that we may have spring, summer, and autumn herrings, as we know they have in some parts of the Baltic. During the spawning season they are seen to rub their bellies against the rocks or sand. As many as 68,606 eggs have been counted in one female. The young do not accompany the larger herrings in their migrations. M. Valenciennes, after reviewing many facts collected by different observers, comes to the conclusion that the Herrings are

Classification—Malacopteri.

not nice in their selection of a spawning place, depositing their eggs at the bottom of the sea, sometimes on sand, sometimes on naked rocks, occasionally in sub-marine meadows, in the eddies of currents, at the mouths of rivers, or in the sea far from the shore where the water is tranquil. They change their places of resort, occasionally wholly deserting their former haunts. For a full account of what is known of the economy and habits of the Herring and its fisheries, we must refer to the *Histoire des Poissons* (Cuv. and Valen.), vol. xx., and to the article on FISHERIES in this Encyclopædia. The Herring fishery of France, carried on by the inhabitants of Normandy, dates as far back as A.D. 1030, according to documents still preserved. That of England has been traced to a still higher date; it is named in the records of the Monastery of Evesham as a source of revenue in 709 A.D.; and in the annals of the Monastery of Barking, the tax levied upon it is called Herring-silver. In Iceland the Herring fishery seems to have been so important at an early age, that the word *sild* (Herring) enters into the composition of the names of many mountains in that island. *Harengula sprattus*, Valenc., is the Sprat, so abundant on the English coasts at certain seasons, and from its cheapness is an aliment that serves to vary the diet of the poorer classes. It is the *Sprattè-sild* of the Danes, many of whose sea-terms and names of fish and implements for fishing, have been preserved with slight alteration in the north of England and Scottish lowlands. A second species is named *Blanquette* by the French in the Mediterranean, and is so like the Sprat that most ichthyologists have confounded the two. *Rogenia alba*, Valenc., is the renowned "White-bait" with which our ministry always regale themselves after winding up their parliamentary labours for the session. Mr Yarrell's able account of it exhausts its history, and need only be referred to here. *Alausa vulgaris*, L'Alöse of the French, and the Shad of the English. Ausonius of Bordeaux, who flourished A.D. 380, in his poem on the Moselle, mentions the Shad as the food of the common people—

"Stridentesque focis opsonia plebis alausas."

Alausa pilchardus, the Pilchard so plentifully caught in its season on the Devonshire coast, and consumed by the inhabitants of that county in pies, in which the heads of the fish protrude through the crust, to denote the nature of the contents. It is the Sardinia of the Spanish peninsula and Mediterranean Sea, and the Ceilan of the French fishermen. Its fishery is important to the inhabitants of the south of England, Brittany, Portugal, and Galicia. At St Yves in Cornwall, 250,000 have been caught in a single draught, and few who have visited Lisbon but must have admired the fleets of sharp-built latine-sailed boats, named "Bean-cods," issuing from the Tagus, to carry on a fishery so invaluable to a Roman Catholic population.

Engraulis encrasicolus, the Anchovy, is another celebrated member of this family, very plentiful in the Mediterranean, and found on the coasts of Greenland, Jutland, and the Baltic; it is occasionally caught in the Irish Channel, but is rare on the English side of the British Channel, though it has been taken, according to Mr Yarrell, on the Hampshire coast, and on Dagenham Breach below Blackwall. Formerly it was more abundant in the British seas, and several acts of parliament passed in the reign of William and Mary regulated its fisheries. It was also a century ago plentiful on the coasts of Brittany, though by no means so now.

Under the head of FISHERIES the statistics of the deep-sea fisheries of Great Britain are fully entered into, and their great importance as a branch of national industry shown in detail. There are, however, wide fields for the employment of British capital in the East, where the supplies are inexhaustible, and the demand in the China and other markets exceedingly great. *Coilia Playfairi* is represented by fig. 17. The *Alausa toli* (Cuv. and Val.) is the subject of a

very extensive fishery on the coast of Sumatra, for the sake of its roes, which are salted and exported to China, the dried fishes themselves being sent into the interior of Sumatra. The fish is named "Trúbu" in the Malay tongue, is about 18 inches long, and between fourteen and fifteen millions are caught annually with very rude tackle.

Another of the Herring tribe, the *Engraulis Brownii*, is exceedingly numerous at all seasons in the Straits of Malacca, and at the mouths of the Ganges. From it a delicious condiment named "Red fish" is prepared by adding vinegar made of the juice of the Cocoa palm, ginger, black pepper, and powdered red-rice to the salted fish. *Dussumiera acuta* and *Clupeonia perforata*, also members of this family, are taken at Penang, and brought to table under the denomination of "Sardines." They are said to have a delicate flavour; but the *Meletta venenosa*, which occasionally visits those seas in shoals, is poisonous, and has produced death when eaten by mistake for the "Sardine." The poisonous fish has red eyes. These facts are from Dr Cantor, whose work on the Malayan fishes goes more into detail.

SUB-ORDER III.—ABDOMINALES.

FAMILY I.—HETEROPYGII.

Tellkampf characterized this family from the blind fish found in the Mammoth Cave of Kentucky, *Amblyopsis spelæus*. It is distinguished from the other *Physostomi abdominales* by the position of the vent on the throat before the ventrals, and small eyes covered with skin; it possesses no accessory gills, no adipose dorsal; a simple swim-bladder; a cæcal stomach; and pancreatic cæca. The very forward position of the anus occurs in other families, notably in *Gymnotidae*, also in several of the *Tenioïdæ*, and *Lophiïdæ*. Dr Wyman, on examining the fish, could discover no ocular speck, but a pretty large optic nerve. Agassiz is inclined to consider the *Amblyopsis* as an aberrant form of the *Cyprinidæ*, but until he has investigated its embryology he reserves his decision.

GENUS I. AMBLYOPSIS. Characters those of the family.

GENUS II. CHOLOGASTER, Agassiz. Habit that of *Amblyopsis*, but it has eyes; it has likewise a guttural anus, but wants the ventrals wholly. There are two horn-like processes on the snout. One species, *C. cornutus*.

FAMILY II.—APHRODEIRIDÆ, Bon.

This family, founded on a single species, is placed by the Prince of Canino in the order of *Heteropygii*, comprising *Amblyopsis* also. Both agree in the guttural position of the anus, but M. Valenciennes places *Aphrodederus* among his Percoids, near *Pomotis*. The characters of the family are those of the genus.

GENUS I. APHRODEDERUS, Lesueur. Scaly *Acanthopteri*, with a single dorsal on the summit of the fusiform body; pectorals and subbrachial or abdominal ventrals; anus before the pectorals, under the gill-openings; branchiostegals six. No spine in the ventrals; a spinous point to the operculum, and crenatures on the suborbital scale bones. Scales ctenoid. Stomach very small, siphonal, gut running forward from the anal fin in a canal among the muscles of the abdomen to the anus, which opens just behind the edge of the branchiostegal membrane. Air-bladder large, simple, with round ends. Milts communicating with the anal opening by a long canal which follows the intestine. One species. Lake Pontchartrain.

FAMILY III. CLUPEIDÆ, Valenc.

Scaly fishes, without an adipose fin. Body generally elongated and very much compressed; belly thin and trenchant, frequently denticulated by the edges or points of a series of dermal bones. Scales always present on the body, but easily detached. No spinous rays in the fins; ventral fins nearly in the middle of the body; dorsal fin always solitary; moderately long *pre-maxillary bones* conjoined with the *maxillaries* to form the *upper border of the mouth* (this character they possess in common with the *Salmonidæ*); *maxillary composed of three pieces* easily separated.

Gill-openings very large; rakers of the branchial arches long, and projecting towards the mouth; no accessory gills present. Ribs long, and with their epipleural spines very slender; the latter diverging from the parapophyses and neuropophyses of the vertebrae, as well as from the ribs; points of the ribs connected with the dermal osseous scales on the edge of the belly. Stomach cæcal, often fleshy; pyloric cæca numerous and long. Ova (roe) very numerous, and,

Classification—Malacopteri.

Classification—
Mallacopteri.

near spawning time, occupying much space in the belly, as do also the male organs (melt). The air-bladder is always large, and has a slender tube by which it communicates with the apex of the caecal cone of the stomach, or in some species with the dorsal side of the stomach or oesophagus; sometimes the air-bladder divides into two long conical processes posteriorly, but this is rare; in all, its anterior end is simple and generally pointed, and does not pass before the centre of the first spinal vertebra, nor are there any ossicles intervening between its point and the acoustic capsule, as in the Carps; neither has the air-bladder of the *Clupeidae* any communication with the interior of the skull.

ANALYTICAL TABLE OF THE *CLUPEIDÆ* (Dum.)

Mouth large.			
Anal separated from the caudal.			
Ventrals conspicuous.....	{ ENCRASICHOLUS	} 12.	
	or ENGRAULIS		
Ventrals none, or scarcely visible.....	ODONTOGNATHUS	14.	
Anal coalescent with the caudal.....	COILIA	13.	
Mouth of moderate size, or small.			
Teeth visible on the jaws.			
Teeth on all the oral bones.....	ROGENIA	6.	
Teeth on the upper jaw and mandible only.....	{ CLUPEA	} 1.	
Teeth on the upper jaw, mandible, and pterygoids.....	KOWALA		9.
Teeth on the tongue only.....	MELETTA	10.	
Teeth on the tongue and palatines.....	SPRATELLA	8.	
Teeth on the tongue and pterygoids.....	CLUPEONIA	7.	
No teeth on any of the oral bones.			
Dorsal with all the rays connected.....	ALAUSA	11.	
Dorsal with one isolated ray.....	CHATOESSUS	15.	
No teeth on the vomer, nor jaws, but on the other bones.....	{ SARDINELLA	} 2.	
No teeth on the vomer only.			
Anal short, far back.....	HARENGULA	3.	
Anal long.			
Ventrals none.....	PRISTIGASTER	5.	
Ventrals present.....	PELLONA	4.	

GENUS I. *CLUPEA*, Cuv. Small pre-maxillary teeth; crenatures on the maxillary so fine as to be discoverable rather by the touch than by the sight; fine teeth also on the symphyseal portion of the mandible which projects farther forward than the upper jaw; a longitudinal band of larger teeth on the vomer; a similar one on the tongue; two or three very small deciduous teeth on the external edge of the palatines. Body elongated; back rounded; belly more or less compressed or trenchant according to the size the roe or melt has attained. Sixteen species.

GENUS II. *SARDINELLA*, Valenc. Teeth on the palatines, entopterygoid, and tongue; none on the vomer, pre-maxillaries, maxillaries, or mandible. Specific characters derived from the forms of the gill-cover or other external part. Seven species.

GENUS III. *HARENGULA*, Valenc. Teeth on the jaws, tongue, palatines, and entopterygoids; no vomerine teeth. Ten species.

GENUS IV. *PELLONA*, Valenc. Dentition of *Harengula*. Body very much compressed. Ventrals before the dorsal; anal long and low; edge of the belly strongly denticulated. Pectorals pointed, their first ray strong, though jointed, and long. Sixteen species.

GENUS V. *PRISTIGASTER*, Cuv. Apodal *Pellona*. Air-bladder various: large and forked behind in some species. Four species.

GENUS VI. *ROGENIA*, Valenc. Teeth on the vomer, palatines, entopterygoids, and tongue; teeth also on the jaws, but scarcely visible.

GENUS VII. *CLUPEONIA*, Valenc. Teeth on the tongue and entopterygoids only; jaws, vomer, and palatines edentate. Five species.

GENUS VIII. *SPRATELLA*, Valenc. Teeth on the palatines and tongue only. Two species.

GENUS IX. *KOWALA*, Valenc. Teeth on the jaws and entopterygoids only; none on the tongue, vomer, or palatines. Form of *Spratella*. Two species.

GENUS X. *MELETTA*, Valenc. A rough band on the tongue; no other teeth. Ten species.

GENUS XI. *ALAUSA*, Valenc. Teeth on the jaws deciduous and very small; no other teeth; a notch in the upper jaw. Air-bladder simple, pointed at both ends, and not extending before the third vertebra; air duct entering the conical point of the caecal stomach. Twenty-two species.

In the preceding genera the mandible is longer than the upper jaw.

GENUS XII. *ENGRAULIS*, Valenc. Mouth large, snout projecting. Nasal bone advancing before the jaws, concealing the small pre-maxillaries; maxillaries slender, not prolonged behind the mouth; vomer, palatines, and entopterygoids narrow, sustaining

teeth sometimes very small. Gill-openings large. The species may be divided into two groups, by the elongation of the upper ray of the pectoral, or by the absence of that character. Twenty-three species.

GENUS XIII. *COILIA*, Gray. Maxillaries large, their posterior ends passing the gill-opening. Dorsal far forward; upper rays of the pectoral prolonged into slender filaments, and divided nearly to their base. Tail generally much compressed and tapering to a point, with a long low anal united to the caudal: there is an exception to this character in a species which has the tail abbreviated, and the caudal wide and rounded. In other respects the genus corresponds with *Engraulis*. Six species.

GENUS XIV. *ODONTOGNATHUS*, Lac. (*Gnathobolus*, Schn.) Body greatly compressed; belly trenchant and very strongly denticulated, from the throat to the anus. No ventrals; dorsal very small, far back on the tail; anal very long and low, extending to near the forked caudal; pectorals moderately long. Mouth small; mandible passing the upper jaw, which is truncated, with the small pre-maxillaries lying transversely; maxillaries long, wide in the middle, projecting backwards beyond the mandibular joint. Teeth on the jaws, palatines, entopterygoids, and tongue; none on the vomer. One species.

GENUS XV. *CHATOESSUS*, Cuv. Mouth small, edentate; pre-maxillaries small, with a medial notch which receives the symphyseal apex of the mandible and a fibrous lip, that runs backwards from it along the whole edge of the maxillary, the latter articulated to the nasal behind the pre-maxillaries; first branchial arch uniting above the pharynx with its fellow, and sending a curious pectinated branch forwards beneath the roof of the mouth. Body in general high, oval, and short; belly strongly denticulated. Pectorals and ventrals small; first ray of the dorsal frequently prolonged. Stomach muscular; pyloric caeca very numerous, united by cellular tissue into a glandular mass, which fills great part of the belly; ova not inclosed in a sac, but dropping into the general cavity of the abdomen. Twelve species.

GENUS XVI. *AMBLOGASTER*, Bleeker. Small pre-maxillaries; the maxillaries constituting most of the upper half of the mouth. Body elongated, compressed; belly rounded, without serratures. No teeth. Head naked above; eyes half covered by a membrane; cheeks venous; five branchiostegals. Indian Ocean.

SALMON FAMILY.

The progress of Ichthyology in the last half century has been rapid, as might be expected of a science which had been previously greatly neglected, but whose importance was at length acknowledged. The old generic groups of fishes were first characterized as families, and afterwards having, by the discovery of new forms diverging more or less from the characters of the typical species, and having, moreover, been found in many instances, by the more correct investigations into their structure that were instituted, to include heterogeneous assemblages, were broken up into several genera, families, or even into groups of a higher order. The genus *Salmo* of Artedi is an example of this. That ichthyologist included in this group all fish which have from twelve to nineteen branchiostegals, teeth on the jaws, and a dorsal standing over the ventrals, with an adipose fin on the tail. Linnæus modified this classification somewhat, and at length three great families have grown out of the single genus *Salmo*, one including all the Salmonoids, with the cheeks or the whole head covered with scaleless integument, being the group comprised in our table under the name of *Salmonidæ*. The *Characini*, a second family of fishes formerly associated with the Salmon, is characterized by the small number of its branchiostegals, a very small mouth, great variety of dentition, almost always in many rows, but rarely with any on the tongue, and with a divided air-bladder. The *Scopelidæ* is the third family of this stock, being distinguished from the others by the maxillaries not forming part of the orifice of the mouth. Some smaller detachments have also been made, as the *Erythrinidæ* and *Macrodonæ*.

Salmo, Cuv. The fishes which constitute this genus are of great importance, and are by far the most esteemed and valuable of all those which inhabit the fresh waters. The value of the fisheries, with the number of men engaged in them, is very great, and the expense of the mate-

Classification—
Mallacopteri.

Classification—*Malacopteri*.

rials which are employed in the capture of one or two species is immense. In Britain they are mostly consumed in the great towns, either in a recent or prepared condition. In the north of Europe and America numbers are salted or otherwise cured for exportation.

The male fish has the nose elongated and the under-jaw hooked during the breeding season. The silvery colours change to gray and red. The species inhabit the sea and fresh waters. Some migrate at the breeding season; all spawn in shallow streams, and both sexes assist in forming the spawning bed. They inhabit Europe, Asia, and America. At the commencement of the genus stands,—

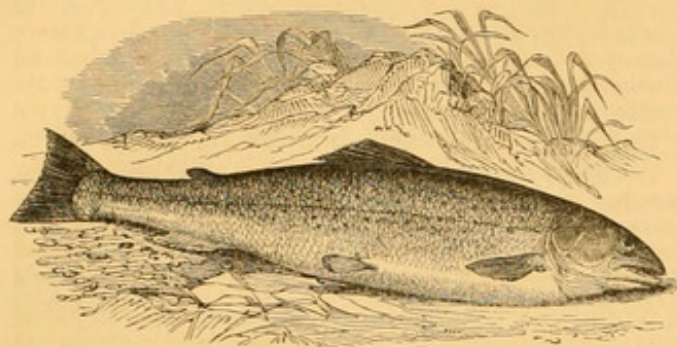


Fig. 70.
Salmo salar.

Salmo salar, or common Salmon, a species which likewise occupies the foremost place in the estimation of both sportsman and epicure. The Salmon is a fish of great elegance, combining a form fitted alike for strength and swiftness; and its depth and thickness, while in good condition, are so proportioned to its length as at once to convey the idea of a pleasing symmetry. The body above is of a rich bluish or greenish gray, changing below to silvery, sprinkled above the lateral line with rather large sub-cruciform black spots, a few of which at the shoulders generally extend below the line. The characters which distinguish it from its British congeners are the different form of the opercular bones, which show a rounded outline to the posterior edge of the gill-covers, the longest diameter of which to the nose would be in a line through the eye, while in all the other British migratory species the same line would pass much below the eye. The black inner surface of the pectoral fin is nearly a constant mark. The tail is forked in the young state, but fills up to a nearly square outline in the adult.

The common Salmon inhabits the seas around Great Britain, and extends to the north of Europe and to Asia. It generally delays entering the rivers in great numbers until the streams become somewhat swollen by rains, although in the larger rivers there may be said to be a limited daily run. When the flood has fairly mingled with, and to a certain extent has saturated the estuaries, the rush of fish is often very great, especially if there has been a continued tract of dry weather. In the latter case they collect at the mouths of rivers, and are seen and often taken in vast numbers; but they do not then attempt an ascent, deterred perhaps by the clearness of the stream, or by some instinctive feeling that the water would yet be deficient to carry them through. As the *fresh* approaches, however, an increased activity may be perceived; and, as far as we can judge, the change is probably indicated by the nostrils receiving a sense of the mixture of the waters, by means of the large ramification of nerves with which they are supplied; and to this same sense may perhaps be attributed the singular fact of the greater proportion of Salmon returning to the very streams in which they were spawned. The fish, on entering the river, rush forward as long as the flood continues, seldom resting in their course during the time that the water continues discoloured. From ten to twenty-

Classification—*Malacopteri*.

five miles daily is the rate, as far as can be ascertained, at which they are supposed to travel.

In their more lengthened courses, where the rivers are deeper and the interruptions less frequent, the rate at which Salmon travel is probably more rapid. Our common kind (*Salmo salar*) makes its way by the Elbe into Bohemia, and through the Loire as far as the environs of Puy, in the ancient Velay. We also know that it works its way up the Rhine, and visits a portion of the rivers of Switzerland, although the irresistible torrent of the Falls of Schaffhausen prevents its ingress to any part of the basin of the great Lake of Constance. It is an entire mistake to state its occurrence in the Persian Gulf, and equally absurd to say that, unrepelled by the gloomy terrors of a subterranean journey, Salmon from the Gulf, adorned by the fanciful Persians with rings of gold and silver, find their way into the Caspian. The non-existence of the supposed communication, is of itself a pretty sufficient barrier, even did no other exist in the laws of nature, and were light and atmospheric air dispensable. M. Valenciennes states that it belongs not only to France, England, and Germany, but to Schleswig-Holstein, Mecklenburg, Scandinavia, Iceland, and Greenland. It exists also in Labrador and Canada, and down the American coast to the Connecticut River, in latitude $41\frac{1}{2}^{\circ}$; and either it, or a species so nearly allied to it as not to be distinguishable except by close comparison, abounds in the Arctic Seas washing the northern shores of the American continent. It does not frequent the rivers falling into the Mediterranean, though Dr Davy informs us, on the authority of an intelligent observer, the clerk of the market at Malta, that a stray Salmon was once caught at that island, and brought to the market for sale. During nine months residence at Constantinople Dr Davy paid frequent, almost daily visits to the well-supplied fish market of that city, but never saw either Salmon or Trouts among the great variety of other fish that were there for sale.

In our lower and clearer waters, however, they travel at a much slower rate than that above alluded to—resting for some time in the pools by the way, and now and then taking a regular *lie* in some chosen spot, which they will return to daily as long as the river continues unfitted for their progress. Upon the least accession, however, to the water, either directly or from some swollen tributary, they are again upon the alert; and it is often felt by them several hours before the quickest or most experienced human eye can perceive a rise upon the river. Having ascended to a considerable height, they remain more stationary, and proceed more slowly with the subsequent floods, till the spawn increases in size. This increase, if not influenced by, is at least so connected with, the commencement of the colder weather, as then to proceed at a more rapid rate. As the spawn advances, the symmetry of the form is disfigured; the female becomes disproportionately large, the colours lose the brightness of their silvery tints, and become dull and gray. The male becomes thin upon the back, the nose elongates, and the under jaw turns up in a large and strong hook, which enters a hollow in the nose before the pre-maxillary bones. The colours and markings become brown and red, those on the head and gill-covers being particularly brilliant, and disposed in lines almost like the marking of a *Sparus*. In this full breeding dress the male and female seek some ford or shallow stream, and commence to excavate a trench or furrow (chiefly by the exertions of the female). In this the spawn is deposited, and impregnated at the same time, and finally covered with gravel by the exertions of the fish. The furrow is generally from six to nine inches in depth; and when the spawn has appeared to be covered beyond that depth, this has occurred from some other circumstances—such as the stream or floods having carried downward additional masses of gravel, &c. After this great effort has been accomplished,

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both sexes are reduced to a state of remarkable emaciation. The elongated nose, and hooked jaw, and brilliant colours, are almost immediately lost; the old scales are cast, and the fish retire to some pool to regain their strength and complete their new clothing. They finally descend to the sea by easy stages, where their former condition and silvery lustre are regained, their strength invigorated, and all their functions so repaired as to enable them ere long to renew their visit to the flowing streams, again to multiply their race.

The ova continue covered by the gravel during the winter, and begin to vivify from about the end of March to the commencement of April. The fry remove from under the gravel when nearly an inch in length, with the ovum still attached; and at this period, if the spawning bed or furrow be turned up, it will appear in motion. We refer to the article FISHERIES for the details of Mr Shaw's observations, which prove that the young fish or *Parr* may remain a full year in the fresh water. On the eve of descending to the sea, the Parr assumes a more brilliant dress and becomes a *Smolt*. At this time it is from four to six inches in length, of a greenish gray above, silvery below, the scales extremely delicate and very deciduous. From the time the Smolts reach the sea, for two months or ten weeks, we lose sight of them, and can only infer their growth from the fact, that after the lapse of that period we find them again ascending the rivers with a weight of from two and a half to four pounds. They are then known under the name of *Gilse* or *Grilse*; and their size, as they ascend from the sea, increases with the advance of the season. The Grilse which thus ascend spawn during the ensuing winter, and are then entitled to the name of *Salmon*. Descending in a weak state (as before mentioned), they return again in the summer of the following year, as fish of from ten to fifteen pounds weight, according to special circumstances. A third year would still increase their weight, as would several ensuing seasons, till the attainment of an enormous size. Pennant, for example, mentions a Salmon which weighed seventy-four pounds; and although we now regard with something of wonder a fish which weighs even the half of that amount, yet there is no doubt that not many years ago Salmon of forty pounds were much more frequent than in these degenerate days. The absence of Salmon of the largest class from many of the Scottish rivers, where they formerly abounded, is in fact owing to the injudicious perfection of our fisheries, which occasions the constant capture of the species in the state of Grilse, or other early condition; and the chances are by consequence greatly against any individual 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. The destruction by poachers, in the higher parts of the rivers, of the large enfeebled *Kelts*, or fish which have completed their spawning operations, is also extremely prejudicial; for these individuals (almost utterly useless as food at the time alluded to) would, if allowed to descend to the salubrious sea, ere long revisit their native streams, greatly increased in size, and full of health and vigour. A Salmon above fifty pounds weight was taken, in 1835, at the mouth of the Leven in Dumbartonshire. The general capture that season was very great in Scotland. Nearly 800 were taken at one haul in a bay of the island of Islay; and our calculation, from accurate data, is, that for some time, about a *hundred thousand Salmon* (including Grilse) were then shipped in Scotland *weekly* from our eastern ports alone. A friend of our own lately saw a Salmon of sixty-one pounds weight on a fishmonger's stall in London; and as these sheets are before us, we read in the *Times* of July 15, 1856, that a

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Salmon was caught at Chanonry Point, Moray Firth, Fortrose, on the 10th, which weighed sixty-two pounds. It was sent to London, and purchased by Mr Barton, fishmonger, of Bishopgate Street. Similar causes have diminished the Salmon in the northern parts of the United States of America. Hudson, in 1609, when sailing up the river that bears his name, "saw great store of Salmons." Now a solitary Salmon straying thither is a rarity.

Dr Davy has for some years been in the habit of recording his observations on the *Salmonidæ*, and has made, with his usual accuracy, a series of important experiments likely to throw much light on the distribution of species. From these, he concluded "that the ova of the Salmon, in an advanced stage, can be exposed to the open air, if dry, but a short time, at ordinary temperatures, without loss of vitality; but for a considerable time, if the temperature be low and if the air be moist; the limit in the former case not having exceeded an hour, whilst in the latter it has exceeded many hours. The vitality of the ova was as well preserved in air saturated with moisture, as it would have been had they been kept in water. It was also preserved even when the ova were included in ice, but if they were exposed to a temperature many degrees below the freezing point, probably effecting their congelation, they were deprived of their vitality. Both the ova and young fish were capable of bearing a temperature of about 80° or 82° in water for a moderate time with impunity, but not without a loss of life at a higher temperature than 84° or 85°. A degree of saltness of water nearly equal to that of sea-water proved speedily fatal to the ovum of the Salmon and to the young fish; the same effect was produced on the young fish by brackish water of specific gravity 1016, but in a longer time; and when the solution is so diluted as to be reduced to the specific gravity of 1007, the advanced ovum may be hatched in it, and the life of the young fish may be sustained in it for many days but with diminishing power."¹

From Dr Davy's excellent paper, the fact of temperature having a still higher influence on the distribution of species of fish than on the higher animals is apparent. An anadromous fish must have its range restricted not only by the temperature and suitableness in other respects of the affluents of a river in which it deposits its roe, but also by the nearness to the equator of the mouth of that river. We may, therefore, find Salmon in the streams flowing down the northern side of a great watershed while they do not exist on the southern side, though the feeders of both river systems interlock at their sources. This Dr Hooker found to be the case with the Trouts, which are confined to the northern face of the Himalaya range. Dr McClelland has described a species, *S. orientalis*, which inhabits the affluents of the Oxus. The parallel of 45° N. Lat. may be roughly considered as the southern boundary of the common Salmon in Europe, overlooking the feeders of the Atlantic rivers which rise to the southward of that latitude; and the parallel of 41° may be taken as the limit in America, adverting to the fact that the mean annual heat in a given parallel of the latter continent in the temperate zone, is from 8° to 15° of Fahrenheit lower than the parallel in Europe. The mean temperature of the year on these parallels lies between 45° and 52° Fahrenheit, and the mean heat of the hottest month between 60° and 68° Fahrenheit. The heat of the waters of the rivers frequented by the Salmon will, of course, vary much less than that of the atmosphere, and fall far short of the hottest months.

Ausonius, in his poem on the Moselle, which we have already had occasion to quote, says of the Salmon—

"Nec te puniceo rutilantem viscere Salmo transierim,"

contrasting it with the characters of two other members of

¹ *Phil. Trans.*, March 1855.

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the family, the *Fario* and *Salar*, by equally descriptive lines which will be quoted when these fish are noticed.

Fario argenteus of Valenciennes, "Truite de mer ou Truite argentée," is stated by him to be identical with the *Salmo Cumberland* of Lacépède, and with the Salmon-Trout of Yarrell, the *S. trutta* of British ichthyologists. It is also according to the last-named author, the "White Trout" of Devonshire, Wales, and Ireland, but is more abundant in the rivers of Scotland, where it is named the Sea Trout. In the Nith it is taken in quantities, associated with young of other species, and sold, together with them, under the name of "Hirling;" but on attaining the larger size of several pounds weight, it is distinguished as the Sea Trout. Its head and dentition are correctly figured in plate 92, fig. 1, A and B of the *Fauna Boreali Americana*. The Hirling has been named *Salmo albus*, and locally, "Whitling." In its largest state, or as known under the specific title of *S. trutta*, it enters the rivers from two and a half to six pounds weight in the end of May. It is of an elegant form, and possesses all the symmetry of the Salmon. The head is small, the back remarkably broad when viewed from above; the tail slightly forked, and wide at the extremity of the web; the colour above greenish, inclining to bluish-gray, lower parts of the clearest silver; body above the line spotted, as in *S. eriox*, with large, deep-black spots, but generally much fewer in number. The flesh is pink, richly flavoured, and much esteemed for the table. It ranks next to that of the Salmon, and by many is esteemed more delicate than even that prized species. The *S. albus*, or smaller and younger state in which it is found, is very nearly of the same proportion, form, and colours. They approach the mouths of the rivers in the end of July and commencement of August, in immense profusion, and immediately enter the fresh waters, where an angler may take almost any quantity without the exercise of great skill. In the North they form a perquisite to the taxmen or kayners of the Salmon fisheries—above a thousand being sometimes taken at a sweep of the net. In the Solway they are taken in equal abundance in houses of the stake-net, covered for the purpose with net of a small mesh, and are then carried to the various country markets, and during the height of the run, to the villages, in cart-loads, for sale. The flesh of this smaller fish (whether species or variety, as the case may be) is also pink, and delicately flavoured. Its food is likewise the same as that of the larger kind; in the sea small Crustacea (*Talitrus locusta* being a favourite and common food); in fresh water, aquatic insects, worms, minnows, or other small fish. They appear also to spawn rather earlier than the Salmon, and after the same manner. The colours of both sorts during the breeding season are deep-grayish black, slightly tinted with brown in the males; and at this time they offer a most marked contrast (being black and lean) to the symmetrical form and brilliant silvery tints of their perfect condition. It is of this fish that Ausonius, in his poem on the Moselle, already quoted, says,—

Teque inter species geminas, neutrumque, et utrumque,
Qui necdum Salmo, nec jam Salar, ambiguusque
Amborum medio *Fario* intercepte sub ovo?

thus well expressing the doubts still entertained after a lapse of fifteen hundred years.

Salar griseus aut cinereus, Willughby and Ray. We have adopted these names as not subject to the same misapprehension with *eriox*, which our modern British ichthyologists have borrowed from Linnæus, but M. Valenciennes, after much investigation into the synonyms of the *Salmonidae*, says that it is altogether impossible to discover at this day the species which the Swedish naturalist had in view when he characterized *eriox*; and M. Valenciennes has not recognised the *S. griseus* in the French rivers. The English fish is named the Bull Trout, the Gray Trout, the

Whitling, and the Round-tail, according to the district in which it is taken. In Wales it is called the Sewin; and Donovan has given it the specific appellation of *Cambriacus*, but it is often confounded in the markets, and even by fishermen, with the *Fario argenteus*. The same thing occurs in Dumfriesshire, the young of the two species on their first return from the sea being sold under the name of "Hirling." They come up the river Nith from the Solway Firth with the tide, and are very plentiful for a short time. The best flavoured Hirlings of the two are the yearlings of the *Fario argenteus*; but the flesh of the *Salar griseus* is also red on coming from the sea, and seems to be more juicy and rich than that of older Bull Trouts. The *Salar griseus* reaches a weight of twenty-five pounds. It is thicker in proportion to its length than the Salmon; the fins are much more muscular; the tail particularly so, and perfectly square at the end in all the stages of growth, while the distance between the two extremes of the web is smaller proportionally than in any of the other species. The head is larger in proportion than that of the Salmon of a similar weight, and the opercular covering is more lengthened. The toothing is very strong. The general colours are—above, greenish gray; the lower parts silvery white; the body above the lateral line being thickly covered with large cruciform black spots. In the breeding dress they assume a much blacker tint than the Salmon, and want much of the red markings. All the under parts, jaws, and cheeks, become blotched with deep blackish gray. The flesh is of a yellowish tint, and is coarse, except in the young state; it has the least flavour, and is consequently less esteemed in the market than any of the other species. The hook of the under jaw of the male does not become so elongated as in the Salmon. The old fish commence to enter the rivers about the end of July, and appear to deposit their spawn and return to the sea about a month earlier than the Salmon. The young fish, of from two to three pounds weight, and in this state known as *Whitlings*, enter the rivers about the beginning of June. In all its states it is a very powerful fish, and feeds voraciously and indiscriminately. When hooked it springs repeatedly from the water, and runs (to use an angler's expression) with extraordinary vigour to free itself. The River Tweed and its tributaries, and the Nith, the Annan, and Esk, which fall into the Solway, are the principal Scottish localities for this fish.

Salmo hamatus, Cuv., is described at length in the *Histoire des Poissons*, and reasons assigned for dissenting from the opinion of Agassiz who holds that it is the male of *Salmo salar*. *Salmo hucho* is the Salmon of the Danube, where it attains the weight of 30lbs, and it is reported, even of 60lbs. Gesner says that its flesh is white, and less agreeable than that of the common Salmon; while Cornide says that it has a good flavour, but is a little dry. The *hucho* spawns in June, in hollows excavated in the gravelly bottoms; the male and female working together and hiding themselves in these hollows from the nets of the fishermen. Mr Reissinger has verified these observations in Hungary. In Galicia this fish is named "Reo." It is a mistake to suppose that it is an inhabitant of the British waters. *S. umbla*, a fourth species, is common in the eastern parts of France, in Switzerland, and the Tyrol. It is the *L'Ombre chevalier* of the French, and M. Valenciennes considers it to be identical with the Charr of England, the *S. carpio* of the *Fauna Danica*, and the "Kebleriksok" of the Greenlanders and of Otho Fabricius; and he quotes, with commendation, Mr Yarrell's figure of the Northern Charr, as enabling him to recognize the species. M. Valenciennes rejects the Linnæan name of *alpinus*, applied by most English ichthyologists to this species, as he says that referred to a different species. He retains, however, the name of *S. salvelinus* for the other English Charr, though that also was differently used by Linnæus; but it is the fish

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so named and figured by Bloch, as he has ascertained by an examination of specimens from the same locality where Bloch procured his.

Salmo umbla is abundant in the English lakes, and in the greater number of those in the north of Scotland, when of any considerable extent; but more seldom seen there, from the absence of the practice of *netting*, and the general unwillingness of Charr to take a fly or bait. This fish is of great repute in the Lake of Geneva, and is also found in many of the alpine lakes of northern Europe. The common Charr reaches a considerable size, being sometimes taken in Britain above 2 lbs. in weight, although the more usual weight is under three quarters of a pound. When in full condition, it is a fish of very great beauty, above of a grayish green, shading into the most delicate white on the lower parts, and tinted with a blush which is comparable to that seen on the breasts of some of the gull tribe when newly shot in spring. The body is sprinkled over with pale spots of a considerable size. In this state they remain in the deeper parts of the lakes, and are not frequently taken, although we doubt not they might be so were the practice adopted of hanging a herring-net in the deep water, instead of trying only the *winter* practice of hauling in shore. We ourselves caught them by the former method, in their prime *silvery* state, in Sutherland, during the month of June. On the approach of the breeding time, they seek the mouths of the small tributaries, and are taken in vast numbers at the very period when their preservation ought to be most strictly attended to, and when, in truth, they begin to fall off in their condition. At this season the colour of the upper parts is darkened, the fins are very rich, and the sides and belly become of a beautiful and brilliant red, the whole spotted with small marks of a paler tint.

S. salvelinus occurs in Wales; and we have already mentioned (in the article *ANGLING* of this work) that both kinds occur in Windermere, to wit, the Charr or Case Charr (*Salmo umbla*), and the Torgoch or Red Charr (*Salmo salvelinus*). These are usually thus distinguished—the former, by having the first rays of the ventral and anal fins white; the latter, by having those parts plain, that is, of the same colour as the other rays. A remarkable distinction is also observable in their natural habits,—the Case Charr ascending rivers, and spawning about Michaelmas; the Red Charr depositing its ova along the shores of the lake, and not till the end of December, or the beginning of the year.

The chief feeder, or head stream of Windermere, is composed of two branches, the Brathay and the Rothay, which meet a short way above the lake, into which they speedily pour their united waters. The Brathay is the left-hand branch (as we ascend from the lake), and draws its sources from the mountain vales of Langdale, reaching Windermere without any resting-place; while the Rothay has previously formed and flowed from two consecutive lakes, Grassmere and Rydal. The Charr, in ascending from Windermere to spawn, invariably turn to the left, and ascend the Brathay (though to no great distance), and as invariably avoid the lake-descended waters of the Rothay. They also spawn lower down the lake of Windermere, at the mouth (or a short way upwards) of the stream called Troutbeck, which is also derived from the flow of mountain tributaries, without any lesser or intermediate lake.

Although the art of angling is not immediately connected with the science of Ichthyology; it is, at the same time, evident that the successful practice of that art necessarily illustrates the *food* of fishes, and therefore makes us acquainted with an important portion of their natural history. For this reason we insert the following memoranda, transmitted to us by Mr John Wilson, jun.:—"The season for fishing Charr (with rod and line) in Windermere and

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Coniston commences about the end of May, and, I should say, is over by the first or second week in July. Trolling with a smallish minnow is by far the most successful mode of angling for this fish. It may, however, be taken with the artificial fly, the green and gray drake being the favourites. I killed three, one day in May last, with a small red *professor*. A Bowness fisherman, on the same day, trolling without intermission from six in the morning till six in the evening, killed *six and twenty*, being the greatest number that has been taken in Windermere, in a single day, by one person, for many years. In Coniston, where this fish is more abundant, I believe it is by no means uncommon to kill three or four dozen in a day. With regard to the size of Charr in Windermere, I should say they average three to the pound. I never saw one that was a pound. Billy Balmer told me that he once saw one that was a pound and a quarter, and that it was the largest ever taken in Windermere." In relation to the same subject, in a different locality, we may also add the following extract from another hand:—"A small red Charr is found in Loch Achilty, Ross-shire, on the property of Sir George Mackenzie. It takes the fly greedily in warm still weather, and, what is singular, during all the summer and autumnal months. I have captured eighteen in a forenoon in July—raising many more. My flies were of various sorts, from a midge to one as large as a sea-trout fly. The water of Loch Achilty is singularly deep and transparent; the soil is rich and loamy, and contains large quantities of imbedded wood—black oak especially. It is supplied by numbers of minute streams, but has no visible outlet, being supposed to discharge itself subterraneously. The Charr found in it average eight or nine inches in length; we, however, caught one much larger. They rise with less velocity than the Trout, and on missing the fly, unless injured, will return to the hook. In Strathglass there is a Loch Bruiach, where Charr are caught of a much larger size, but chiefly with the net: except in the month of October, when, as our informant, the Rev. Mr Chisholm, told us, they may be taken in the shallows with the rod, but at no other season."

On dissecting the Charr which we killed last summer in Sutherland, with a view to ascertain their food, we found the stomach usually empty, but the lower part of the intestine filled with green vegetable residuum. This we found to be the remains of the *cases* of aquatic larvæ (*Phryganidæ*), a few of which we discovered in a half-digested state in the upper portion of the intestinal canal.

The true *S. alpinus* of Linnæus is, according to M. Valenciennes, a Salmon which corresponds perfectly with the figure of the *Roëding* by Ascanius, and the only species that agrees with the description given in the *Fauna Suecica*. It inhabits the Norwegian and Swedish waters, and also the rivers of Siberia which fall into Lake Baikal. For the other species of Salmon we must refer to the pages of the *Histoire des Poissons*.

Professor Nilsson of Lund has investigated the Scandinavian Salmon, and compared them with the original specimens of Linnæus, still in the museum at Lund.

I. TRUTTA, "Lachs" Suecis.

(a.) Teeth in the front only of the vomer.

1. *Salmo salar*, L.; "Blanklachs" Suecis. (*Fauna Bor. Amer.*, pl. 91, fig. 1. Salmon from the River Urr in Galloway.)
2. *Salmo eriox*, L.; "Graulachs" Suecis. (*Fauna Bor. Amer.*, pl. 91, fig. 2. Head of a Trout from Glamorganshire, in Mr Yarrell's possession, said to be the Sewin.)

(b.) Teeth in one row down the mesial line of the vomer.

3. *Salmo trutta*, of which the following are varieties:—*S. ocla*, Nilss.; *S. truttula*, Nilss.; *S. fario*, L.; *S. punctatus*, Nilss.

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- II. SALVELINI, "Rothföhren" Suecis; Charr. Anglis.
4. *Salmo salvelinus*, L.; of which *S. pallidus*, Nilss., *S. alpinus*, L., are varieties.
5. *Salmo carbonarius*, Str., of which *S. ventriosus* is a variety. (Arch. für Naturg. von Trosch, 1849, 310.)

Fario Lemanus, or the Salmon-Trout of the Lake of Geneva, is another fine species of this genus, fully described by M. Valenciennes, and beautifully figured by M. Agassiz.

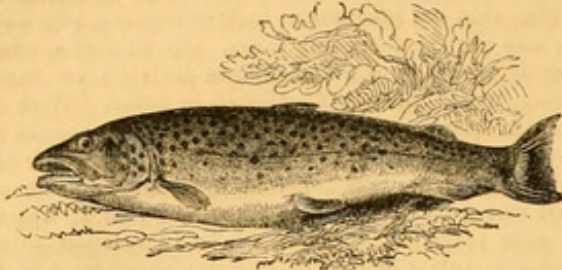


Fig. 71.
Fario Lemanus.

Salar Ausonii. Under this new appellation, M. Valenciennes, treats of the well-known *Salmo fario* of authors, the river Trout of England, and the burn Trout of Scotland. Having adopted the word *fario* for the appellation of a generic division of the family, he has taken a specific name from the author who has so briefly, yet so well, characterized the three members of the family that are the most remarkable for the frequency of their occurrence in the rivers of Europe. The propriety, however, of setting aside a specific name so long established as *fario*, and so little mistaken, may be questioned.

"Purpureisque *Salar stellatus tergore guttis*."

This line which, with others, from the same author, we found in the *Histoire des Poissons*, and have quoted in preceding pages, gives a neat description of the Trout. One of our own poets says:—

"The springing trout in speckled pride,
The salmon, monarch of the tide,
The ruthless pike intent on war,
The silver eel and mottled parr."

thus singling out three of the salmon tribe that frequent the Leven, flowing over its smooth, round-pebbly bed.

This lovely Trout is most extensively distributed over the whole of Northern Europe, being found in every burn and tarn, in every lake and river. It may be also said to be one of the most pleasing in its appearance; and, when newly taken in "golden glory" from some translucent stream, is exquisitely beautiful. The variation of the tints of the ground colour is infinite; yellow, however, is the most predominant, varying to the most brilliant orange; while at other times the ground colour of the body runs from a dark-greenish black to violet, in most instances numerous spotted with black and red. Sometimes, however, the black is alone present in the form of large round spots, placed in a pale circle, but in all cases beautifully relieved, and breaking up the uniformity of the other colours. In a few instances the spots have been observed to be wanting altogether. One cause of the variation in the Trout, is the difference of food; and, according to every information we possess, those which feed on fresh-water shells and *Gammari* (screws, or fresh-water shrimps, as they are sometimes called), are of the most brilliant tint, and also of the finest flavour, with a decided pinkness in their flesh. Those feeding on the ordinary water insects are next in brilliancy and flavour, while such as live chiefly upon aquatic vegetables are dull in colour, and of soft consistence. This is further confirmed by the Trout in *stews* being always finished, or *fed off* as it is called, on the foresaid *Gammari*, collected often from a distance. It is only in this way also that we can account for the variation in the appearance and

flavour of Trout found in two adjoining bays of the same lake. The individuals, in fact, do not appear to stray to any distance, but seem to be satisfied with whatever food is found within a limited district, and which of course will be in many instances of a peculiar and local kind. It is also true, that the colours of Trout accommodate themselves to the tint of the water, and to the prevailing tone of the bottom, whether of rock or gravel, or of softer substance; and so constantly is this the case, that an experienced and observant angler has little difficulty in accurately predicating the general aspect of the fish of any lake or river. The presence of moss, so frequent in alpine districts, has invariably the effect of deepening the tints, particularly the shades of green and yellow.

In form this fish, when in perfect condition, may be said to be nearly symmetrical; the head only being sometimes rather large in proportion to the body, when considered in relation to what we regard as the *beau ideal*. The fins are of moderate strength, those of the body assuming a variation of form, from a rounded to a lengthened extremity. The tail is almost always forked; the fins are always coloured, that is, never of the transparent whiteness observable in the migratory species, and their tints are generally of a paler shade than those of the corresponding parts of the body. The anal fin is often bordered on its lower surface with white. The scaling is proportionally less than in the migratory kinds. The tothing is in general strong, and very prominent on both the tongue and vomer.

The average growth of the common Trout, taking the species generally, may be stated at about a pound, and certainly not more than a pound and a half. In almost all rivers, fish weighing beyond this may certainly be found; but they are comparatively uncommon. Individuals from two to six pounds weight are occasionally taken, even in what may be termed a "wild state." In ponds or stews, again, they reach a much greater size, but cannot be said to be in the natural condition of uninclosed fish. The Thames Trout seem to reach most frequently the largest size, being short compared to their length, but of great thickness and well flavoured. Two were lately taken, the one of eleven, the other of fifteen pounds weight. The lakes in the north of England produce Trout of very fine quality, and which are often passed off for Charr. Loch Leven, too (of which the barren isle and now dismantled castle are famous in history as the prison-place of the beautiful Queen Mary), has long been celebrated for its breed of Trout. These, however, have fallen off of late considerably in their general flavour and condition, owing, it is said, to the partial drainage of the loch having destroyed their best feeding ground, by exposing the beds of fresh-water shells, which formed the greater portion of their food. Farther north (as in Sutherlandshire) the immense multitude of lochs produce a corresponding abundance and variety of Trout. Of these, however, only a few are of superior quality; but these few may assuredly vie with the Trout of any country in the world. Another large species, occurring in the British waters, and not yet distinctly known elsewhere, is the—

Salar ferox, Jardine. This species reaches a weight of twenty-eight pounds, and is of very great power compared with its size. The characters which distinguish this fish from *S. Ausonii* are the great size which it attains in a natural state, the large proportional size of the head, the square extremity of the tail in all the stages of its growth, the relative position of the fins, and the number of rays in the dorsal, which vary from 2-11 to 4-11. The external skin or covering of the scales is also extremely tough; and there is a difference in the form of the scales of the lateral line. In colour the upper parts are generally of a deep purplish brown, shading into purplish gray, and finally, on the lower parts, to greenish or grayish yellow, more or

Classification—
Mallacopteri.

Classification—Malacopteri.

less tinted with orange. The spotting is large and not numerous, and consists of black spots placed in a pale circle, and of large pink spots with a similar light area. These extend over the gill-covers, upper fins, and often over the tail itself. A variety occurs in Loch Loyal, in Sutherland; above, purplish brown; beneath, blackish gray; the whole body spotted over with dark sepia coloured spots, of a smaller size on the lower portions. *Salmo ferox* appears to be entirely confined to the lakes, seldom ascending or descending rivers, or wandering in and out of them, and never migrating to the sea. When spawning, it ascends for a short way up the rivers or streams which run into the lakes, but never, as far as yet known, descends those which run out of them. It inhabits, among the English lakes, Ulswater; but does not there reach a size above ten or eleven pounds. In Ireland, as far as we can yet learn (specimens having not yet reached us on this side of the water), it is found in Loch Neagh and some other large lakes; and in Scotland we have taken it in Loch Awe, Loch Laggan, the upper end of Loch Shin, and Lochs Loyal and Assynt. It is a fish of remarkable ferocity, and as great an enemy to its smaller companions as the Pike. It may be taken by night lines, or by strong trolling tackle, baited with a small Trout, and will return a second and third time to the bait, even after it has been dragged for forty or fifty yards.

The *Salmonidae*, though they take so important a place among the fresh-water fishes of Europe, are still more abundant in the northern Siberian rivers, and in the great lakes and rivers of North America. On the Pacific coast, indeed, of British North America some populous tribes of natives subsist chiefly throughout the year on the Salmon and Trout, which they take at the beginning of the spawning season, and preserve by drying. Descriptions of some of the species are given in the *Fauna Boreali Americana*, and the *Fauna Rossica* of Pallas contains accounts of the numerous interesting Asiatic *Salmonidae*. The common Salmon, we have said above, frequents the Atlantic and Arctic coasts of British North America; but there is a Trout in the great lakes and interior rivers which equals the Salmon in size, and is at least equal to it in flavour and excellence as an article of diet. This is the *Salar namaycush* (Pennant), which is very commonly taken of a size varying from twenty to forty pounds, and is reported to grow to sixty and upwards, though fish of that weight are as rare as a Salmon equally heavy. The *Namaycush* is taken in considerable numbers for the American markets at the fisheries established on Lakes Huron and Superior for the capture of another member of the family of still greater excellence, the *Coregonus sapidus* of Agassiz, or the *albus* of the *Fauna Boreali Americana*. This *Coregonus*, the well known "White Fish" of the fur traders, is found in every lake and river from the United States northwards, and it descends even to the mouths of the rivers that fall into the Arctic Sea. In flavour, and all the qualities that a fish can possess as an article of food, it surpasses, we believe, every other, whether fresh-water or marine; and Europeans previously accustomed to a sufficient variety of diet, have lived almost solely upon it for a year or more without tiring of it. To the native population it is of vital importance, and it is only in the Buffalo prairies that they can subsist without its aid; while to many tribes it forms the chief food. Within a few years fisheries, employing a large fleet of ships, chiefly belonging to the United States, have been established for the capture of this fish on Lakes Huron and Superior. Several other species of *Coregonus*, known locally by the name of "Herring Salmons," exist in the American waters, but they are much inferior in quality, and resemble the European species more nearly as articles of diet. Even they, however, are delicate food, and would be esteemed were they not so much surpassed by the "White

Classification—Malacopteri.

Fish." It may be remarked here that M. Agassiz, who is now in a position to investigate the ichthyology of America thoroughly, has already perceived that every lake, basin, and river system in that country possesses peculiar species of fish, though some species are common to several watersheds. He found this to be the case with *Lepidosteus* and *Coregonus*; and if his observations prove the fact in that continent, we may expect to perceive that the same law exists elsewhere, though the European lake and river systems, being comparatively very small, it may not be so apparent with us. M. Valenciennes describes many European *Coregoni*. Of the British species, he says that the *Coregonus pollan* of Thomson (Yarrell, *Supp.* 24) is very similar to his *C. sikus*, which inhabits Norway, in the vicinity of the North Cape, but that its head is smaller and its jaws more equal. The *Pollan* inhabits Loch Neagh, and Mr Thomson says that 17,000 were taken there at either three or four draughts of the net in September 1834. It is a fish that is brought in quantities to Belfast market during its season. Of the Powan (Yarrell), the *C. Cepedei* of Parnell, he says that he has found the original description of Noël de la Mariniere, on which Lacépède founded his *C. clupeioides*, in which the fish is called also "Span" or "Pollock." Noël had gone to Loch Lomond to see what were said to be sea Herrings naturalized in the fresh-water lake, and thus the species was introduced into our systems. Pallas had already used the specific name of *Clupeioides* for another *Coregonus*, and the name given by Dr Parnell will therefore remain as the scientific appellation of the fish. At Loch Lomond *Shelley* is one of its local names. M. Valenciennes thinks that this species has not yet been discovered on the Continent. *C. Pennanti* is the Welsh Gwyniad of Yarrell (*Brit. Fish.*, ii., 85); but, according to M. Valenciennes, very different from the *fera*, with which Pennant confounded it, and equally so from the Lavaret of Switzerland. The specific name of *Pennanti* is therefore employed in the *Histoire des Poissons* to distinguish it. The species which inhabits Lochmaben, a piece of water that bathes the ruins of Bruce's Castle, is locally known as the *Vangis*, *Vendace*, *Juvangis*. According to the traditions of the place, it was originally imported thither from the Continent by Queen Mary. Sir William Jardine was the first who correctly described the Lochmaben fish under the name of *C. Willughbii*, but recognizing at the same time its close resemblance to the *S. albula* of Linnæus. M. Valenciennes, by a comparison of specimens, has decided it to be in fact the *albula* of the *Fauna Suecica*, and has therefore described it under that specific name in the *Histoire des Poissons*. It is the *Blitka* of Lake Siljan in Dalecarlia, and the *Vemme*, or, when its resemblance to the Herring is referred to, the *Land-sild* of the inhabitants bordering on Lake Mïæs. According to Bloch, it exists in Silesia, Brandenburg, Pomerania, and Mecklenbourg; and M. Martens found an extremely similar *Coregonus*, if not actually the same, at Kamtschatka. Artedi mentions *Sik-loja* and *Strut* as its Swedish names, *Blieta* as its Silesian one, and *Moiku* and *Räpis* as those by which it is known to the Fins. The *Vendace* of Lochmaben, whatever scientific name it may ultimately receive, is one of the most elegant of the *Coregoni*, though of a small size, reaching from four to ten inches in length. The head is of an angular shape, and small compared with the size and depth of the body. The crown of the head is very transparent, and the form of the brain, which is heart-shaped, is seen through the integuments. This peculiarity is one of the first things pointed out to the stranger naturalist who visits Lochmaben to see this species. The eye is large and brilliant; the body rises gracefully to the back fin, and recedes with a gradual curve to the tail; the under line is nearly straight from the gills to the ventral fin. The upper parts are of a delicate greenish-

Classification—*Malacopteri.*

brown, shading gradually into a clear silvery-white; the dorsal fin greenish-brown, the anterior edge much lengthened and pointed; the lower fins all blush-white; the tail much forked. They spawn about the commencement of November. The roe is minute and abundant, and of a bright orange colour. The flesh is white and rich, and highly prized as food; but as it requires almost to be eaten *on the spot*, it is not useful as a market commodity when transmitted to any considerable distance. The lochs of Lochmaben are the only authentic British habitat for this species.

The Grayling (*Thymalus vulgaris*) is a local fish in England, being chiefly found in the Test, the Avon, the Dove, the Lug, the Wye, the Irvon, the Teme, and the Clun, in the southern counties; in the Trent, the Dove, and Dee, in the midland districts, and in the Wiske, the Wharfe, the Ure, the Ribble, and the Derwent, in the northern counties. In America the Graylings have not been detected south of the 61st parallel of latitude, but two or more species abound in the clear affluents of the Mackenzie, issuing from granitic and other primitive rocks. One, the *Thymalus signifer*, is the most beautiful known species; and the Eskimos, seizing on its most characteristic feature, name it "*Hewlukpowak*" or the "fish with the wing-like fin." It affords fine sport to the angler, tugging like a bull-dog when it feels the hook.

Stenodus Mackenzie, the *poisson inconnu* of the canoe-men who accompanied Mackenzie in his voyage down the great river which bears his name, is still so called by the fur-traders who frequent the district. It ascends the Mackenzie from the Arctic Sea as high as Great Slave Lake, a course of 500 miles, but shuns clear water, and has not hitherto been discovered in any other river than the Mackenzie. M. Valenciennes, having seen no specimen, has not introduced it into his great work, but it is nevertheless a very distinct generic form, not liable to be confounded with any other. When obtained soon after its ascent from the Arctic Sea it is agreeable food, but people who feed solely on it tire of it sooner than either of the "Namaycush" or "White Fish;" and after it has been for some time in fresh water its flesh becomes soft and oily. Its weight varies from five to fifteen pounds, but it has been taken of a considerably greater size.

The preceding pages contain as full an account as our limits will permit of the typical *Salmonidæ* with fleshy cheeks, and, on account of their importance to man, and the general interest felt in their history, we have devoted more space to them than we can give to other groups of fishes. M. Valenciennes has separated the Salmonoids which have the cheeks cuirassed by an enlargement of the sub-orbital scale bones so as to cover, in great part or wholly, the muscles which move the mandible. These present a great variety of forms, which he has subdivided into lesser assemblages of genera. The *Characini* and *Scopelini* of Müller nearly comprehend this division, but the group is not exactly the same.

Some of the genera belonging to this division, and named in the table, are vegetable eaters, and have long intestines doubled up in the belly; others are fierce devourers of flesh. Some of the most curious, from their habits, live in the great rivers of South America. The *Myletes paca* of Humboldt is said to be a fish of exquisite flavour, but with its flesh full of ribs. It is an inhabitant of the Amazon and its affluents. The species of *Serrosalmus*, so voracious and so expert in carrying away a mouthful of flesh, bitten off with their cutting teeth, are dreaded by the natives of the districts in which they abound. Any animal falling into the water is immediately attacked and cut in pieces by swarms of these fish. Known to the Indians by the names of *Caribe* or *Caribito*, on account of their thirst for blood, they assail bathers the instant they plunge into

the water, and inflict dangerous wounds before the sufferers are able to escape. Their haunt is at the bottoms of the rivers, but a single drop of blood thrown into the water will bring them in thousands to the surface.

Classification—*Malacopteri.*

A very curious white and translucent fish is the *Salanz Reevesii*, known to the Europeans at Canton by the name of "Whitebait," and eaten as a delicacy, served in the same way that the fish of the same name is cooked at Blackwall. One group, the *Scopolini* of authors, is remarkable for the extreme metallic brilliancy of round spots, placed generally in rows along the body, or for other brilliant places about the head and elsewhere; many are nocturnal, coming to the surface at night, and some have luminous eminences on the head visible in the dark. They abound in the Mediterranean and China seas, but they comparatively rarely appear in northern latitudes.

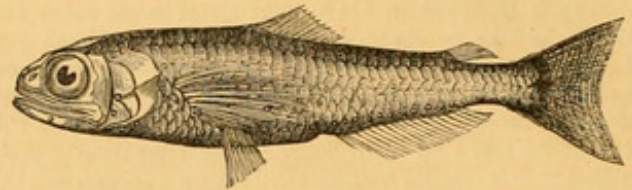


Fig. 72.

Scopelus or *Myctophum boops*.

One species only has been detected on the British shores. The *Scopelus Pennanti* was first noticed by the naturalist whose name it bears, but was mistaken by him for the Atherine. It has been taken at the island of Sheppy, on the coast of Flintshire, at Exmouth, and in the Orkneys. The *S. borealis* (Nilss.) is a Norwegian fish, different from the British one. Fig. 24 represents a scale of *Scopelus resplendens*, an Atlantic fish, and *Chauliodus Fieldii* is represented by fig. 2.

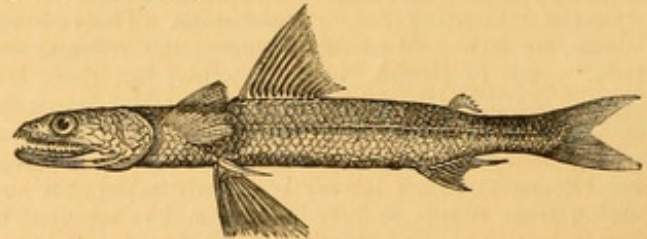


Fig. 73.

Saurus undosquamis.

The Saureys are curious from the forms of the teeth; in some species long, slender, and barbed at the points. The dentition of the *S. nehereus* (Hamilton), *S. ophiodon* (Cuvier), is of this kind, and on that account Lesueur proposed *Harpodon* as a generic name for it. It is a fish of voracious habits, and at certain seasons its body is brilliantly phosphorescent, like some of the Scopelines. It is rich food, though delicate when newly taken. When salted and dried it gets the singular appellation of "Bombay ducks" in commerce, or of *Bummaloti*, and is exported in large quantities from Bombay and the Malabar coast to other parts of India. Fig. 41 shows the form of a scale from the lateral line of *Saurus undosquamis* (Richardson).

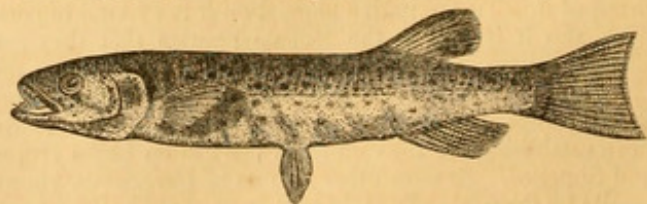


Fig. 74.

Galaxias truttaecus.

The *Galaxidæ*, though they want the adipose fin of the Trouts, yet have much the aspect of these familiar fishes, and represent them in the southern hemisphere, where no

Classification—*Malacopteri.*

true Trouts are found. They are inhabitants of fresh water, and are named "Trouts" by the settlers of New Zealand and Australia. As an article of food they are softer and more oily than the northern Salmonoids.

Classification—*Malacopteri.*

FAMILY IV.—SALMONIDÆ, Müll.

Scaly fishes, with an adipose fin. Upper half of the orifice of the mouth formed by the pre-maxillaries and maxillaries; numerous branchiostegals. A large, simple air-bladder, without contractions; supplementary branchiæ, and numerous pyloric cæca. They possess most of the characters of a Clupeoid that has not the acute and denticulated belly. Their teeth are often absent, or small; often all the pharyngeal bones are armed with them; they are conical and in one row, and when they exist on the jaws and palatines the tongue also is furnished with teeth. The distribution of the vomerine teeth furnishes M. Valenciennes with generic characters for the subdivision of this most important but difficult family.

(A.)

GENUS I. SALMO, Valenc. A few teeth at the end of the vomer, but no prolonged row on the mesial line. Body fusiform. Head moderately large; throat well armed, often wide; pre-maxillaries short, and rather on the sides of the mouth than across its upper edge; maxillaries articulated to the ends of the pre-maxillaries, and not compound; mandible strong, often with the symphysis rising into a small tubercle, but in some species the tubercle is much developed. Strong conical teeth on the jaws; a small group at the end of the vomer; one row on the palatines, entopterygoids, and on each side of the tongue; some have two rows on the tongue. An adipose fin on the tail. Thin small scales covering the body. A short intestinal canal; a siphonal stomach; ova, when detached from the ovary, falling into the cavity of the abdomen before they are excluded in spawning. A large air-bladder, simple, with thin coats, and opening anteriorly into the pharynx, almost directly or without the intervention of an air-tube. With the exception of the peculiarity of the vomerine dentition, many of these characters are common also to the two genera which immediately follow. Twenty-five species.

GENUS II. FARIO, Valenc. Salmon with a single mesial line of teeth running down the vomer. Four species.

GENUS III. SALAR, Valenc. Vomer armed with two rows of teeth, without any remarkable group on the chevron of the vomer, as in the preceding two genera. Eight species, besides about twelve doubtful ones hitherto imperfectly described.

GENUS IV. OSMERUS, Cuv. Pre-maxillary teeth small and hooked; vomerine teeth big, conical, and so far forward that they appear to belong to the jaws; a row on the outer edge of the palatines, and one on the internal border of the entopterygoid; big teeth also on the tongue. In other respects the Spirlings resemble the other *Salmonidæ*. They have a small adipose fin; ventrals situated under the anterior rays of the dorsal. Gill-openings widely cleft; air-bladder having within silvery walls, and communicating with the upper part of the œsophagus. Four species.

GENUS V. MALLOTUS, Cuv. Mouth rather less widely cleft than that of *Osmerus*, armed with very small, slender, or conical teeth in a single row on the jaws; more numerous on the palatines and vomer; small teeth also on the tongue. Eight branchiostegals. Intestines of the Trouts. One species.

GENUS VI. ARGENTINA, Cuv. *Salmonidæ*, in having an adipose fin, and the upper half of the orifice of the mouth formed by the very short pre-maxillaries and the maxillaries. Mouth small; no teeth on the jaws; on the chevron of the vomer a curved band of uniform teeth, prolonged on each side by a dental stripe on the palatines; lingual teeth of variable size in different species. Gill-openings wide; branchiostegals six. Stomach moderately large, cæcal; numerous short pyloric cæca; ova falling into the abdominal cavity as in the Salmon. Air-bladder covered by a coat of silvery fibres, which tear off, and is used in the fabrication of artificial pearls. Four species.

GENUS VII. THYMALUS, Cuv. Mouth small, the orifice horizontal under the snout; teeth small, conical, uniserial on the jaws, chevron of the vomer and fore part of the palatines. Intestines like those of *Salar*. Air-bladder large, communicating with the œsophagus by a very small tube. The disposition of the scales under the throat is peculiar in some species. Eight species.

GENUS VIII. COREGONUS, Cuv. Pre-maxillaries crossing the upper part of the mouth, thin, and of variable depth; maxillaries on the sides of the mouth also thin and attached to the ends of the pre-maxillaries, generally of an oval or oblong form. Teeth small or none. Dorsal fin farther forward than the ventrals. Forty species.

Agassiz retains the name of *Coregonus* for the species which have the mandible shorter than the upper jaw; and gives the name of *Argyrosomus* to those which have it longer.

GENUS IX. STENODUS, Rich. Pre-maxillaries crossing the upper part of the mouth, giving a truncated appearance to the snout, each armed by a narrow linear-lanceolate band of small raduliform teeth; maxillaries articulated to the palatine bones, long and broadish, with a posterior, ovate, accessory piece as in the *Coregoni*, and forming the sides of the mouth; toothless; vomerine teeth in a transversely oval disk on the chevron (but not down the mesial line), uniting with the crescentic bands of teeth of the same kind on the palatines. These palatine bands have the hollow of the crescent facing the sides of the mouth, and taper to a point posteriorly. On the tongue, the teeth are rather coarser, and cover its surface. Mandible rather shorter than the upper jaw, the part opposed to the pre-maxillaries transverse with a knob at the symphysis, and armed there by a very narrow band of villiform or raduliform teeth; limbs of the bone longitudinal, with rather acute perfectly toothless edges. The whole orifice of the mouth is nearly quadrangular. In general aspect the *Stenodus* rather resembles a *Coregonus* than a Salmon, but bears no strong likeness to either. The ventrals are under the anterior part of the dorsal, and the adipose fin corresponds to the posterior half of the anal, which commences with the last third of the fish, caudal included, and does occupy above a ninth of the entire length of the fish. Branchiostegals nine to eleven, often one more in number on the left side. Stomach but slightly cæcal, the upward turn which ends in the pylorus being short, with the œsophagus longitudinally folded within. Pyloric cæca numerous, and crowded for an inch below the pylorus, but after the insertion of the gall-duct confined to one side of the intestinal tube; lower part of the gut furnished with valvulæ conniventes. Air-bladder communicating with the œsophagus by a wide tube. Only one species known, the *Stenodus Mackenzii*, Richardson (*Back's Voyage down the Great Fish River in 1834 and 1835*, p. 521).

(B.)

M. Valenciennes makes a second division of the Salmonoid fishes by grouping together those in which the sub-orbital scale bones are large, and conceal almost the whole, or at least a great part, of the interval between the orbit and the ascending limb of the preoperculum. This division includes the *Characini* and *Scopelinæ* of Müller; but from the former, M. Valenciennes separates his *Erythrinidæ*.

FAMILY V.—CHARACINIDÆ.

Characini, J. Müll. Malacopterygian fishes with abdominal ventrals; adipose fin; scaly bodies; scaleless head; no accessory branchiæ; upper half of the orifice of the mouth formed by the pre-maxillaries and maxillaries; villiform pharyngeal teeth above and below; cæcal stomach; numerous pancreatic cæca. Air-bladder divided by a transverse strangulation into two, and connected with the acoustic organs by a chain of ossicles as in the *Cyprinidæ* and *Siluridæ*. Branchiostegals four or five; numerous pancreatic cæca. South American or African fluviatile fish.

M. Müller includes *Erythrinus* and *Macrodon* among his *Characini*, but these fish want the adipose fin of the Salmon family, and are placed by M. Agassiz near the *Clupeidæ*. M. Müller's genera *Catopron*, *Myleus*, *Serrasalmus*, *Pygocentrus*, and *Pygopristis*, have the belly serrated. The other genera are *Anodus* (*Curimatus* Valenc.), *Hemiodus*, *Xiphostoma*, *Xiphoramphus*, *Hydrolycus*, *Anostomus*, *Leporinus*, *Schizodon*, *Chilodus*, *Hydrocyon*, *Citharinus*, *Piabuca*, (including *Schizodon*, Valenc.), *Gasteropelecus*, *Epicyrtus*, *Raphiodon*, *Pacu* (*Prochilodus*, Agass.), *Distichodus*, *Exodon*, *Salminus*, *Brycon*, *Chalceus*, *Alestes*, *Tetragonopterus*.

ANALYTICAL TABLE OF THE CHARACINIDÆ (Dum.)

Teeth, none.....	{ ANODUS, M. CURIMATUS, V. }	1.
Teeth, none on the tongue, present elsewhere in the mouth.		
<i>Teeth elsewhere uniserial.</i>		
Pre-maxillary teeth stronger, <i>tricuspid</i>	GASTROPELECUS	14.
Pre-maxillary teeth stronger, <i>conical with canines</i> .		
Belly rounded.....	EPICYRTUS	3.
Belly keeled	{ RAPHIODON, M. CYNODON, V. }	29.
Pre-maxillary teeth not stouter.		
<i>Dorsal opposed to the ventrals.</i>		
Pre-maxillary teeth wide, entire.....	LEPORINUS	2.
Pre-maxillary teeth fissured.....	{ PIABUCA, part. SCHIZODON, M. }	8.

Classification—Malacopteri.

Classification—Malacopteri.

Pre-maxillary teeth narrow, round	{ CITHARINUS, sp. } 7.
Pre-maxillary teeth narrow, conical	{ CHILODUS, M. } 27.
	{ HYDROCYON } 27.
<i>Dorsal not opposed to the ventrals.</i>	
Dorsal before the anal	CITHARINUS 7.
Dorsal above the anal	PIABUCA 8.
<i>Teeth elsewhere pluriserial.</i>	
Dorsal above the ventrals.	
Teeth feeble, slender; labial ones biserial	{ PACU } 6.
	{ PROCHILODUS } 6.
Teeth firm, fissured, biserial,	DISTICHODUS 15.
Teeth large; anterior ones conical ...	{ EPICYRTUS, sp. V. } 3.
	{ EXODON } 3.
<i>Dorsal between the ventrals and anal.</i>	
Teeth conical, triserial above, biserial below	SALMINUS 5.
Teeth flat, pointed, triserial on the mandible	{ CHALCEUS, sp. } 21.
	{ BRYCON } 21.
Teeth flat, pointed, biserial above.	
Belly keeled	CHALCEUS 21.
Belly round	
Mandibulars uniserial	{ TETRAGON- } 11.
	{ OPTERUS } 12, 13.
Mandibulars biserial	ALESTES 16.
<i>Teeth present on the tongue.</i>	
<i>Teeth on both jaws.</i>	
Palatine teeth, conical, uniserial; canines	{ XIPHORAMPHUS } 30.
Palatine teeth granular, crowded; canines	HYDROLYCUS 29.
Palatine teeth none	XIPHOSTOMA 32.
Teeth on the mandible; none on the upper jaw	HEMIODUS 9.

GENUS I. CURIMATUS, Valenc. Resembling the Graylings (*Thymali*) in the smallness of their mouth, and feeble dentition, often wholly absent on the jaws. Mouth toothless; jaws with trenchant edges, without lips, the superior one notched to receive a symphyseal tubercle of the mandible. Ascending branch of the stomach thick and muscular. Pyloric cæca numerous (amounting to eighteen). Branchiostegals four. Species seven.

GENUS II. LEPORINUS, Spix. Body elongated; belly rounded. Mouth small; lips fleshy; teeth few in number on the pre-maxillaries and mandible; the mesial pair above and below longer than the rest and almost horizontal. Pharyngeal teeth in transverse bands; each tooth having a long laterally compressed crown, terminating in two hooked points of unequal length. Branchial aperture small, from the union of the membrane to the scapula. Branchiostegals four. Pyloric cæca from ten to eighteen. These fish are vegetable feeders. Eight species.

GENUS III. EPICYRTUS, Müll. Conical teeth on the pre-maxillaries and maxillaries, some of them projecting from the surface of the jaw like the canines of some Labroids (*Calliodon*, for instance, figure 56). Pyloric cæca, six or seven. Intestines short. Two species, which include *Exodon*.

GENUS IV. PARODON, Valenc. Teeth planted in the walls of the upper lip, moveable and slightly curved, their crowns small triangular disks with denticulated edges; mandibular teeth on the side lips only, and not opposed to the pre-maxillary ones of the upper jaw. Four branchiostegals. One species, unknown to Müller.

GENUS V. SALMINUS, Agass. Teeth in several rows on the jaws. Body elongated like that of a Trout, and the mouth also similar, except that the tongue and roof of the mouth are smooth as in most Characins. Pre-maxillary teeth conical, in two rows; one row on the maxillaries; mandibular teeth in two rows, and the interior ones remarkable for their small size, their equality, and their oblique insertion into the limbs of the jaw. Five species.

a. M. Valenciennes forms a group of *Prochilodus*, *Citharinus*, *Hemiodus*, and *Piabuca*, which have the teeth curiously crenated, and no denticulated keel to the belly, but with an adipose fin, as in the other *Salmonida*.

GENUS VI. PROCHILODUS, Agass. (*Pacu*, Müll.) Mouth small, protractile, situated at the extremity of the head, and surrounded by very thick lips, supporting under their edges a row of excessively small teeth like hairs, which, when viewed under a lens of considerable power, are seen to have a disk at the extremity, often denticulated or crenated. Farther back towards the middle of the lips there is a second series of similar teeth in a crescent with the hollow towards the interior of the mouth. Body elongated and somewhat compressed, but clumpish like that of a Carp. Four branchiostegals. Ascending branch of the stomach fleshy, but not so much so as in

Curimatus. Pyloric cæca very numerous, so as to deter one from counting them. Thirteen species.

GENUS VII. CITHARINUS, Cuv. (Including *Chilodus*, Müll.) Body elevated, compressed, rhomboidal; mouth horizontal at the extremity of the head, the upper arch of the orifice almost entirely formed by the pre-maxillaries, the maxillaries lying behind, but covering the corner of the mouth; teeth extremely small, implanted in the lips, and resembling hairs; none within the mouth. Two species, Nile.

GENUS VIII. PIABUCA, Cuv. Salmonoids, with uniserial, trenchant, and compressed teeth, denticulated on the cutting edge, implanted in the lip, and very moveable, the row corresponding to the pre-maxillaries and mandible. It comprises the *Schistodons* of Agassiz and Müller. Three species.

GENUS IX. HEMIODUS, Müll. Small labial teeth, implanted close to one another in a row on the upper lip; the pre-maxillary and maxillary teeth moveable to the touch like the keys of a piano. There are none on the lower lip. Each tooth is compressed, rounded in front, with denticulated crown or disk. Pre-maxillaries very small and concealed beneath the lip. Mouth very small; body elongated; belly rounded. Branchiostegals four to five. Two species.

GENUS X. PLECOGLOSSUS, Schl. Teeth on the pre-maxillary six; on each maxillary between the bone and the lip fourteen moveable ones in one row; they are somewhat compressed and pointed; a band of card-like teeth on each palatine, and the tongue also covered with teeth; three pockets formed by a membrane attached before the tongue. Branchiostegals four.

GENUS XI. TETRAGONOPTERUS, Artedi. Body elevated, rhomboidal or orbicular, passing in some species into oval or lengthened forms. Mouth small; two rows of teeth in the upper jaw, one in the lower one. Twenty-one species.

GENUS XII. BRYCINUS, Valenc. Separated from *Tetragonopterus*. Body elongated as in *Chalceus*; teeth crenulated and standing close as in *Tetragonopterus*. The interval between the two rows is greater in the upper jaw, and a distinctive character exists in the presence of a spur on the crown of the teeth, which resemble those of *Chalceus*, but may be readily distinguished; dorsal and anal high. Senegal.

GENUS XIII. PIABUCINA, Valenc. Separated from *Tetragonopterus* and *Piabuca*, on account of a combination of characters; body elongated like *Piabuca*, with fixed crenulated teeth as in *Tetragonopterus*, but differing from those of the latter in that the double row is on the mandible; on the upper jaw there is only one row. One species resembling *Erythrinus*. Maracaibo.

GENUS XIV. GASTEROPELECUS, Pall, Gronov. Pre-maxillary teeth in two rows, tricuspid; maxillary teeth conical, much pointed, uniserial; pharyngeal teeth villiform, densely crowded. Body excessively compressed and high in the pectoral region. Dorsal far back. Gill-openings large; branchiostegals four. Scales. Intestine remarkably short; seven pancreatic cæca. Surinam.

GENUS XV. DISTICHODUS, Müll. Teeth on both jaws in a double row; small, close together, with a slightly compressed forked crown. Body elongated and compressed, belly rounded; caudals and adipose fin scaly like the rest of the body, naked only at the border. Stomach long, ascending branch long and very muscular. Pyloric cæca numerous and elongated like small intestines, extending along one side of the duodenum. A vegetable feeder. One species, the *nefasch* of the Arabs.

GENUS XVI. ALESTES, Müll. Pre-maxillary teeth in two rows, those of the exterior row having three trenchant points, while in the interior row the crowns are more obtuse; but there are some projecting points among them; no maxillary teeth; mandibular teeth biserial, the disk channelled, with crenated crowns; behind the symphyseal ones, some small conical ones; pharyngeal teeth very small. Ten to fourteen pyloric cæca. Voracious insectivorous fishes. Air-bladder prolonged posteriorly on the right side of the interhæmal spines, whereas in most other fishes when the air-bladder is extended back out of the abdomen it is forked, and sends a horn on each side of these bones. Three species.

GENUS XVII. MYLETES, Cuv. Pre-maxillary teeth having truncated crowns and standing in two rows; for the most part there are only two conical teeth in the inner row behind the symphysis, but in some species there are seven. The teeth are mostly prismatic with rounded ribs, the crowns of the anterior row being slender, cutting, and feebly denticulated; in the second row the posterior edge is more elevated, and the middle somewhat pointed. Body compressed; belly keeled and often strongly denticulated. First interneural of the dorsal lying horizontally, with its spinous point directed forwards. Intestines long; cæcal stomach, with a short, thick, pyloric branch. Vegetable feeders. Seventeen species.

GENUS XVIII. TOMETES, Valenc. A row of pre-maxillary teeth with sloping or chisel-formed cutting crowns like the hu-

Classification—
Malacopteri.

man incisors; behind which there is a second rank in which the teeth near symphysis have their crowns somewhat truncated, but the lateral teeth are all incisorial, the slopes of the two rows being on different sides, so that they form a furrow which receives the points of the mandibular teeth. At the symphysis of the mandible there are two interior, very small, compressed, and sharply pointed teeth. No maxillary teeth. Three species, unknown to Muller.

GENUS XIX. MYLEUS, Müll. Pre-maxillaries armed with two rows of teeth; the exterior ones compressed and incisorial; the interior ones truncated like molars, but with the posterior edge elevated and cutting; mandibular teeth in one row, pointed and incisorial on the anterior part of the jaw, but with no conical ones behind them. Body compressed; belly keeled and denticulated; these dermal ossicles forming two rows near the anus. Branchial openings large; pharyngeal teeth villiform; dorsal with its pointed interneural spine in front, placed over the interval between the ventrals and anal. Three species.

GENUS XX. MYLESINUS, Valenc. Dorsal and anal fins as in *Myleus*; pre-maxillary teeth five, sharply cutting, standing closely side by side, with their crowns a little dilated, and having a little cusp on each side, so that they may be called tricuspoid, though the middle lobe forms most of the cutting edge; the neck of the tooth is narrower; a little behind the two mesial teeth, though in the same row or nearly so, there are three teeth with truncated or sloping cusps, which are rather notched than tricuspoid; mandibular teeth twelve on each limb, in a single row, tricuspoid, with the middle cusp oval and elongated; no conical teeth forming a second row at the mandibular symphysis. Lips thick, fleshy, and densely papillose. One species.

GENUS XXI. CHALCEUS, Cuv. (*Brycon*, Müll.) Pre-maxillary teeth triserial, multicuspoid; the anterior ones the smallest, and seeming conical from the smallness of their lateral cusps; mandibular teeth biserial, the front ones large and multicuspoid, the lateral ones and those of the anterior rows conical; behind the symphysis two stronger conical teeth, as in *Myleus*. Body elongated, compressed; belly rounded like that of a Trout, but covered with large scales like a Carp. A great number of pyloric caeca. Eleven species.

GENUS XXII. CHALCINUS, Müll. Pre-maxillary teeth small, crenulated, multicuspoid, biserial; mandibular teeth, biserial like those of *Chalceus*, multicuspoid, and strong anteriorly; two small conical ones behind the symphyseal ones, and an interior lateral row of very small conical ones towards the angle of the mouth. Body compressed; edge of the belly trenchant but not serrated. Dorsal far back; anal very long; and pectorals long and pointed. Three species.

The genus *Alysia* of Lowe (*Zool. Tr.* 1839) probably belongs to some of the preceding genera of *Characini*, but the teeth are not described with sufficient minuteness to determine its proper place.

b. M. Valenciennes makes a small group of *Serrasalmus*, *Pygocentrus*, *Pygopristis*, and *Catopriion*.

GENUS XXIII. SERRASALMUS, Lacép. Teeth triangular and trenchant, in a single row on the pre-maxillaries, palatines, and mandibular; maxillary not entering into the composition of the orifice of the mouth, but lying under the edge of the pre-orbital, and behind the pre-maxillary. Body compressed, for the most part rhomboidal, the first dorsal and anal ray proceeding from the most prominent points of the upper and under profile; belly keeled and serrated with a double row of dermal spines before the anus; first interneural of the dorsal projecting one pungent point anteriorly and two posteriorly; branchial openings pretty large; four branchiostegals; stomach a very large conical sac; from thirteen to twenty-one pyloric caeca. Voracious carnivorous fishes. Ova not dropping into the cavity of the abdomen.

GENUS XXIV. PYGOCENTRUS, Müll. No palatine teeth; pre-maxillary and mandibular bones carrying a single row of triangular, trenchant, feebly-crenulated teeth. Maxillary bone as in *Serrasalmus*, almost hidden behind the pre-maxillary. Body compressed; belly trenchant and serrated, the points near the anus being doubled; branchiostegals four; caecal stomach; caeca varying from ten to fifteen; air-bladder divided into a small globular anterior one, and a very large second one, which communicates with the oesophagus by a very short canal. Ova not dropping into the cavity of the abdomen. Four species.

GENUS XXV. PYGOPRISTIS, Müll. Separated from *Pygocentrus* by the edentate and smooth roof of the mouth, but the jaw teeth are crenulated, and strongly denticulated. Two species.

GENUS XXVI. CATOPRION, Müll. and Trosch. Salmonoids, with a serrated belly, having two rows of conical pre-maxillary teeth, and one row of trenchant triangular mandibular ones. One species.

GENUS XXVII. HYDROCYON, Cuv. Salmonoids, with large and strong teeth implanted in a single row on both jaws; these teeth

are conical, slightly compressed, and have cutting edges; roof of the mouth smooth. Body elongated; sides flattened in the middle; belly rounded like the back; intestines very short, with a considerable number of pancreatic caeca (thirty-five to forty). Branchiostegals four. One species.

GENUS XXVIII. CYNOPOTAMUS, Valenc. Differ from *Hydrocyon* in having two rows of pointed pre-maxillary teeth, those of the exterior row very short; interior row containing four large canines; maxillary on the side of the orifice of the mouth like that of a trout, edged by a row of very small conical teeth; mandible armed at the end by eight canines; and a second interior row is composed of very small teeth; palate destitute of both teeth and granular eminences. Branchiostegals five.

GENUS XXIX. CYNODON, Spix. Salmonoids, with granular teeth on the palate; pre-maxillaries, maxillaries, and mandible armed by a single row of pointed conical teeth, among which there are enormous canines, the largest being near the symphysis, those of the mandible entering corresponding holes in the palate. Body much compressed at the pectorals; belly frequently compressed; anal very long and scaly. Pectorals pointed and laid along the body, descending to a right angle with the longitudinal axis when they act. Stomach remarkably large. Carnivorous. Three species. *Cynodon scomberoides*, Val., is the genus *Hydrolycus* of Müller.

GENUS XXX. XIPHORYNCHUS, Agass. Differs from *Cynodon* in having a single row of pointed teeth on the palatines, as well as on the jaws. Carnivorous fish. Twelve pancreatic caeca or thereabouts. Five species.

GENUS XXXI. AGONIATES, Müll. Intermediate between *Hydrocyon*, which is remarkable for long canines, and *Tetragonopterus*, which has two rows of pre-maxillary teeth, some of them tricuspoid. This dentition distinguishes *Agoniates* from *Cynopotamus*. One species.

GENUS XXXII. XIPHOSTOMA, Spix. Snout conical and elongated by the extension of the pre-maxillaries, palatines, nasal and prefrontal, and the dorsal aspect of the skull wholly covered by a granular engraved casque. The elongated pre-maxillaries and the mandible are furnished with numerous minute teeth, set closely side by side in a single row, their points recurved like a small fishing-hook; palatines wrinkled and rough, with odontoid granulations. Body slender, elongated, and round. Dorsal very far back beyond the ventrals. Pancreatic caeca very considerable in number. Five species.

GENUS XXXIII. SALANX, Cuv. (*Leucosoma*, Gray.) Body slenderly fusiform, the thin end of the spindle being the anterior one; jaws equal, the cleft of the mouth horizontal, slightly arched in the middle; maxillary curving over the corner of the mouth, and sending a slip in front of the end of the pre-maxillary, forming a considerable part of the border of the orifice; pre-maxillaries armed with a single series of small teeth, with four tall, subulate, recurved canines among them on each bone, the space nearest the symphysis have only a row of small ones; maxillary edged with a pectinated row of short teeth; mandibular teeth on the sides of the bone smaller and more numerous than those of the upper jaw; tip of the mandible toothless, but close to it there are three strong teeth, whose points when the jaws are close pass through a rhomboidal membranous space near the point of the snout; palatine bones set with a row of fine teeth, but there are no teeth on the vomer, which does not project. Ventrals about the middle of the fish; dorsal in the middle of the posterior half, the anal still nearer the caudal fin, and the adipose fin corresponding to the posterior part of the anal. One species.

GENUS XXXIV. HYDROPARDUS, Reinh. Teeth on the pre-maxillaries, elongated maxillaries, and mandible, uniserial, canines and conical ones intermixed; the anterior mandibular teeth received into pits in the palate; palatine teeth minute, granular; pharyngeal teeth villiform. Body elongated, compressed; belly keeled. Scales small. Gill-openings extremely large; five branchiostegals; internal rakers of the branchial arches having the form of small osseous tubercles, studded with the finest spines; ventral fins none; dorsal fin over the anal, which is exceedingly long, and has a scaly base. (An. 1850.)

GENUS XXXV. GONOSTOMA, Rafin. Pre-maxillaries short, not passing the eye; the maxillary completing the upper half of the mouth, as in the *Clupeidæ* or *Salmonidæ*; teeth large, conical, and sharply pointed, widely set on the jaws, with very small ones in the intervals; palatines and entopterygoids covered with minute raduliform teeth, and there are rough spots on the tongue; pharynx very narrow, the superior pharyngeal teeth resembling the teeth of a harrow, in two groups, the anterior group composed of three teeth larger and longer than the rest; fourteen branchiostegals, sub-orbital very delicate; dorsal placed far back; free recurved spines on the sides of the tail. Ovarian sacs shut. One species.

GENUS XXXVI. CHAULIODUS, Bloch. (*Astronesthes*, Richardson. *Phanodon*, Lowe, *Ann. Nat. Hist.*, x., p. 52.) Mouth formed nearly

Classification—
Malacopteri.

Classification—
Malacopteri.

as in *Gonostoma*, but the dentition differs; the teeth are slender pointed, compressed, and curved, adhering to the bone, the mandibular ones being the largest; maxillary teeth arranged in a pectinated manner on the edge of the bone, inclining backwards; palatine teeth shorter; tongue armed on the sides with teeth; pharyngeal teeth narrow-like. Branchiostegals fifteen to seventeen; pectoral fins attached low down; gill-openings large; dorsal far back, anal still more posterior, its last rays opposite to the thin adipose fin. *Astronesthes niger*, R., fig. 2, p. 132.

Mr Ayres, in the *Journal of the Boston N. H. Society* for 1849, describes a fish which seems nearly allied to *Chauliodus*, but if the symphyseal mandibular barbel and branchiostegals have not been overlooked, it can not be the same. The generic characters given of it are as follows:—

GENUS XXXVII. MALACOSTEUS, Ayres. Scales small; mouth very deeply cleft, its upper border chiefly formed by the maxillaries; pre-maxillaries short; pre-maxillary and maxillary teeth small, sharp pointed; mandibular teeth very long, somewhat curved, smaller ones behind them; no teeth on the palatines, vomer, or gill-arches; a double row on the tongue; and a tuft on each pharyngeal; small fins; dorsal far back over the anal; gill-cover membranous without ossification, and no branchiostegals perceptible. All the bones unusually soft. One species, *M. niger*, found in the North Atlantic. Could the bones have been softened by spoiled spirits?

GENUS XXXVIII. APLOCHITON, Jenyns. Characterized by a peculiar fold or longitudinal pouch in the integuments of the belly; wholly without scales; uniserial small teeth on both jaws; two rows on the tongue and vomer; none on the palatines; branchiostegals three. Elongated form of a Grayling, but thicker. Magellan's Straits.

The last six genera are scarcely members of this family.

FAMILY VI.—SCOPELIDÆ.

Scopelini, Müll.; *Sauridæ*, Valenc. Scaly or scaleless fishes with an adipose fin, whose mouth is bounded above from corner to corner by the pre-maxillary, the maxillary lying behind; accessory gills. Swim-bladder absent in most. Genus *Aulopus*, Cuv.; *Saurus*, Cuv.; *Scopelus*, Cuv.; *Maurolicus*, Cocco; *Ichthyococcus*, Bonap.; *Chlorophthalmus*, Bonap.; *Odontostomus*, Cocco; *Paralepis*, Risso; *Sudis*, Raf. not Cuv.; *Sternoptyx*, Herm.; *Argyropelecus*, Cocco.

They are separated from the *Salmonidæ* by the structure of the mouth, and by the ova being discharged by a proper canal, and not falling into the general cavity of the abdomen. The maxillaries in some genera approach the corner of the mouth, and form a portion of its orifice, and in *Argyropelecus* they are formed of three pieces, one of which is dentiferous. This genus and *Sternoptyx* belong, by the structure of the mouth, to the *Characinidæ*.

GENUS I. ARGYROPELECUS, Coc. Body greatly compressed, high, with an irregular polygonal outline; tail narrow at its commencement, and generally very thin near the caudal fin; mouth nearly vertical, formed above by the pre-maxillaries and maxillaries, the latter in some species occupying but a small part of its orifice, in others nearly the whole upper half; maxillary composed of three pieces, one of them dentiferous; curved, unequal teeth on the jaws; smaller ones on the palatines; branchiostegals nine; the scapular chain of bones largely developed; thin nuchal osseous crest; four pancreatic cæca. Four species.

GENUS II. STERNOPTYX, Herm. Body high, compressed, with long ribs seen through the silvery integument; mouth cleft almost vertically, bordered above with very short pre-maxillaries, and on the sides by the maxillaries, as in *Salmo* or *Salar*; pluriserial teeth on the jaws, the shorter ones placed in an exterior row, and the larger ones more interiorly; palatines armed with two or three longer curved teeth anteriorly; vomer edentate; branchial arches and inferior pharyngeals rough with small teeth, but the extremity of the tongue smooth. The dentition of the jaws is like that of *Saurus*, and the palatine teeth resemble those of *Chauliodus*. Gill-openings wide; branchiostegals five, of different forms; coracoid bones forming a keel with an anterior point under the throat; pubic bones also having a sharp point; a triangular osseous crest before the dorsal, with one large projecting spinous point. Adipose fin pretty long. One species.

GENUS III. ODONTOSTOMUS, Coc. Upper half of the mouth formed entirely by the pre-maxillaries which carry the teeth, the maxillary lying posteriorly and being toothless; mandible, palatines, and chevron of the vomer armed with moveable teeth, which rise by their elasticity when pressed down; no teeth on the tongue; eye large, with an adipose fold. One species.

GENUS IV. SCOPELUS, Cuv. (*Myctophum*, *Maurolicus*, *Lampanyctus*, Bonap. Upper half of the mouth bordered by the pre-maxillary, the toothless maxillary supporting it behind; teeth of the jaws small, and differing little in size; on the palatines the

teeth are minutely raduliform; no teeth on vomer, in which the genus differs from *Odontostomus*. Twenty species.

GENUS V. SAURUS, Cuv. Elongated body, wide mouth, long, rounded pre-maxillaries, ending in a point; the toothless styloid maxillary being hidden under the integuments. Teeth numerous, conical, somewhat curved, and often with a hastate or barbed point, forming narrow-like bands on the jaws, the palatines, tongue, and pharyngeals; the small teeth being in the exterior ranks, and the larger ones interiorly. First rays of the ventrals shorter than the posterior ones, as in *Platycephalus* and *Callionymus*, and also in the united ventrals of *Gobius*. Branchiostegals sixteen; sub-operculum large, also frequently the inter-operculum. Cæcal stomach large, with a short pyloric branch; pancreatic cæca few. Ovaries in a shut sac. No air-bladder. Seven species.

GENUS VI. SAURIDA, Valenc. Differ from *Saurus* in having an internal band of acute teeth surrounded by minute ones, as well as the band of longer palatine teeth which *Saurus* possesses; internal ventral rays not so much prolonged as in that genus. Two species.

GENUS VII. FARIONELLA, Valenc. Resembling a Trout. Dorsal standing over the space between the ventrals and anal; an adipose fin above the end of the anal; caudal small. Upper half of the moderate-sized orifice of the mouth formed by the pre-maxillaries, the very small toothless maxillary lying behind. Teeth simple and conical on the pre-maxillaries, palatines, and mandibular, also along each side of the tongue. One species.

GENUS VIII. AULOPUS, Cuv. Maxillary dilated posteriorly, with supplementary pieces, but bordered in front by the pre-maxillaries, which form the upper border of the mouth. Teeth small, crowded, nearly of equal size, forming a narrow band on both jaws, on the palatines, and on the chevron of the vomer; two dental plates of very fine teeth on the entopterygoids, and the pharyngeals above and below bristle with pretty strong heckle-formed teeth. Large gill-openings. Bones of the head cavernous, with spinous points on the hinder part. Thick jointed inferior rays on the pectoral, as in some *Sclerogenidæ*, with which in other respects the genus presents many analogies. It has also somewhat of the external aspect of a *Gadus*, but is allied more closely to *Saurus* by dentition, and the presence of an adipose fin. Two species.

GENUS IX. PARALEPIS, Risso. (*Sudis*, Rafin.) Malacopterygian abdominal fish, with an adipose fin, slender fusiform bodies, elongated jaws, and the upper half of the orifice of the mouth formed by the pre-maxillaries, which pass before the maxillaries. Dorsal and ventrals opposite to each other and very far back; adipose fin radiated, but the rays not articulated like true rays. Teeth trenchant, much like those of *Sphyræna*. In the *Hist. des Poiss.* the first dorsal was considered to be spinous, but Reinhardt has shown that its rays are articulated, and Müller assigns it a position among the *Scopelinidæ*.

GENUS X. ALEPISAURUS, Lowe. Body elongated, tapering, much compressed, acute-edged posteriorly above and below. Jaws elongated, with a wide mouth, which is bordered above from corner to corner by the pre-maxillaries, armed with small subulate teeth; lanceolate teeth on the palatines and sides of the mandible, with long subulate ones on the fore part of the latter bone. The dentition has much resemblance to that of *Sphyræna* or *Lepidopus*, and the bones have great similarity in structure to those of the *Scomberidæ*. No teeth on the vomer. A long anterior dorsal extending backwards from the nape; posterior one adipose; ventrals abdominal. Neither air-bladder nor pyloric cæca. Lowe. Three species in the Atlantic and Australian seas.

FAMILY VII.—GALAXIDÆ.

Shape of a Trout, but with no adipose fin, and the dorsal far back. No scales. Moderate-sized, uniserial pointed teeth on the pre-maxillaries and mandible, sometimes three canines at the curve of the latter; stronger curved styloid teeth in one row on the palatines and each side of the tongue; pre-maxillaries not reaching the corner of the mouth, but the maxillary is excluded from the edge of the orifice by the thick lip. Inhabit fresh waters in Australia, Van Diemen's Land, New Zealand, the Falklands, and Patagonia, where they represent the Trouts.

GENUS I. GALAXIAS, Cuv. Seven species.

HYODONTS.

This small family group was instituted by M. Valenciennes to comprehend three genera, which have the greatly compressed sides of the Herrings, but not the serratures on the lower edge of the belly exhibited by all the typical members of that family: the presence of pancreatic cæca separates them from *Chirocentrus* with which they would

Classification—
Malacopteri.

Classification—
Megalopteri.

otherwise associate. They are fresh-water fishes, interesting to ichthyologists from their characters, but of no great importance to man. The Hyodonts, from which the group derives its appellation, are small fishes of North America, known locally by the name of Gold Eye, and having a resemblance to the Trouts in feeding on insects and taking the artificial fly freely. They, as well as *Osteoglossum*, are among the fishes which have the interior of the mouth most fully armed, since they possess strong teeth far back on the palate as well as on the tongue and jaws.

FAMILY VIII.—HYODONTIDÆ.

Hyodontes, Valenciennes. M. Valenciennes places in this group *Osteoglossum*, *Ichnosoma*, and *Hyodon*, which have compressed bodies, and a keeled belly, without denticulations, but with *pancreatic cæca*, the presence of which, he says, alone separates them from *Chirocentrus*, though the suborbital scale bones are more developed than in the latter. Their intestinal canal resembles that of the *Mormyri*.

GENUS I. OSTEOGLOSSUM, Fereira. Body and head compressed like the blade of a sabre; head bony above, and the cheeks protected by the suborbitals and opercular pieces; mouth much cleft; small conical teeth on the premaxillaries and slender maxillaries, which move little, and are partially concealed by the preorbital; lower jaw armed like the upper one with two fleshy barbels under the symphysis; minute crowded teeth cover the vomer, the palatines, entopterygoids, presphenoid, lingual bone, and body of the hyoid bone. Gill-openings very large, overlaid by the wide membranous border of the gill-cover; branchiostegals ten. Anal long, but separated from the small caudal; ventrals ending in a filamentous point. Belly trenchant, but without denticulations; stomach rounded, without any caecal projection; two pancreatic cæca; air-bladder large, simple, without either partitions or horn-like prolongations, but communicating with the upper part of the œsophagus by a tube having an excessively small mouth. Two species, one in the Amazon, the other in Borneo.

GENUS II. ISCHNOSOMA, Spix. An *Osteoglossum*, with the anal and caudal united.

GENUS III. HYODON, Lesau, Rafin. Body scaly, greatly compressed, thickest above the lateral line; back acute, belly more so; profile suboval. Dorsal short, over the long anal. Eye large, preorbital scale bones covering the whole of the cheek; mouth wide, premaxillaries and maxillaries forming equal portions of its upper border. These bones have uniserial conical teeth, largest towards the symphysis; the mandible has two rows with their points inclined backwards, and the interval between the rows covered with minute teeth; the vomer is similarly armed, but the dental surface widens gradually as it approaches the gullet; the palatines are armed by a single row of conical teeth, with a small oval plate of very minute ones within the middle of the row; tongue strongly armed by a marginal row of hooked teeth bigger than the others, and the rest of the surface covered with minute card-like teeth, having their points reflexed. Stomach siphonal; one pancreatic cæcum; air-bladder large, communicating with the œsophagus. Fresh-water North American fish.

CLUPESOCIDÆ.

This family was indicated by Müller in his treatise on the Natural Families of Fish, and was considered by him to be distinct from the true Herrings by having no pseudobranchiæ, which the Clupeoids all possess. On subsequently examining some examples of the genus *Megalops*, he found the pseudobranchiæ present, though evanescently small; and he also discovered that *Gnathobolus*, a genus closely related to *Notopterus*, has pectinated pseudobranchiæ. He therefore ceased to consider the *Clupesocidæ* as a separate family, and referring them all to the *Clupeidæ*, enumerates as members of that family, *Clupea*, *Pristigaster*, *Alepocephalus*, *Gnathobolus*, *Notopterus*, *Engraulis*, *Thryssa*, *Megalops*, *Elops*, *Lutodeira*, *Hyodon*, *Butirinus*, *Chirocentrus*, *Stomias*, *Chauliodus*, *Heterotis*, *Arapaima* and *Osteoglossum*. Neither *Amia* nor *Chauliodus* have pseudobranchiæ. M. Valenciennes has treated of the genera here enumerated as intermediate between the *Clupeidæ* and *Esocidæ*, and considers several of them to be types of distinct families, some

of which have been named by him. After abstracting these, the remainder are here placed under the head of *Clupesocidæ*, as a convenient term indicating their position between the natural families of the Herrings and Pikes. When their anatomy has been more perfectly investigated, they will be distributed by ichthyologists to their proper places in the system. One part of the structure of a fish is much attended to by Müller in his searches after the natural affinities of the various genera he examines, viz., the investments of the ovaries, or the organs which hold the roe or eggs. In the Salmon tribe the eggs are not contained in a separate sac, but drop off from the ovary as they come to maturity, into the general cavity of the abdomen, and are expelled from thence; in the *Galaxidæ* and in various groups that have been separated from the *Salmonidæ*, the ovaries are inclosed in a sac, which has a canal of its own, through which the eggs pass in the process of spawning. A too rigid adherence to a single character often separates fish that are connected by many natural affinities; and some of the *Clupesocidæ* would associate well with the *Scopelidæ* did they possess an adipose dorsal; the absence or presence of teeth on the palate has also been occasionally made of too much importance by systematists.

The genus *Notopterus* is peculiarly interesting to systematic naturalists on account of the combination of characters of very different orders of fish which it presents. With the compressed body of a Clupeoid, it has the denticulations of the preorbitals, suboperculum, and mandible, and the cranial crests observed in several families of *Acanthopteri*, together with a Gobioid union of the ventrals, in which also it agrees with *Gonorhynchus*; the dentition, especially the existence of spheroidal teeth, allies it to *Butirinus*, while the armature of the tongue brings it near to the *Hyodontidæ* or to *Mormyrus*. The eggs are not shut up in a sac, but fall freely into the abdominal cavity as in the *Salmonidæ*.

The genus *Arapaima*, so named by Müller, and since called *Vastres* by Valenciennes, was termed *Sudis* by Cuvier; but Rafinesque having previously used the word *Sudis* to denote a fish of a totally different kind, the name has been necessarily dropt as an appellation of this genus. The species are of much interest not only from the peculiarities of structure which they exhibit, and their encasement in strong, bony, compound scales, but from the great size which they attain, exceeding that of almost all other fresh-water fishes, and also from the excellence of their flesh as an article of food. Sir R. Schomburgk mentions, that in the Rio Negro some are taken which measure fifteen feet in length, and weigh four hundredweight. They are harpooned, or taken with a baited hook, and are the objects of considerable fisheries. They fetch a high price, and are excellent when fresh, especially the belly part which is very fat. When salted they are exported in large quantities to Para, and are there preferred to the salted fish from the banks of Newfoundland.

Butirinus and *Heterotis* are also interesting, but more from peculiarities of their structure than from their utility to man, though, as articles of food they rank among the more highly prized fishes.

FAMILY IX.—CLUPESOCIDÆ, Müll.

No adipose fin; no accessory gills; premaxillaries bounding the orifice of the mouth in the middle above, and the maxillaries the sides. Some have a simple swim-bladder; pyloric cæca in a few, in others absent. Distinguished from the *Clupeidæ* by the absence of accessory gills. They include the following genera: *Stomias*, *Chirocentrus*, *Notopterus*, *Osteoglossum*, *Heterotis*, and *Sudis*, Cuv. (or *Arapaima*, Müll.)

These genera were either associated with *Esoc* by M. Valenciennes, or considered as types of peculiar families; and at a later period Muller ceased to consider these fish as forming a proper family, but we have placed them together until appropriate positions are found for them.

Classification—
Megalopteri.

Classification—
Mallacopteri.

GENUS I. STOMIAS, Cuv. Elongated scaly fish, having somewhat of the form of *Scomberesox*, but with a short high head and a barbel depending between the limbs of the mandible. Dorsal and anal opposite near the caudal; ventrals in the posterior quarter of the fish before the vertical fins. Scales thin, forming hexagonal divisions in the skin, not imbricated. Mouth cleft far past the eye, which is near the end of the very short snout; upper border of the mouth formed by the premaxillaries and maxillaries; mandible projecting beyond the snout; strong conico-subulate curved teeth on the premaxillaries and mandible, with very small teeth on the part of the maxillary, which passes beyond the premaxillary; small teeth exist between the tall ones; the tongue is toothed in the same manner, and the branchial rakers are in the form of long, hooked teeth. Branchiostegals seventeen; pretty large gill-openings. Alimentary canal a long straight tube, without a stomachal dilatation; no pancreatic caeca; ovaries, two long sacs; a long, slender air-bladder. One Mediterranean species.

The want of an adipose fin seems to be the only character that separates this fish from *Chauliodus*, and other *Scopelini*.

GENUS II. MICROSTOMA, Valenc. General form of *Stomias*, but less elongated, with a small head and a very small mouth, wholly anterior to the proportionally enormous eye. The anal behind the dorsal, and neither of them so far back as in *Stomias*. Upper half of the orifice of the mouth formed by the small premaxillaries and maxillaries, both without teeth; a few vomerine teeth, none on the palatines, nor on the tongue or pharyngeals, but the branchial rakers are long and pointed. Branchiostegals four. Intestine and air-bladder as in *Stomias*; pseudobranchia crested. One Mediterranean species. The specimen in the Paris Museum is the same with Risso's, but the imperfect descriptions of the latter giving it an adipose fin, led Müller to believe them to be different.

The *Chirocentres*, says M. Valenciennes, approach *Esox*, and even *Cyprinus*, by the absence of pancreatic caeca, but they depart from these families to place themselves near the Clupeoids by the junction of the premaxillaries and maxillaries. It is a family of only one species, forming the

GENUS III. CHIROCENSTRUS, Cuv. Body compressed, elongated; belly trenchant, not denticulated. Dorsal far back on the tail, opposite to the anal; pectorals pointed with a long styloid bone in the axilla covered with scales; ventrals excessively small. Pharyngeal teeth strong and curved; two mesial premaxillary teeth horizontal; upper jaw formed of small premaxillaries soldered to dentiferous maxillaries which have two supplementary pieces as in *Clupea*, one of them hidden under the preorbital scale bone, the other extending beyond the corner of the mouth; teeth very fine and short on the palatines, two pterygoid bones, the tongue, the branchial arches, and the pharyngeals. Stomach caecal; intestine short, with the interior mucous coat forming a long spiral valve; no pancreatic caeca; swim-bladder long, slender, with interior imperfect transverse partitions, and an air-tube going to the stomach. Branchiostegals eight.

GENUS IV. NOTOPTERUS, Valenc. Body greatly compressed, very thin towards the tail. Snout obtuse, with little projection, the nasal bone scarcely passing the turbinal; two small premaxillaries placed transversely at the extremity of the nasal, and suspending the free maxillaries, the latter a single bone (not of several as in the *Clupeidae*); limbs of the maxillaries having a deep, oblong, dorsal cavity, with two trenchant edges carrying teeth; jaws armed with minute raduliform teeth, also the palatines; a small spot on the end of the vomer, an oval surface on the presphenoid; and very long crooked ones on the edges of the tongue. The foremost two suborbital scale bones are serrated on their edges, and the edges of a large hollow on the inferior limb of the preoperculum, which hides entirely the smooth interoperculum; operculum large, and *suboperculum wanting as in the Siluri*. Large muciferous cavities in the cranium, on which there are five longitudinal ridges, namely, a mesial interparietal one and two lateral ones on each side; the suprascapula is also cavernous, and pierced for the passage of mucoducts. Dorsal very small; anal very long and united to a small caudal; ventrals united to one another, but scarcely perceptible from their minuteness. A genital papilla behind the anus. Belly very much compressed, and edged by a double series of denticulations. Scales small, covering the body, the gill-covers, and part of the cheeks; lateral line straight. Branchiostegals seven, erroneously stated in the "*Regne Animale*" to be only one. Stomach compressed, globular, with the cardia and pylorus in front, one over the other. Ova not shut up in an ovisac, but dropping into the abdominal cavity. Air-bladder multilocular, having numerous interior partitions, and some exterior contractions, with two long posterior horns; and two little horns that, proceeding from the fore-part of the bladder attached to the cranium, pass under the acoustic sacs which contain the otolite, onwards to the third tubercle of the brain—a unique circumstance in fishes. Three species.

Notopterus is considered by M. Valenciennes to be the type of a peculiar family.

Classification—Mallacopteri.

GENUS V. ARAPAIMA, Müll. (*Sudis*, Cuv.; non Rafin.; *Vastres*, Valenc.) Body more or less rounded, covered by a mosaic work of osseous scales, which extend over the vertical fins. Anal and dorsal short, and far back. Head formed of deeply sculptured bones, with mucous cells, clothed in a thick skin; large cheek bones; mouth pretty large, bordered above by the premaxillaries and maxillaries, both carrying teeth, and below by the mandible, toothed in the same way; small raduliform teeth cover the palatines, the pterygoids, the vomer, the presphenoid, the lingual bone, and all the body of the os hyoides; and there is a plate of teeth on the internal surface of the mandible; the presphenoidal and palatine teeth vary with the species. Air-bladder said to be cellular like the lungs of a fowl; two valves at the arterial orifice of the ventricle, and no muscular bulb. About six species in the rivers of South America.

GENUS VI. HETEROTIS, Ehren. A large cuirassed head, clothed in mucous skin, and hard mosaic scales on the body, give this genus a resemblance to *Sudis*, but the vertical fins are not scaly. The teeth stand in a single row on the jaws, they are recurved with a rounded point; no teeth on the palatines, vomer, or presphenoid, but there are groups of straight conical teeth on the pterygoids and dilated part of the hyoid bone. Two long, thick, pancreatic caeca. A cellular air-bladder enters into rings formed by the parapophyses of the caudal vertebrae, as in the *Exocoeti*. Two species, Africa.

GENUS VII. BUTIRINUS, Com. (*Albula*, Gronov.) Has the general aspect of some of the Indian Cyprinoids. Body regularly fusiform, with a conical head, and pointed snout, passing the end of the mandible a little. Dorsal in the middle of the length, its hinder third opposite the ventrals, the anal half-way between the latter and the largely-forked caudal. Head naked. Body covered with large, hard, firm scales; furrows on the cranium perceptible through the skin. Fine card-like teeth on the jaws, palatines, front of the vomer, and pharyngeals; and what is characteristic of the genus are small, cup-shaped, hemispheric patches of teeth, covering a part of the presphenoid, and another on each pterygoid. The convex tongue fits into the canal formed by these three bones, and its surface is also covered with granular teeth. Intestines like those of the *Clupeidae*. Stomach large, caecal; pancreatic caeca twenty-two; hexagonal cells in the mucous coat of the rectum; ovarian sacs opening on each side of the anus. A long air-bladder, having its thin membrane enveloped in an exterior fibrous sac, communicates with the stomach by a short tube. Nine species.

The Butirines, says M. Valenciennes, are undoubtedly allied to the Clupeoids by their large air-bladder and numerous pancreatic caeca, and the want of teeth on the maxillary, but they are kept apart from that family by the absence of a keeled denticulated belly.

ERYTHRINIDÆ.

A small family established by M. Valenciennes of several genera whose true place in the system has been much canvassed. *Erythrinus* is stated by the ichthyologist just named, to present in its skeleton a resemblance to the *Salmonidae* in the adjustment of the bones of the face, to the *Cyprinidae* in the size of the lateral occipital foramina, to the *Clupeidae* in the parieto-occipital foramina, and in the form of the basi-occipital, which differs totally from that of the Cyprinoids in wanting that vaulted dilatation to which the median pharyngeal plate is attached in that family; but again it possesses Cyprinoid characters in the union of the first vertebrae and in the existence of the Weberian ossicles, connecting the air-bladder with the auditory organs, though not exactly in the same way as in the *Cyprinidae*.

FAMILY X.—ERYTHRINIDÆ.

Erythroides, Valenc. Body moderately thick; back and belly rounded; head large; snout obtuse; upper arch of the mouth formed of the small premaxillaries, with the maxillaries articulated to their extremities, both crowded with small conical teeth, as is also the mandible. Villiform teeth cover the palatines and pterygoids, and form an arched plate on the roof of the mouth, separated from its fellow on the other side by a smooth vomerine line; pharyngeal teeth also villiform. Entire cheek covered by bony suborbital scales, followed by two temporal plates which are characteristic of the family. Stomach conical, siphonal; pancreatic caeca numerous;

Classification—**Ma-** air-bladders two, united by a neck, the anterior one roundish and **laco-**pteri. covered by a thick fibrous coat as in the *Catostomi* and other *Cyprinidæ*, and inserted into the third and fourth vertebral processes, but not communicating with the ear; the second is subcellular anteriorly, without extensive partitions, but with recesses formed by longitudinal and transverse bridles in the walls of the viscus, which project inwardly in thin folds. A tube runs from the second air-bladder to the top of the œsophagus.

Erythrinus, says Müller, belongs decidedly to the *Characini*.

GENUS I. ERYTHRINUS, Cuv., Müll. Simple, card-like teeth on the palatines; the bigger canines among the mandibular teeth are proportionally short. Swim-bladder cellular. Six species.

GENUS II. MACRODON, Müll. A row of bigger conical palatines in place of the card-like teeth of *Erythrinus*; on the mandible isolated very large canines. Swim-bladder not cellular. Six species.

GENUS III. LEBIASINA, Valenc. Having the aspect of a *Cyprinodon* and the tricuspid teeth of that family, but with the suborbitars cuirassing the cheek; numerous pancreatic cæca, and a double air-bladder, partially cellular as in *Erythrinus*.

GENUS IV. PYRRHULINA, Valenc. In some of its characters this fish approaches the *Cyprinidæ*. A scaly, fusiform fish, with the mandible projecting, and the upper lobe of the caudal elongated. Snout very short; eye rather large; mouth formed above by the short premaxillaries carrying minute crowded teeth, and on the side by oval edentate maxillaries, which fit into pits in the mandible; the mandible has large limbs, with small conical teeth, and moves after the manner of the jaw of *Mugil*; the second and third suborbital scale bones cover the cheek. Stomach roundish; six pancreatic cæca; a double air-bladder, like that of *Macrodon*, without cellular walls, but with a tube from the posterior conical half, which communicates with the upper part of the œsophagus. One species, Surinam.

GENUS V. UMBRA, Kram. Small premaxillaries, articulating at their extremities with the maxillaries, both carrying teeth; vomer and palatines also studded with teeth. Branchiostegals five; œsophagus short and globular. Stomach long, cylindrical, siphonal; no pancreatic cæca; air-bladder simple, pointed behind, rounded before, and communicating with the pharynx by a wide opening. A thickly fusiform fish, with a short-conical, smooth head, large scales on the body, and a dorsal rather posterior to the middle of the fish, and opposite to the small ventrals and anal. Caudal fin cuneate at the end.

This genus is one which ichthyologists find a difficulty in assigning to any family that has as yet been characterized. It combines the characters of several groups. Müller remarks that it does not belong to the Pœcilian genus *Cyprinodon*, since, in addition to the premaxillary teeth, it has teeth on the vomer and palate bones; and a mouth bounded anteriorly by the premaxillaries, and externally by the maxillaries, as in *Esox*, with which it agrees also in having no cæcal projection of the stomach, and in the intestines and the covered pseudobranchiæ. (*Arch. für Naturg.*)

GENUS VI. DUSSUMIERA, Valenc. This fish, having the aspect of a *Clupeoid*, but, being without denticulations on the belly, is one of the species whose combinations of characters mock at our attempts at arrangement. It has teeth on the jaws, palatines, pterygoids, and tongue, but the vomer is smooth. There are raduliform patches of teeth on the palatines and pterygoids as in *Elops*, but it cannot enter the *Elopidæ* family, because it wants the sublingual bone of *Elops*. It ought to be placed, M. Valenciennes thinks, between *Butirinus* and *Elops*. One species, *D. acuta*.

GENUS VII. ETRUMEUS, Bleek. Separated from *Dussumiera* because it has vomerine teeth. (*Clupea micropus*, Schlegel.)

ELOPIDÆ.

The existence of a bone between the limbs of the lower mandible is one of the characters of this family, and the want of it in *Butirinus* (left among the somewhat heterogeneous *Clupesocidæ*) is the reason why M. Valenciennes did not place that genus with his *Elopiens*. *Amia* is another genus in which this sublingual bone is present, but Müller has adduced various arguments founded on its structure for considering it to be one of the few living Ganoids, and we shall accordingly mention it under that order along with the *Lepidostidæ* which are more unequivocal Ganoids.

The figure No. 75, represents the *Elops saurus*, or Silverfish of Garden, a fish which has been introduced into our systematic works under four different specific names and

three generic ones. It is the only representative of the genus *Elops* yet discovered, and is one of the few fishes which are

Classification—**Ma-** laco-**pteri**.

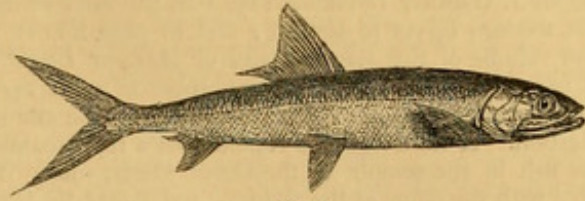


Fig. 75.
Elops saurus.

common to the warmer parts of both the Atlantic and Pacific Oceans. It has been captured at New Orleans, Surinam, and on the coast of the Brazils; also on the opposite African coast at Senegal. In the Red Sea also, at the Isle of France, in the Indian Ocean, and, lastly, on the North Australian coasts and in the seas of Polynesia, westward to Japan and China.

There is a likeness between the genera *Lutodeira* and *Elops*, but the great number of branchiostegals which the latter possesses at once distinguishes them.

FAMILY XI.—ELOPIDÆ.

Elopiens, Valenc. Separated by M. Valenciennes on account of the presence of a sublingual bone from the *Butiridæ*, to which they are nearly allied. This bone exists in *Amia*, but that genus has another kind of dentition. These fish are remarkable among their allies for the number of their branchiostegals, and the median bone under the branchiostegal membrane, between the limbs of the mandible, is also an unusual part of their structure. The mouth is, like that of the *Clupeidæ*, bordered above by small premaxillaries, and long free maxillaries on the side. Teeth so fine on the premaxillaries, maxillaries, mandible, palatines, entopterygoids, vomer, presphenoid, and tongue, that they appear merely to be slight asperities. Body long and rounded; no denticulations whatever on the belly. Dorsal medial, with no prolongation of the last ray. An enlarged and indurated scale on the dorsal and ventral edge of the base of the deeply-forked caudal; long scaly appendages in the axillæ of the ventrals and pectorals. Head naked; a diaphanous, waxy-looking, adipose eye-membrane. Stomach conical, with an ascending fleshy branch; numerous pyloric cæca; a large air-bladder communicating with the digestive canal, and forked anteriorly, but not entering the cranium.

GENUS I. ELOPS, Linn. Character of the family as above. Two species.

GENUS II. MEGALOPS, Commer. Body elongated, of moderate height and elegant form. Mouth bordered above by the small premaxillaries, and by the large, moveable, compound maxillaries on the sides, with the edges of both rough with minute teeth: there are teeth also on the mandible, the palatines, the pterygoids, the front of the vomer, the presphenoid, the lingual and hyoid bones, and on the pharyngeals. Wide gill-openings; branchiostegals numerous (twenty-two to twenty-five). A sublingual bone between the limbs of the mandible. An adipose eye-lid to the pretty large eye. Small dorsal, with the tip of the last ray filamentous and long. A large conical stomach; numerous slender, filiform, pancreatic cæca; air-bladder large, forked anteriorly, with an air-pipe from it opening into the pharynx. Three species.

MORMYRIDÆ.

A small family of fishes which abound in the rivers of both sides of Africa, the Nile, Senegal, and Congo. They are timid fish, of nocturnal habits, that frequent rocky basins in the rivers, and would be seldom taken but for the high price they command, which renders the fishermen very assiduous. They are caught with lines to which many hooks baited with worms are affixed, and one fisherman rarely succeeds in taking more than two or three in the course of the night. Their flesh has an excellent flavour, and is greatly esteemed by the epicures of Egypt. These fish seem to have been objects of as great attention to the ancient Egyptians as they are to the present inhabitants of that country. In the Egyptian museum of Paris there is a small bronze representation of one of the sharp-nosed

Classification—Malacopteri.

Mormyri surmounted by the mythic horned circle emblematic of the divinity Athor; and mummified *Mormyri* are not rare. Sir J. Gardner Wilkinson says, that the name of these fish in modern Egypt is *Mizdeh*; and in page 250 of the second volume of the second series of *Ancient Egypt*, he gives two very recognisable representations of a *Mormyrus* taken from bronzes, one of them crowned by the emblem in question. A third figure is copied from a representation of the fish in the temple of the Great Oasis, where it is coupled with the name of the goddess, and shows, Sir Gardner thinks, that the fable of the metamorphosis of Venus into a fish was of Egyptian origin. The ancient Egyptians appear to have made the *Mormyrus* an object of veneration, but to have abstained from eating it, according to Plutarch, because it was one of three different kinds which devoured a part of the body of Osiris, and which Isis therefore was unable to recover when she collected the rest of the scattered members of her husband. The *Mormyrus longipinnis* of Rüppell, or *M. caschive* of Hasselquist and Valenciennes, has been ascertained to possess electric organs, which probably exist in other species also, and may be one reason for the veneration of the whole genus by the ancient Egyptians. The long-finned species represented by one of the bronzes figured by Sir Gardner Wilkinson is either this *M. caschive* or the *M. oxyrhynchus* which has also a long dorsal. Müller found the premaxillaries of the *Mormyri* to be united so as to form a single bone.

FAMILY XII.—MORMYRIDÆ, Müll.

Mormyri, Cuv. Longish compressed bodies, with a tail slender at its origin, but swelling out at the attachment of the caudal. Head encased in a thick, naked skin, which envelopes the gill-cover and branchiostegals, and leaves only a perpendicular slit for a gill-opening. Branchiostegals six. Mouth small, and bounded above mesially by a single bone formed of the coalescent premaxillaries as in *Diodon*; laterally the maxillaries enter into the composition of the orifice. Dentition various. The post-frontal or temporal apparatus is simpler than in other fish, therein resembling the *Siluridæ*. The cranium has a peculiar canal closed by the skin, leading to the interior hollow of the skull, and the acoustic labyrinth. Accessory gills absent; stomach globular; intestine long and slender; two pyloric cæca; swim-bladder simple.

GENUS I. MORMYRUS, Müll. A row of slender teeth, curved at the tips on the premaxillaries and mandible, and in the young a stripe of raduliform teeth on the hinder parts of the vomer. *M. cyprinoides*, *oxyrhynchus*, *dorsalis*, *longipinnis*.

GENUS II. MORMYRUPS, Müll. Conical teeth on the jaws in place of curved tipped ones. *M. anguilloides*, *labiatus*.

M. Valenciennes does not adopt these genera of M. Müller, as he says that conical and slender teeth exist on the jaws of the same species. He describes twenty species, in two groups, characterized by the length of the dorsal fin. Since the publication of the *Histoire des Poissons*, Peters has discovered six new ones on the Mozambique coast. Most of the species described by M. Valenciennes have two minute lateral cusps to the teeth, separated by a notch as in *Crenidens*.

CYPRINODONTS.

The typical forms of this family are small fishes, formerly considered to be Cyprinoids, but, as their name denotes, differing from the true Carps in possessing teeth, and, moreover, in having protractile jaws; they want also the kind of pharyngeal grinding apparatus which is peculiar to the Carps. Species exist both in the Old and New Worlds; and some inhabit indifferently fresh, brackish, or salt water. We have seen specimens procured in a brine spring and salt marsh on the shores of the Dead Sea, on the supposed site of Sodom, probably from one of the slime pits of Siddim of which the valley was full in Abraham's time. In one member of this family, the *Guapucha* (*Pacilia bogotensis*), which inhabits the little river of Bogota on the plateau of Santa Fe, 8840 feet above the sea level, Humboldt found a double air-bladder; and, on examining the contained air, ascertained that 93 parts in 100 were azote, the rest being

carbonic acid and oxygen. The *Orestias* are found at a still greater altitude, being inhabitants of Lake Titicaca and other elevated sheets of water on the Cordilleras of Peru and Bolivia, between the 14th and 19th degrees of latitude, and from 13,000 to 14,000 feet above the sea. The flesh of these fishes is a great delicacy; and they are sought for during the winter season, when they can be transported without spoiling.

Anableps is a genus which excites the attention of the dullest of observers by a conformation of the eyes which no other vertebrated animal possesses, in the cornea being divided into two somewhat unequal elliptical parts by a bridle of the conjunctiva, giving to each eye the appearance of being double. This very peculiar structure has most likely a connection with the habit the fish has of swimming with the eyes partly out of the water. *Panchax* and *Vandellia* were considered by M. Valenciennes to have affinities with *Pacilia*, but owing to their possessing teeth on the palate he places them after *Esox*. Neither has *Diplopterus* been enumerated among the *Cyprinodonts* by Müller, but no other more convenient place for these three genera occurs than just before the *Esocidæ*.

FAMILY XIII.—CYPRINODONTIDÆ, Agass.

Cyprinodontes, Agass. This is a very precise family, with prominent characters. Its members resemble the *Cyprinidæ* in habit, but they do not possess the large pharyngeal tooth, nor the bony process of the basi-occipital. Upper and under pharyngeal teeth card-like; maxillary as in the *Cyprinidæ*, and the premaxillaries forming alone the upper half of the mouth, but they are armed with teeth; jaws protractile. Swim-bladder simple, and unfurnished with a chain of acoustic ossicles. No supplementary gills. Stomach siphonal; no pancreatic cæca. Some are viviparous.

GENUS I. PACILIA, Valenc. Jaws depressed, horizontal and protractile, the upper border of the mouth formed solely by the premaxillaries; moveable and curved teeth on both jaws in an exterior row, with a stripe of villiform teeth behind; roof of the mouth edentate, soft; many rows of hooked teeth on the pharyngeals. Five branchiostegals. A single, simple air-bladder. Long, simple intestines; viviparous. Eight species.

GENUS II. MOLLINIENESIA, Lesq. Having the dentition, branchiostegals, and intestines of *Pacilia*, they differ in the position of the anus, advanced to between the ventrals, which are rather far back. A large and long dorsal and expanded caudal. One species, Lake Pontchartrain.

GENUS III. XIPHOPHORUS, Heck. Teeth bristly, short, surrounded by a row of stouter ones. Ventrals as in *Molliniensia*; anal in the male close to the ventrals, the front rays thickened, connected together by a long plate, whose extremity is used as a prehensile organ; the posterior rays very short. Three Mexican species.

GENUS IV. CYPRINODON, Lacép. (*Lebias*, Cuv.) Viviparous fishes, with the jaws rather less depressed than in *Pacilia*, the teeth in a single close row, compressed and tricuspid. Branchiostegals five. Intestines and air-bladder of *Pacilia*. Small fishes resembling a Minnow. Eight species.

GENUS V. FUNDULUS, Lacép. Characterized by the presence of fine card-like teeth on arched premaxillaries, the upper half of the orifice of the mouth being semicircular. Head flat beneath; and the jaws not depressed as in *Pacilia*. Branchiostegals five. Eight species.

GENUS VI. HYDRARGYRA, Lacép. Teeth of *Fundulus*. Six branchiostegals. Four species.

GENUS VII. GRUNDULUS, Valenc. Body compressed, oval; the flat upper jaw shorter than the mandible; numerous teeth on the jaws. Dorsal far back, opposite to the anal. Branchiostegals five. Air-bladder double, the posterior one much the largest. One species, seen only by Baron Humboldt.

GENUS VIII. ORESTIAS, Valenc. Thickly fusiform, apodal, scaly fishes. Dorsal and anal opposite to each other, behind the middle of the body, on the commencement of the tail. Mouth rather small at the extremity of a muzzle which bulges beneath by the projection of the mandible; teeth fine and hooked; pharyngeal teeth card-like. Five branchiostegals. Scales of the fore part of the fish hard horny bucklers, with occasional intervals of naked skin; posteriorly they are ordinary cycloid scales like those of a Carp. Lower part of the belly destitute of scales, shining and metallic in lustre. Nine species, Andes.

M. Gervais has instituted a genus which he names *Tellia*, for an

Classification—Malacopteri.

Classification—Malacopteri.

Classification—Malacopteri. Algerine fish which is distinguished from *Cyprinodon* by the want of ventrals. We know it only by a brief notice in the *Archiven für Naturgeschichte*, and are not told in what respect it differs from *Orestias*.

GENUS IX. ANABLEPS, Bloch. Elongated scaly fishes, with a flattish, rounded back, and depressed head. The maxillaries carry no teeth, and do not enter into the composition of the border of the mouth, which is formed above by the premaxillaries alone. On these there are teeth, the outer row being moveable like those of *Poecilia*, and the inner ones minute, in a crowded band; roof of the mouth smooth, edentate; tongue a very small tubercle; pharyngeal teeth two plates above and below, conical pointed, villiform, crowded; lips thick; eyes prominent under a scaly arch, having the cornea and iris divided by a longitudinal band, so as to give them the appearance of being double. Branchiostegals five. In the male the excretory canal of the organs of generation, common also to the urinary bladder, is carried along the front of the anal beyond the tip of its first ray, in a tapering, scaly appendage, with the orifice at the extremity. The female is viviparous, but seldom produces more than seven or eight young at a time. Air-bladder pretty large, with a pneumatic duct in the foetal state, which is obliterated as the fish attains maturity. Four or five species.

GENUS X. DIPLOPTERUS, Gray. (*Luciocephalus*, Bleeker.) Is placed by its affinities between *Cyprinodon* and *Esox*; the existence of vomerine teeth brings it near *Panchax*, which it resembles in the position of the ventrals under the pectorals. A single anacanthous dorsal opposite the anal. Upper half of the mouth composed of the very protractile premaxillaries, which have moreover a tuft of teeth on their ascending pedicels, and uniserial teeth on their labial limbs; mandibular teeth pluriserial in front; vomer rough, with minute teeth; four complete branchial arches; no pseudobranchiæ; inferior pharyngeals widely separated, armed with conical teeth. Gill-openings large, coming forward under the eye. Branchiostegals five. Nostrils two in the preorbital space. Scales Ctenoid on the body, Cycloid on the head. Stomach caecal, intestine short; no pancreatic caeca.

GENUS XI. PANCHAX, Hamilt. Buch. Thickly fusiform scaly fishes, highest in the middle, and tapering rather more towards the head than posteriorly. Dorsal far back over the posterior part of the larger anal; abdominal ventrals before the middle of the fish. Upper arch of the mouth formed by the premaxillaries, behind whose descending limbs the maxillary lies and does not touch the edge of the orifice, which is garnished all round by a narrow band of teeth as fine as hairs. Teeth on the palatines; branchiostegals five.

GENUS XII. VANDELIA, Valenc. Body elongated, rounded, slenderer anteriorly; snout depressed, prominent; mouth small, situated on the ventral aspect; lips thick, with a fleshy barbel at the corners of the mouth on each side; teeth on the vomer; none, or little visible teeth on other parts of the mouth. Ventrals small, on the posterior third of the body; dorsal standing over the interval between the ventrals and anal. One species, India.

ESOCIDÆ.

By the abstraction of groups formerly included in the Pike family, only a single genus remains to represent it, and of this there is only one European species, viz., *Esox lucius*, Linn. (the common Pike). During the earliest stage of its life it is of a greenish hue, but in the second year it becomes gray with pale spots, the latter ultimately acquiring a yellowish colour. Its markings,



Fig. 76.
Esox lucius.

however, are very variable, and instances have occurred of its being perfectly white. It is one of the largest of fresh-

water fishes, and indeed, if the accounts which some writers give are not exaggerated, it occasionally attains a size not greatly inferior to the gigantic inhabitants of the ocean. Individuals are recorded as measuring from 5 to 9 feet in length. They frequently weigh above 30 lb. in the lakes of the north of England; and Dr Grierson mentions one taken in Loch Ken, in Galloway, which weighed 61 lb. Pallas states that the lakes in the government of Tobolsk in Siberia nourish multitudes of Pikes which attain the size of between 30 and 40 lb. In North America, which seems to be the headquarters of the family, since not only the common European species, but several others exist in the great lakes of that country, 30 lb. is considered a large size, though doubtless some individuals attain a greater weight. Most authors have cited the accounts of one said to have been caught at Kaiserslautern, near Mannheim, in 1497, which was nearly 19 feet in length, and weighed 350 lb. The skeleton of this extraordinary specimen was for a long time preserved, and bore a brass ring with an inscription to the effect that the fish was put into a pond by the hands of the Emperor Frederick II., the 5th of October 1262. From this it is inferred that it was upwards of 235 years old. M. Valenciennes enters at some length into a critical examination of the truth of this story. Gesner, who lived soon after the time assigned to the capture of this remarkable fish, and who might have known eye-witnesses of the event, says that it was caught near Heilbronn, in Suabia; and in 1592 Lehman saw a painting of the Pike and a sketch of the ring kept in a tower on the road from Heilbronn to Spires, and the piece of water whence it was taken was still named *Kaiserweg*, or the Emperor's Lake, in 1612. There seems to be no doubt but a fish of great size and great age was taken about the time mentioned, but there are discrepancies enough in the various accounts that are given of it by authors to make the details doubtful; and a celebrated anatomist having examined the skeleton of the said Pike, then kept in the Cathedral of Mannheim, found the vertebræ to be more numerous than those of a single Pike, and in fact that the skeleton had been lengthened to fit the story, which had itself undergone the same process from that love of the marvellous which is common to every age. The common Pike is not only an inhabitant of most of the larger waters of Europe and northern Asia, but it is certainly one of the native fishes of North America. This is a question of interest to those who are engaged in tracing the distribution of animals, and some pains were taken to ascertain the identity of the species in the two hemispheres. A specimen brought from Lake Huron was examined by Baron Cuvier and M. Valenciennes, and found to be the same with the European one; and Sir John Richardson carefully compared the European and American fishes with each other without detecting any specific difference. Some American ichthyologists have questioned the accuracy of these examinations, but they do not appear to have given sufficient weight to the fact of there being more than one species in the great lakes of their country, and the chance of the specimen they commented on being one of these. *E. estor* inhabits Lake Huron, as well as *E. lucius*, and most likely there are others in that lake or in the fresh-water seas that communicate with it. M. Yarrell gives some interesting facts respecting the value of this fish at different periods of English history. Edward the First fixed the price of a Pike higher than that of fresh Salmon, and ten times greater than that of the best Turbot or Cod; and in the reign of Henry the Eighth a large one was sold for double the price of house-lamb in February, and a Pickerel or young Pike for more than a fat capon. These facts are sufficient to show the error of some writers on British ichthyology, who have fixed upon the reign of Henry the Eighth as the epoch of the introduction of the Pike into the British isles; which Albin says

Classification—Malacopteri.

Classification—*Malacopteri.*

was in 1537. Leland mentions that a Pike of great size was taken in Ramesmere, Huntingdonshire, in the reign of Edgar. Pikes are proverbially voracious. There seems, indeed, to be no bounds to their gluttony; for they devour indiscriminately whatever edible substances they fall in with, and almost every animal they are able to subdue. "It is," says M. de Lacépède, "the Shark of the fresh waters; it reigns there a devastating tyrant, like the shark in the midst of the ocean; insatiable in its appetites, it ravages with fearful rapidity the streams, the lakes, and the fish-ponds that it inhabits. Blindly ferocious, it does not spare its species, and even devours its own young; gluttonous without choice, it tears and swallows, with a sort of fury, the remains even of putrified carcasses. This bloodthirsty animal is also one of those to which nature has accorded the longest duration of years; for ages it terrifies, agitates, pursues, destroys, and consumes the feeble inhabitants of the waters which it infests; and as if, in spite of its insatiable cruelty, it was meant that it should receive every advantage, it has not only been gifted with strength, with size, with numerous weapons, but it has also been adorned with elegance of form, symmetry of proportions, and variety and richness of colour." A singular instance of its voracity is related by Johnston, who asserts that he saw one killed which contained in its belly another Pike of large size, and the latter, on being opened, was found to have swallowed a water-rat! Its flesh is well flavoured and easy of digestion, and is consequently much sought after as an article of food, especially for convalescents, and others of weakly habit. It is most tender and nutritive in young individuals, but full-grown Pikes are occasionally found in which the flesh on the back and near the vertebral column acquires a greenish colour, which is held in high repute, and often purchased at a great price. Sibbald, writing in the reign of Charles the Second, says that the heart of the Pike is a remedy against febrile paroxysms, that the gall is of much use in affections of the eyes, that the dried jaws reduced to powder are a remedy in pleurisy, gravel, and stone in the bladder, and that the ashes of the fish are used to dress old wounds. These and the rest of his statements on medical subjects have the formal approbation of the President and Censor of the Royal College of Physicians of Edinburgh.

Even the names of the Pike is a subject not without its interest. It is the *Lucio* or *Luzzo* of the Italians, an appellation evidently descended from the Latin *lucius*. Ausonius, in using this term, says that it was a despised fish on the Moselle, very contrary to the estimation in which it was held in England ten centuries later—

"Lucius, obscuras ulva cænoque lacunas
Obsidet. Hic nullos mensarum lectus ad usus,
Fervet fumosis olido nidore popinis."

In Sweden it is named *Gädda*, and in Denmark *Giedde*, *Gedde*, *Gede*, or *Gei*, names differing little from the appellation of the fish in the lowlands of Scotland, "Ged," and showing, with many other instances of Scandinavian words relating to maritime affairs and fisheries, the origin of the population that displaced the Celtic races from the country lying to the south of the Firth of Forth, and on the east coast of Scotland still farther north. M. Valenciennes has printed a long list of the names which the fish bears among the Slavonic and Tartar peoples, none of which seem to have any relation to those by which it is known on the western coast of Europe. The Scandinavian name had probably its origin in the sharpness of the teeth of the Pike, and the consequent danger of injury to those who attempted to handle it, for we find a similar word, *Gede* or *Geede*, used to designate a goat in Danish (also lowland Scottish "Gait"), and *Gedehams*, to signify a hornet. The English names Pike and Pickerel are evidently sprung from the Saxon *Piik* (sharp-pointed), and the French Canadians term the *Lucioperca* of that country the *Piccarrel*, which

it well merits, as its teeth are no less formidable than those of the *Esox lucius*.

Classification—*Malacopteri.*

FAMILY XIV.—ESOCIDÆ, Müll.

Scaly fishes without an adipose fin, and possessing covered glandular accessory branchiæ. Orifice of the mouth formed above in the middle by the premaxillaries, and on the sides by the maxillaries. A simple swim-bladder. Diffuse vascular ramifications exist on the inner surface of the skin, which are peculiar to this family. Stomach siphonal; no pancreatic cæca. Type of form the common Pike; inhabitants of fresh waters only, in the northern hemisphere.

GENUS I. *ESOX*, auct.

GONORHYNCHS.

The members of this small family are more interesting from the peculiarities of structure that they exhibit, and which are briefly denoted in the generic characters, than by their importance in an economical point of view. The *Chanos*, however, has been named Milk Fish, from its delicacy as an article of food.

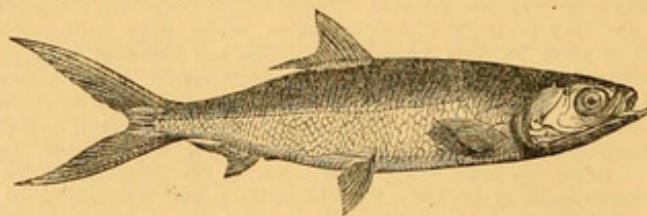


Fig. 77.

Chanos or *Lutodeira salmonea*.

A scale of this fish has been represented on a preceding page (fig. 40), and the following woodcuts give the portrait of *Gonorhynchus Greyi*, a fish of Western Australia, and of one of its scales.

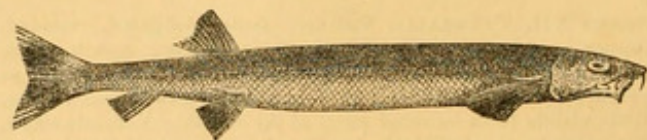


Fig. 78.

Gonorhynchus Greyi.



Fig. 79.

Scale of *Gonorhynchus Greyi*.

On the *Alepocephalidæ*, we have no remarks to make.

FAMILY XV.—GONORHYNCHIDÆ.

Gonorhynques, Valenc. This small family was constituted by M. Valenciennes for the reception of two genera which want oral teeth, and thus have some affinity with the *Cyprinidæ*.

GENUS I. *CHANOS*, Lacép. (*Lutodeira*, Van Hass., Rüpp.) The *Chanos* have an affinity to the *Clupeidæ* without actually belonging to that family, and are separated from the characteristic Herrings by the belly being rounded and not carinated, nor denticulated. They resemble the *Butiridæ* and *Gonorhynchi* in their fatty eyelids, toothless jaws, and scaly appendages in the axillæ of the pectorals and ventrals; they have, moreover, a lanceolate scaly fillet above and below the lateral line on each side, extending longitudinally over the caudal, dividing the long acute lobes of the forked caudal from a small central portion. *Chanos* is further character-

Classification—Malacopteri. —ized by a peculiar hollow behind the gill-opening, which communicates with the gills through an aperture, and lodges an accessory gill that has cartilaginous supports. The intestinal canal is very long, being doubled upon itself many times, and in the interior of the œsophagus there is a complete spiral valve, of numerous turns, and with fringed edges, which have been observed in no other genus. Pancreatic cœca numerous. Air-bladder double, communicating with the œsophagus. Upper half of the mouth formed partly by the premaxillaries, partly by the maxillaries. General aspect that of a *Coregonus*. Species eight.

GENUS II. GONORHYNCHUS, Gronov. (*Rhynchœna*, Rich.) Body elongated, with a slenderly conical head, ending in an acute snout, which has a small median barbel beneath. Dorsal and anal fins opposite, very far back; long scaly processes in the axils of the pectorals and ventrals; branchiostegal membrane uniting with the surface of the throat, and leaving merely a vertical slit for a gill-opening. Branchiostegals four; lips fringed and lobed. Scales small, pectinated on the edge by a row of long and strong teeth. Pharyngeal teeth cylindrical, truncated; pyloric cœca six to nine; no air-bladder. Two species.

FAMILY XVI.—ALEPOCEPHALIDÆ, Valenc.

This family consists of a single species, of which M. Valenciennes says "the genus *Alepocephalus* is separated from all others, and forms the type of a peculiar family." The upper jaw is that of the Pikes (*Esox*), with an alimentary canal like that of the Clupeoids, and a spiral valve in the rectum like *Amia*, but with many pancreatic cœca and no air-bladder, whereas *Amia* and *Chirocentrus* have remarkable air-bladders and no pancreatic cœca. No denticulations on the belly like those of the Clupeoids. Body compressed, rounded beneath; long scaleless head. Short premaxillaries bearing teeth, forming the upper half of the mouth; toothless maxillaries lying behind them; palatine and mandibular teeth small. Siphonal stomach with numerous pancreatic cœca; spiral valve in the rectum. One species.

GENUS I. ALEPOCEPHALUS, Risso.

CYPRINOIDS.

This large family is a very natural one, but the great conformity of structure exhibited by its very numerous species is a source of difficulty to ichthyologists who have attempted to divide it into genera, and other subordinate groups. It is wholly a fresh-water family, and among the least carnivorous in the class of fishes.



Fig. 80.
Cyprinus carpio.

Cyprinus carpio, the common Carp. This well-known fish is of an olive-green, yellowish beneath, having the anal and dorsal spines strong and denticulated, and the barbels short; the pharyngeal teeth are flat and striated on the crown. It is a native of the central countries of Europe; but, owing to its value as an article of food, it was early distributed by human agency over the whole of that Continent. The ease with which it can be transported from one place to another, and its speedy growth and propagation in ponds and artificial reservoirs, afforded great facilities for its rapid dispersion. The year 1614 is assigned as the date of its first introduction into England; but it was naturalized in Germany and Sweden nearly half a century before that period. It delights in tranquil waters, preferring such as have a muddy bottom, and the surface partially

shaded with plants. Its food consists of the larvæ of aquatic insects, minute Testacea, worms, and the tender blades and shoots of plants. The leaves of lettuce, and other succulent plants of a similar kind, are said to be particularly agreeable to them, and to fatten them sooner than any other food. Although the Carp eats with great voracity when its supply of aliment is abundant—to such a degree, indeed, as sometimes to produce indigestion, which occasionally proves fatal—it can subsist for an astonishing length of time without nourishment. In the winter, when the Carps assemble in great numbers, and bury themselves among the mud and the roots of plants, they often remain for many months without eating. They can also be preserved alive for a considerable length of time out of the water, especially if care be taken to moisten them occasionally as they become dry. Advantage is often taken of this circumstance to transport them alive, by packing them among damp herbage, or wet linen; and the operation is said to be unattended with any risk to the animal, especially if the precaution be taken to put a piece of bread in its mouth steeped in brandy! In a similar way, the Dutch preserve them by suspending them from the roof of a damp apartment in a bag-net filled with moss, which is continually kept moist, and they are fed with vegetables and bread steeped in milk—a mode of treatment by which they are not only kept alive, but actually thrive and fatten.

The fecundity of these fishes is very great, and their numbers consequently would soon become excessive, but for the many enemies by which their spawn is destroyed. No fewer than 700,000 eggs have been found in the ovaria of a single Carp, and that too by no means an individual of the largest size. Their growth is very rapid, more so perhaps than that of any other fresh-water fish, and the size which they sometimes attain is very considerable. In certain lakes in Germany and Prussia, individuals are occasionally taken weighing thirty or forty pounds; and Pallas relates that they occur in the Volga five feet in length, and even of greater weight than the examples just alluded to. The largest of which we have any account is that mentioned by Bloch, taken near Frankfort-on-the-Oder which weighed seventy pounds, and measured nearly nine feet in length. M. Valenciennes commends the small figure of the Carp in Mr Yarrell's *British Fishes*, as being the very best representation of the fish that he had seen.

Cyprinus auratus (Gold Fish). This beautiful species, the most brilliantly adorned of all our fresh-water fishes, and scarcely surpassed even by the more richly ornamented inhabitants of the ocean, is well known to be a native of China, although it is now domesticated, so to speak, in almost every country, both of the old and new world. Like the Carp, it has the dorsal and anal spines denticulated. When young it is of a blackish colour, and it gradually acquires the fine golden red by which it is characterized; but some examples are of a silvery hue, and others are variegated with three different shades of colour. Like most other animals that have been long estranged from their natural habits, and subjected to artificial influences, this species presents a great many varieties, extending even to some important parts of structure. Individuals occur without a dorsal, others with a very large one, others with the caudal greatly enlarged, and divided into three or four lobes; and in some instances the eyes are enormously dilated. The Golden Carp is said to have been originally confined to a lake near the mountain Tsiensing, in the province of The-kiang, in China, about N. Lat. 30. It was first brought to England in 1691, but was very scarce till 1728, when a considerable number were imported, and they soon became generally known. They do not flourish in rivers and open ponds, not, however, because such places are uncongenial to them, but because they are exposed to many enemies, against which they have no means of de-

Classification—Malacopteri.

Classification—Malacopteri.

fence. When kept in confinement they ought to be nourished with fine crumbs of bread, small worms, flies, and yolks of eggs dried and powdered, and the water ought to be frequently changed. The ordinary length of this species is from four to six inches; but they have been sometimes known to reach a foot. Although natives of a warm climate, they can sustain a great degree of cold uninjured. An individual, which was accidentally exposed during the night, was completely frozen up in the centre of its glass jar; but as the ice thawed it recovered its vigour, and seemed to suffer no further inconvenience.

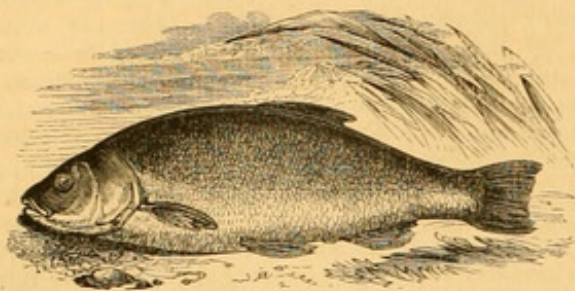


Fig. 81.
Tinca vulgaris.

The Tench (*Tinca vulgaris*) is of a deep yellowish brown, sometimes, however, assuming a fine golden colour. Its usual length is from 12 to 14 inches; but instances are on record of its having reached 3 feet. It inhabits stagnant waters with a muddy bottom; and in the winter conceals itself among the mud, and seems to undergo a kind of torpidity. In May and June it deposits its ova among aquatic plants; these are very minute, of a green colour, and so numerous that 297,000 have been reckoned in one female. The Tench is very extensively distributed, appearing to occur throughout Europe and Northern Asia.

“ Quis non et virides vulgi solatia Tincas norit.”

AUSONIUS.

Its flesh is not much esteemed, as it is soft, insipid, and difficult of digestion.

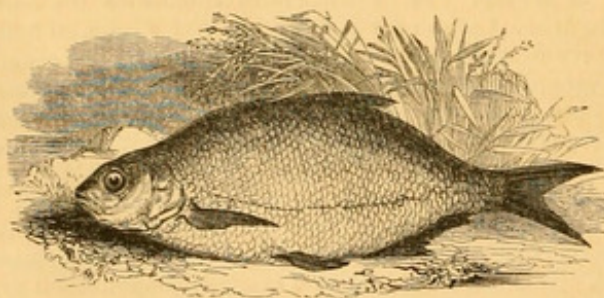


Fig. 82.
Leuciscus brama.

The Bream (*Leuciscus brama*, Valenc.) is common in slow-flowing rivers and lakes in most European countries. It sometimes acquires 2½ feet in length, but its ordinary dimensions may be stated to be about 1 foot. Worms, confervæ, and aquatic plants are its usual food; but like many allied species, it often swallows mud, which renders its flesh unsavoury. “There exists in the River Trent, in the neighbourhood of Newark, two species or varieties of Bream. The common Bream is known there by the name of Carp Bream, from its yellow colour, and has been taken of nearly eight pounds weight. The other species or variety, which I believe to be a nondescript, never exceeds a pound in weight. It is of a silvery hue, and goes by the name of White Bream.”

Leuciscus rutilus (Valenc.) is the *Gardon* of French fishermen, and the *Rödskalle* (Red-scale), or *Rödfisk* (Red-

fish), of the Danes. In some parts of Germany it is named

Classification—Malacopteri.

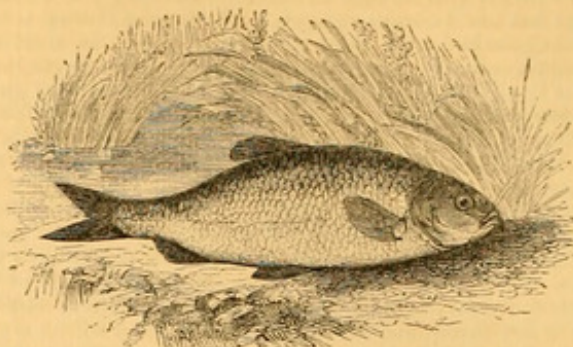


Fig. 83.
Leuciscus rutilus.

Röthauge, but in general it is called in that country *Roche*, an appellation evidently identical with its English one.

The Chub, named in Cumberland *Skelly*, is a well known English fish, and has received its northern appellation (*quasi* Scaly) from the size of its scales.

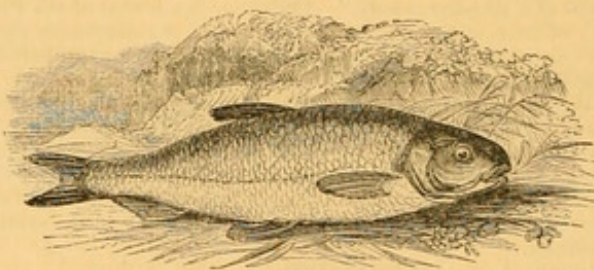


Fig. 84.
Leuciscus cephalus.

English ichthyologists have all given it the specific name of *cephalus*, but M. Valenciennes remarks that the term *cephalus* was applied by Linnæus to an assemblage of an *erythrinus* with the tenth species of Artedi, which itself comprehends several European *Cyprini*. He therefore employs the specific name of *Jeses*, also Linnæan, to denote the Chub of England, which is the *Jentling* or *Bratfisch* of the Danube, and the *Jeses* or *Jese* of the Oder. *Leuc. phoxinus* (common minnow) is familiar to all. It is the smallest species of the genus found in Europe, the greatest length which it attains seldom exceeding 3 inches. It first makes its appearance in March, and disappears in October, passing the winter beneath the mud. It is well known to be a gregarious species, and small shoals are to be found in almost every shallow stream, especially in clear weather, as they seem to delight in warmth and sunshine. They usually spawn in the month of June, but their ova are often found at a much later period. The flesh of the minnow is delicate and well-flavoured, but its size is too small to admit of its being of much value as an article of food. It is principally used as a bait for the capture of larger kinds.

FAMILY XVII.—CYPRINIDÆ.

Cyprinoidei, Agass. A small, soft, toothless oral orifice, the upper half formed by the pre-maxillaries only, the maxillaries lying behind them; no teeth except on the bones circumscribing the posterior aperture of the mouth; under pharyngeals armed with one large tooth; upper pharyngeal wanting. On the base of the cranium, or basi-occipital, and opposed to the under pharyngeals, there is a projecting process covered for the most part by a horny plate. Most have scales (*Aulopyge*, Heck., is an exception). No adipose fin. Siphonal stomach; no pancreatic cæca; swim-bladder in most divided into a fore and hinder part, and connected with the acoustic organs by a chain of ossicles. The presence or absence of supplementary branchiæ varies with the genera. *Cobitis* and *Acanthopsis*, having bony coverings to the swim-bladder, ally themselves to the other *Cyprinidæ*, as *Clarias*, *Heterobranchus*, *Heteropneustes*, and

Classification—*Macropтери.* *Ageneiosus*, which have a bony capsule to the swim-bladder, do to the *Silaridæ*. This structure does not exist in all the *Cyprinidæ* allied to *Cobitis*; and in *Schistura* there is a thick-skinned swim-bladder behind the enlargement of the vertebrae. Both M. Agassiz and M. Valenciennes restrict the genus *Cobitis* to the species which want teeth.

This great family, as now restricted, comprises fresh-water fishes only. It contains a great number of species in all parts of the world, and no one has as yet made a satisfactory arrangement of them, and characterized the groups so that they can be easily distinguished. We follow M. Valenciennes in the primary grouping.

GENUS I. *CYPRINUS*, Lacép. A long dorsal, with three stiff pungent rays, the third and longest one being often denticulated on its hinder edge, resembling the rays of some *Silaroids*; anal with two strong solid rays. The under pharyngeal teeth are five, one being very large, with curved, seemingly concentric edges, and three somewhat wavy parallel enamelled ridges, separated into two by a longitudinal furrow: farther back on each side of this principal tooth there are two others, not half as big, having flat and worn crowns; before the large mesial tooth there is another rounded one, without eminences; and behind all, a fifth very small tooth. This is the dentition of the *Cyprinus carpio*, or common Carp, but the number of teeth varies with the species. Body thick, more or less high, with flat sides, and thick scales. One group (*Cyprinus*) has small barbels at the corners of the mouth; another wants them (*Cyprinopsis*, Fitzing.) Twenty species in the *Histoire des Poissons*.

GENUS II. *BARBUS*, Flem. Body fusiform. Dorsal short, with three small simple rays in front, and a fourth very strong one, like that of *Cyprinus*, sometimes denticulated, in other species smooth; two barbels in front of the maxillary joint, and two labial ones from the corners of the mouth; four in all. Pharyngeal teeth conical, elongated, and a little curved. Sixty-two species, subdivided by the smooth or denticulated rays, and the projecting or non-elongated snout.

GENUS III. *LABEOBARBUS*, Rüpp. Body elongated. Lips thick, the inferior one having a single symphyseal thick barbel, making five barbels in all, including the pair of maxillary, and pair of labial ones. A firm ray not denticulated in the dorsal, and a short anal. Three species.

GENUS IV. *SCHISOTHORAX*, Heck. Cyprinoids with a maxillary and labial barbel on each side. Dorsal and anal short; three dorsal osseous rays, the third one denticulated. Scales small; a cutaneous fold on the posterior part of the belly, clothed with larger scales, concealing the anus and greater part of the base of the anal, like a slit sheath. Mouth various, giving rise to subdivisions founded on its several kinds of form. Ten species.

GENUS V. *RACOMA*, McClell. Differs from *Schisothorax* in the projecting maxillaries; the premaxillaries form a moveable appendage to the mouth.

GENUS VI. *OREINUS*, McClell. Head fleshy; mouth vertical; mandible shorter than the premaxillaries; snout muscular and projecting. Dorsal preceded by a serrated ray. Scales small. Intestinal tube five or six times as long as the body, capacious. Mountain fish.

GENUS VII. *SCHISOPYGE*, Heck. Separated from *Schisothorax*, by the acute cartilaginous-edged mandible, and the bony ray of the dorsal, standing either before or above the ventrals.

GENUS VIII. *DANGLA*, Valenc. Remarkable for the length of the dorsal, without the anterior osseous ray, differing in the latter character only from the dorsal of *Cyprinus*: another peculiar character is the conical papillæ on the border of the upper lip, resembling small teeth; a labial and a maxillary barbel on each side.

GENUS IX. *LOBOCHEILUS*, Bleek. Between *Labeo* and *Barbus*. Border of the mouth threefold; lips smooth, not fringed, the inferior one forming a square fleshy lobe; snout prominent, fleshy. Four maxillary and labial barbels. No toothed dorsal or anal spine. *Labeo falceifer*, Cuv. and Valenc., and three others.

GENUS X. *CROSSOCHEILUS*, Bleek. Mouth inferior, with a threefold border, the orifice a parallelogram; lips crenated or fimbriated with papillæ; snout fleshy, very prominent, with two barbels. No toothed dorsal or anal spine. *Labeo oblongus*, Cuv. and Valenc.

GENUS XI. *DEVARIO*, Heck. Pharyngeal teeth knife-edged; mouth subinferior; lips round. Two barbels at the corners of the mouth, or none. Dorsal and anal fins elongated, each with a smooth osseous ray having a flexible tip. Intestine between four and five times the length of the body. Seven species.

GENUS XII. *NURIA*, Valenc. Cyprinoids with the dorsal far back like that of a Pike, short and without spines. No maxillary barbels, but a pair of labial barbels at each corner of the mouth, keeping up the number four. Thin lips. Two species.

GENUS XIII. *ROHITA*, Valenc. Four barbels round the mouth; thick fleshy lips, with their edges fringed more or less. A thick fold of skin inclosing the lips, forming above a sort of muzzle; and below a veil covering the closed mouth. Premaxillaries small,

and attached to beneath the point of the nasal, so that the mouth is protracted like a cupping-glass. When the lips are retracted they retire within the second lip or fold of skin. Intestinal canal very long. Herbivorous. Twenty-three species.

GENUS XIV. *CAPOETA*, Valenc. Intermediate between *Barbus* and *Gobio*, and containing species with a barbel at each angle of the mouth, or two in all; some with a denticulated ray in the dorsal; others with a solid ray, not denticulated; and a third group again with the ray soft.

GENUS XV. *CIRRHINUS*, Cuv. Maxillary barbels, two in all; no labial ones. A moderate-sized dorsal without spines, all the rays being flexible. Lips thin; snout not elongated beyond the mouth.

GENUS XVI. *GOBIO*, Cuv. Dorsal and anal short, without spines. Barbels labial, i.e., at the corners of the mouth. Pharyngeal teeth conical, slightly curved at the tip, and in two rows.

GENUS XVII. *TINCA*, Cuv. Thick and broad body, covered with small scales, and a labial barbel at each side of the mouth. Pharyngeal teeth clubbed.

GENUS XVIII. *LABEO*, Cuv. Snout thick and fleshy, projecting over the mouth, which is furnished with triple lips, one emanating from the preorbital and extending over the two others, a second from the maxillary, and a third the true lip below, detached so as to make a mandibular velum; a small barbel at the corner of the maxillary. Anterior dorsal rays slender and simple, the others branched and very flexible. The *Labeos*, therefore, are Cyprinoids, with the dorsal of *Gobio* or *Tinca*, but with lips approaching those of *Rohita*, and differing merely in their disposition. These fish belong entirely to the old world.

Heckel makes a group of the Cyprinoids which have these double or triple rows of lips, which he names *Pennochitæ*; and includes in it the genera *Labeo*, *Rohita*, and three characterized by himself, *Pylognathus*, *Discognathus*, and *Cyrene*.

The following genera want barbels.

GENUS XIX. *LEUCISCUS*, Valenc. The length of the anal has been given as a distinctive character of *Abramis*, and its shortness of *Leuciscus*; but M. Valenciennes, finding that there was an imperceptible gradation in the length of this fin among the species, ranges them all under *Leuciscus*, and considers generally as mere specific characters those derived from the form of the pharyngeal teeth by which Agassiz, Bonaparte, and Heckel have sought to define the numerous groups they have formed. *Leuciscus* is to be known, then, chiefly by negative characters. Short dorsal without spines; anal short or long, also without spines, and no particular conformation of the lips. In the *Histoire des Poissons* one hundred and forty species are described in eleven groups.

The following genera have been characterized by the authors whose names are given, and Dr McClelland, in his account of the Indian Cyprinidæ, has named and described numerous groups, but a revision of the entire family is needed before the proper places of these proposed genera can be found. The Prince of Musignano's *Catalogo Metodico dei Cyprinidi d'Europa* may be consulted with advantage by those who wish to master the arrangement of the Cyprinoids.

GENUS XX. *GILA*, Baird and Girard. Body fusiform, compressed, with the back more or less arched in the older fish. Head depressed, uncommonly small, its upper profile concave; snout elongated; no barbels. Pharyngeal teeth oblique, compressed in two rows, hooked at the point. Four gills.

GENUS XXI. *CHONDROSTOMA*, Agass. A horny cartilaginous plate covering the lower lip, easily detached in dead fish, but leaving the soft keel on which it was implanted. Some have labial barbels, and others maxillary barbels, and there is much variety in the pharyngeal dentition. Ten species.

GENUS XXII. *CATLA*, Agass. Maxillaries dilated, and forming thin laminae, which advance over the equally thin premaxillaries, forming a snout shorter than the mandible, whose limbs are likewise so dilated as to encase one another, and give a prominent, rounded form to the throat; when depressed the lower jaw looks like the bowl of a large spoon. The lower lips are thick and fleshy, but without barbels; and the branchial rakers are long and hair-like, and very flexible, resembling the same organs of a Clupeoid rather than of a Cyprinoid. One species.

GENUS XXIII. *ASPIDOPARIA*, Heck. Mouth small; no barbels. Suborbital scale-bones covering the cheek. Short base of the dorsal fin standing over the interval between the ventrals and longer anal; ventrals with seven divided rays; lateral line much decurved.

GENUS XXIV. *CATASTOMUS*, Forster, Lesu. Resembling the European Barbel in general form, but having neither maxillary nor labial barbels, and no bony or denticulated rays in the dorsal. Mouth under the snout, without teeth; lips large, lobed, and variously

Classification—*Macropтери.*

Classification—Malacopteri.

furrowed and papillated according to the species. The pharyngeal bones, large and semicircular, are armed with a pectinated row of compressed teeth, whose crowns are wider than their bases; and whose size decreases gradually from below upwards. Gill-covers large. Scales varying in size with the species. The intestine is long, and the air-bladder is divided into two in some, into three or even four parts in others, the foremost division having an exterior, thick, fibrous outer coat, which the others want. Twenty-two species.

GENUS XXV. RHINICHTHYS, Agass. Distinguished from other *Catostomi* by the conical elongation of the snout.

GENUS XXVI. SCLEROGNATHUS, Valenc. Mouth not quite terminal, but the snout advances less beyond it than in the *Catostomi*. The premaxillaries are suspended, as in that genus, under the cartilaginous extremity of the nasal, have long pedicels, and very short transverse processes, the rest of the orifice being formed by a fibrous ligament within a thin upper lip. The maxillary is a broad solid bone, under which the lip retires, and it is itself hidden by the broad preorbital. Lower lip narrow and thin. The structure of the mouth is that of *Catostomus*, without the fleshy development of the lips. Mucous pores as in the *Catostomi*, and also a pectinated row of pharyngeal teeth, but not so large. Air-bladder divided into two, with two small lobules behind the second. Two species.

GENUS XXVII. EXOGLOSSUM, Rafin. Body elongated, little compressed. Small scales. Anus far back. Head without scales, flattened beneath; mouth terminal; mandible short, divided into three or five lobes, and resembling a tongue. Ventrals nine-rayed, opposite to the dorsal. Pharyngeal teeth hooked, without denticulations, with a small flat crown, and in two rows. No pores on the head. Species five.

GENUS XXVIII. COBITIS, Artedi. Mouth small, edentate, surrounded by from four to eight barbels; gill-opening a vertical slit, high up; branchiostegals three. Preorbital hidden entirely by the skin, or in some prolonged into a spine, seldom followed by the other suborbitals, which are absent in most *Cobites*. No solid dorsal ray; no superior pharyngeals. Scaly fishes like all the *Cyprinidæ*.

M. Agassiz separates the species with spinous preorbitals under the name of *Acanthopsis*, and M'Clelland calls the group which have forked caudals *Schistura*; but M. Valenciennes does not consider these divisions as natural or established on important peculiarities of structure. Forty-six species are described in the *Histoire des Poissons*, in four groups.

GENUS XXIX. BALITORA, Gray. (*Platycaea*, M'Clell.; *Homaloptera*, Kuhl et Van Hasselt.) Allied to *Cobitis* by the edentate mouth, furnished with small barbels, but differing in their flatly depressed head, and in the size of the pectorals and ventrals, the bones which sustain these fins forming large plates, from which the fins spread horizontally like those of *Callionymus*. Body scaly above, naked on the ventral aspect. A short, simple, intestinal canal, with a globular stomach; no air-bladder. Seven species.

SILUROIDS.

This very large family brings up the rear of the Malacopterygians which have an air-tube to their swim-bladder (*Physostomi*, Müll.), and in fact some of the rays of their fins are firmer, stouter, and nearly as hard as the spinous rays of the *Acanthopteri*. It is indeed only when the joints of Malacopterygian rays have much length that they have great flexibility; and there are gradations of abbreviation and consolidation until the joints become nearly or wholly obsolete, and the rays as pungent as the first rays of the pectorals and dorsal of the Siluroids, which are powerful bony weapons, often strongly toothed or serrated. Yet these strong bones (which, in the fossil state, are named *Ichthyodorulites*) frequently betray their compound nature by their tips being soft, flexible, and jointed.

There are many peculiarities in the skeleton of the Siluroids, arising from the absence of some bones, and the greater development of others. The cavity of the cranium is not open laterally, as in most osseous fishes, but is closed, as in the *Cyprinidæ*, by the orbitosphenoids and the ethmoid that unite with the prefrontals, carrying forward the cranial cavity to the nasal bone without leaving a membranous septum between the orbits. The petrosal is often wanting in fishes of this family, and some do not possess even the parietal. But the supraoccipital is greatly developed, and in many, the suprascapula is united by suture to the sides of the cranium. In numerous members of the family the skull is

enlarged, posteriorly, to form a kind of helmet which spreads over the nape; the lateral angles of this production are formed by the suprascapulae, augmented and fixed by suture, and the median part is the extension of the supraoccipital, which stretches out to touch or even articulate with the osseous expansions of the anterior interneurals. The supraoccipital, which is generally very large, articulates anteriorly with the frontal, and passing backwards between the postfrontals, the parietals, the mastoids, and the suprascapulae, goes past them all on the nape. The mastoids interpose between the postfrontals and the parietals, so as to come in contact with the supraoccipital, and the parietals, but little developed, are pressed to the back part of the cranium, and in some instances wholly disappear.

The suprascapula most frequently unites to the mastoid by an immoveable suture, which includes the parietal when that bone is present, and extends even to the supraoccipital; it gives out besides two processes, one of them resting on the exoccipital and basioccipital, or wedging itself between them, and the other going to the first vertebra; sometimes a plate from the exoccipital supports that same vertebra. This vertebra, though it presents a pretty continuous centrum beneath, is in reality composed of three or four coalescent vertebræ, as we ascertain by its diapophyses by the circular elevations of the neural canal and by the holes for the exit of the pairs of spinal nerves. There is great variety in the development of the various processes of the bones we have mentioned, and there is no less in the magnitude and connexions of the first three interneurals.

In general, in the species which have a strong dorsal spine, the second and third interneurals unite to form a single plate, named in the *Histoire des Poissons* the "buckler," and which is usually more or less crescentic in shape; the great spine is articulated to the third interneural, and there is only the vestige of a spine on the second interneural in form of a small oval bone, forked below, whose function is to act as a bolt or fulcrum to the great spine when the fish wishes to use it as an offensive weapon. The great spine itself is joined by a ring to a second spine which belongs to the third interneural. This articulation by ring exists in *Lophius* and a few other fishes not of this family.

The first interneural does not carry a ray, and it varies much in the species whose helmet or casque is continuous with the buckler, as in many of the *Bagri* and *Pimelodes*. In these cases the supraoccipital, extending backwards, conceals the first interneural, passing over it to touch with its point the buckler formed by the second and third interneurals. In other instances, as in *Synodontis* and *Auchenipterus*, the supraoccipital and second interneural, forking and expanding, inclose and join themselves to the first interneural, but leave a larger or smaller space in the middle of the nuchal armour which they contribute to form. When the point of the supraoccipital does not reach quite to the second interneural, the first interneural remains free from connection, and occasionally shows us a narrow plate, interposed between the other two; in such a case the helmet is not continuous with the buckler. The neural spines of the coalescent centra which form the apparently single first vertebra, concur also in sustaining the nuchal plate-armour and the first great dorsal spine; they carry the interneurals, are joined to them by suture, and one of them is often inclined towards the occiput to assist in sustaining the head; in fact, this part of the skeleton is constructed to give firm mutual support.

The scapular chain of the Siluroids is also formed to give the resistance to the strong weapon with which it is armed. The suprascapula, as we have said above, is often united by suture to the cranium, and it obtains support below by one or two processes that are fixed on the basioccipitals and exoccipitals, and upon the diapophysis of the first vertebra: *no scapula* is ever present; it is between the two arms

Classification—Malacopteri.

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copteri.

Classification—
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copteri.

of the suprascapula that the top of the coracoid is fixed. In most osseous fishes the coracoid completes the lower key of the scapular arch in joining its fellow by suture or synchondrosis without the intervention of the radius; but in the Siluroids the radius descends to take part in this joint, and sometimes even to occupy the half of the suture, which is not unfrequently constructed of very deep interlocking serratures. The solidity of this base of the pectoral spine is further augmented by the intimate union of the radius and ulna, which often extends to junction by suture, or even to coalescence; and these bones, moreover, give off two bony arches,—the first, a slender one arising from the salient edge of the radius near the pectoral fin, and going to the interior face of the ulna that is applied to the interior surface of the ascending branch of the coracoid; this process is analogous to one in the *Cyprinidæ* where it is a separate bone: the second and broader supplementary arch does not exist in the *Cyprinidæ*, and is often perforated by a large hole; it also emanates from the same salient edge of the radius, but proceeds in an opposite direction to the inferior edge of the coracoid, a little before the insertion of the pectoral spine. These two arches give attachments to the muscles that move this spine; in the *Synodontes* and many *Bagri*, the upper arch remains in a cartilaginous or ligamentous condition; while in *Malapterurus* it is the lower arch that does not ossify, but both are fully formed in the *Siluri* and many other Siluroids more closely allied to that typical genus. The *epicoracoid* is also wanting in the Siluroids (Nos. 49, 50, figs. 10 and 15.) The pterygoid and entopterygoid (25, 24, *id.*), are reduced to a single bone, and so are the epitympanic and pretympanic: the mesotympanic (31) is wholly wanting, and the palatine is merely a slender cylindrical bone. The suboperculum is likewise constantly absent in all the Siluroids. This long anatomical detail has been extracted from the *Histoire des Poissons*, because without it descriptions of this peculiar and interesting family could not have been understood.

The Siluroids have no true scales, though some of them (*Doras*) have the lateral line armed with bony plates, and in others (*Callichthys*) these biserial plates are developed so as to incase the entire body. There are also varieties of external structure similar to those which occur in other large families of fishes, such as the different positions of the fins, and even the entire absence of certain of these members in some groups. Many of the Siluroids are fresh-water fishes which attain a great size, and they are what are called ground fishes, and remain habitually at the bottom of the pieces of water that they inhabit. In the genus *Silurus*, as well as in *Pimelodus*, the choroid vasoganglia and pseudo-branchiæ are both absent. *Silurus glanis*, L., is the largest of European fresh-water fishes, and the only one of this extensive genus inhabiting the Continent. It is smooth, greenish black, spotted with black above, and yellowish-white beneath. The head is large, with six barbels. It sometimes attains the length of 12 or 15 feet, and the weight of 300 or 400 lbs. As this creature is somewhat unwieldy in its motions, it does not pursue its prey, which consists of small fishes, but lies concealed among the mud, and seizes such unwary stragglers as happen to come within reach. The fishermen of the Spree say that they always take the largest fish of this kind in a thunder-storm. Insects are the best bait for the younger ones. It has occasionally been observed in the sea, but always near the mouths of rivers. Gronovius and Temminck both authenticate its occasional capture in the salt water. The flesh is fat and sweet, and its lard has been employed in some places as a substitute for that of the hog. Sir Robert Sibbald, at the conclusion of his list of river fishes, adds *Silurus sive Glanis*; from which it has been inferred that this gigantic species may, at one period, have inhabited the Scottish

ivers; but this fish is a stranger to the waters of France, Spain, and Italy, as well as to England, which furnishes a strong argument against the conclusion that has been drawn from the sentence in Sibbald, unsupported as it is by any reference to accounts of its capture in Scotland. In fact, it is in the western European rivers that it is common, in the Elbe to the north, and the Danube on the south, and in the rivers still further west; and it is one of the fishes brought to the market at Constantinople. It occurs in the Scandinavian peninsula but rarely. In the rivers that fall into the Caspian it is very common, but it is a stranger to all the Siberian rivers which flow towards the Arctic Ocean. It is undoubtedly the *Glanis* of Aristotle.

The Synodonts of all the Siluroids that possess an adipose fin are the most remarkable for the armature of the head and nape, as they are also for their peculiar dentition. They are either destitute of parietals, or these bones at an early period of the life of the fish coalesce with the suprascapulæ. The suprascapulæ extend to the sides of the supraoccipital, but this latter bone goes still further backwards to join the second interneural plate; embracing, in conjunction with it, the plate of the first interneural, as we have mentioned above. The process of the suprascapula which rests on the basioccipital descends lower, and expands into a thin plate, to which the anterior lobe of the air-bladder is attached. The ossicles of Weber are present in their usual form; but the first parapophysis of the compound or coalescent anterior vertebral centra reaches forward between the suprascapula and exoccipital, and then sends a thin plate downwards into the air-bladder, in which it forms a diaphragm. The coracoids and ulno-radial bones, united below by suture, expand upwards in form of a vertical plate, which constitutes a bony diaphragm, dividing the branchial from the abdominal cavity, leaving a single opening for the passage of the œsophagus. Some species of *Synodontis* have been supposed to be the Nile fishes mentioned by Strabo, under the name of *χοιπος* (*porcus*), which, according to Aristotle, are the only marine fish that are not deterred by dread of the crocodile from ascending the Nile. This Saurian does not dare to attack it on account of its strong spines. The Mugils also ascend the river, but it is under the protection of the Synodonts. The species of which Strabo speaks has not yet been clearly made out, and may possibly be a Siluroid of a different group.

The *Doras* of South America have excited attention by their habit of travelling during the dry season from a piece of water about to dry up, in quest of a pond of greater capacity. These journeys are occasionally of such a length, that the fish spends whole nights on the way; and the bands of scaly travellers are sometimes so large, that the Indians who happen to meet them fill many baskets of the prey thus placed in their hands. The Indians suppose that the fish carry a supply of water with them, but they have no special organs like the *Anabas*, and can only do so by closing the gill-openings, or by retaining a little water between the plates of their body, as Mr Hancock supposes. This gentleman adds, that both the *Doras* and *Callichthys* make regular nests, in which they cover up their eggs with care, and defend them, male and female uniting in this parental duty until the eggs are hatched. The nest is constructed at the beginning of the rainy season of leaves, and is sometimes placed in a hole scooped out in the beach. The *Callichthys* differ in many parts of their skeleton from other Siluroids, and their cranium does not owe its breadth to the expansion of the supra-temporals, but to the development of the three frontals, and the coalescence of a piece of the mastoid and suprascapula. These fish, like the *Doras*, travel in search of water, and sometimes bury themselves in the mud of wet meadows, where they are often captured by the natives, who dig them

Classification—Malacopteri.

out. The *Callichthys* are monogamous, both male and female remaining by the side of the nest, and watching it carefully. A specimen of the nest, spawn, and fish, exists in the College of Surgeons of London.

Arges, *Brontes*, and *Astroblepus*, are three forms of Siluroids of exceeding interest. They are some of the small fishes which issue from the bowels of the active volcanoes of South America, and are carried into the plains beneath by the torrents of muddy water, which these mountains vomit forth. They issue from Cotopaxi, Tungurahua, Sangay, Imbaburu, and Cargueirazo, a phenomenon first properly communicated to the scientific world by the illustrious Humboldt. They are expelled from craters or from lateral openings, always 16,000 or 17,000 feet above the sea, and the plains themselves into which these clayey streams descend, lie at least at half that height. Humboldt ascertained, by consulting the records of the neighbouring towns, that in 1691 Imbaburu threw out myriads of these fish in the neighbourhood of the city of Ibarra, and has continued to do so down to a late period. Cotopaxi also covered the estate of the Marchèse di Salvatègre with so large a quantity of these subterranean Siluroids, that the odour of their decaying bodies spread far and wide, so much so indeed, that the pestilential fevers which then prevailed were attributed to these putrid exhalations. In the eruption of 1698, when the peak of Cargueirazo fell in, vast quantities of these fish were brought down by the muddy and smoking streams which the mountain poured forth. M. Humboldt has proposed many questions bearing on these facts, without offering a solution. What streams of water, or what lakes exist in the cavernous recesses of these mountains? How does it happen that water submitted to so high a temperature retains air enough to support the life of such multitudes of fishes? How do animals with flesh so soft escape being cooked as they pass far, and for a long time, through the smoke which envelopes the streams of mud that issue during the eruption? These fish are called in the country *preñadillas*, a name not confined to a single species. The one that Humboldt specially described is the *Arges cyclopus*, originally named by him *Pimelodus cyclopus*.

In *Clarias* the nape is not armed, and the development of the bones of the head is lateral; the suborbitals, which, in the rest of the family, are mere slender tubes, in this genus give extension to the helmet, and the supratemporals which, in most fishes are very small, and in the greater number of Siluroids are imperceptible, here become enormously large, and coalesce on the sides of the cranium, with the prefrontal, frontal, postfrontal, and mastoid. An apparatus for holding water in the vicinity of the branchiæ exists in this genus, and its near allies analogous to that of the *Anabasidæ*. The *Clarias anguillaris* of Hasselquist has been by some writers on Egypt considered to be the *Alabes* of Strabo, cited by Archestratus, as one of the sacred fishes of the Nile. It is now known on the banks of that river by the name of *Harmouth*, or, as Sir Gardner Wilkinson writes the word, *Karmoot*. It was either worshipped, the latter author says, in the Thebaid, or was connected with one of the genii of the Egyptian Pantheon, who appears under a human form, with the head of this

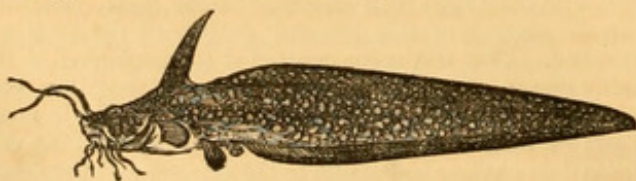


Fig. 85.

Plotosus microceps.

fish in the sculptures of the Diospolite tombs. In Lower

Egypt the *Karmoot* was caught for the table; but there is no evidence of its having been eaten in the Thebaid, which may be an argument in favour of its sacred character.

Plotosus is a genus of the Siluroid family which frequents the seas of southern Asia and the eastern coasts of Africa, and from thence southwards to Australia, where there are several species. One of these, *Pl. microceps*, is represented by the annexed woodcut, and the lips by figure 50.

Aspredo differs greatly from the rest of the Siluroids, and from other osseous fishes, in the rudimentary and immoveable condition of its gill-flaps, the three pieces that generally perform the office of a valve to the gill-openings being mere vestiges confluent with the preoperculum in such a way, that the opening and closing of the aperture does not depend on the tympanico-opercular apparatus. The mouth likewise is peculiar, the premaxillaries being articulated longitudinally, so that the orifice is a slit in the axis of the fish, with teeth in its posterior part only. Some curious sucker-like appendages are formed on the females at certain times by the expansion of pores and development of filaments on their edges. These are not found in the males. Bloch named a species *Cotylephorus* which had these organs, and McClelland has characterized a genus chiefly by their existence. Their presence, however, appears to be temporal, and to extend to the females of all the species.

Malapterurus electricus, Lacép. The electric powers of this fish were noticed by Adanson in 1756, but in Purchas' *Pilgrims*, there is a much earlier account of it extracted from the narrative of Baretus and Oviedo, dated 1554. It is there said, that there exists in the Nile a fish (called by Purchas a *torpedo*), which, if held in the hands, causes on the slightest movement a severe pain in all the arteries, nerves, and joints of the body. In the same work Richard Jobson is reported to have perceived in the River Gambia a fish like an English Bream, but thicker, which, on one of the sailors taking hold of, he instantly cried out that he had lost the use of his hands and arms. Another sailor, on touching the fish with his foot, felt his legs benumbed. This was in 1620. As the *Malapterurus* abounds in the Nile and in Senegal, and the *torpedo* has no resemblance to a Bream, the former was doubtless the fish to which Purchas alluded, notwithstanding his use of the name *Torpedo*. Rudolphi¹ has given a detailed description, with figures of the electric organs of this fish. In the great work on Egypt by Geoffroy (Pl. XII., 2), there is the figure of a *Malapterurus* opened to show the viscera, but by a singular inaccuracy the fish is represented as scaly; now there are no scales whatever on this fish, and no fish known to possess electric powers has either scales or spines. The *Torpedo*, the *Gymnotus*, and the *Malapterurus*, have all naked skins. The *Tetrodon electricus* is also destitute of spines on the skin, though all its congeners have skins as bristly as those of a hedgehog.

M. Valenciennes, examining the electric organs of the *Malapterurus* with a full knowledge of what had been previously observed by Geoffroy and Rudolphi, describes it as being composed of a thick layer of spongy cellular tissue, lying immediately under the skin, and framed of thin interlacing leaflets, filled with a gelatinous fluid, and lined on its internal face by a silvery aponeurosis to which it adheres strongly. This aponeurosis extends from the forehead and the gill-openings to the posterior end of the anal, and is divided into lateral halves by a membranous raphe that appears on the dorsal and ventral aspects. Under this aponeurosis run the great vascular and nervous trunks, whose branches pass through it, to be expended on the cellular tissue. Then beneath this aponeurosis there is a peculiar membrane which forms the subject of Rudolphi's *Memoir*. It consists of at

Classification—Malacopteri.

¹ Ueber den Zitter-wels, Abh. Berl. Acad. vii.

Classification—Malacopteri.

Classification—Malacopteri.

least six layers, readily separable the one from the other, as well as from the subjacent muscles, to which it is attached merely by a loose and scanty cellular tissue. These aponeurotic layers extend to the caudal. They are thin, dense, and can be stretched under the finger; their external surfaces become flocculent when they imbibe water. These flocculi resemble moist cotton, and when examined with a high microscopic power, present a felt-like interlacement of extremely minute fibrils. The tunics receive from their interior sides filaments of the same nerve (*par vagum*, Rudolphi) which runs under the aponeurosis. There are other filaments also of extreme tenuity, which penetrate the six layers to expend themselves on its interior surface; these spring from the intercostals. In thus deriving the nervous energy of its electric organs from the "vagus" and from the "rami ventrales" of the spinal nerves, as well as in possessing the cellular apparatus of the *Torpedo* and the laminated membranous one of *Gymnotus*, the *Malapterurus* combines the characters of these two genera in its peculiar organ. In the *Edinburgh Philosophical Journal* for 1856, Mr Murray gives a good figure of a species of this genus from the Bight of Benin. The Arabs, fully appreciating the nature of the benumbing powers of the *Malapterurus*, name it *Raad* or *Raasch* (thunder). The fish gives its discharge when touched on the head, but is powerless when held by the tail, and in fact the electric organ does not reach the caudal fin. In giving a shock it moves the tail however, as it must do when the muscles of the body are acting. A fish of only seven inches in length can give a vigorous discharge. The fish is eaten, and it is one of the most esteemed Siluroids as an article of diet.

M. Valenciennes considers *Trichomycterus* and *Eremophilus* as forming a link between the Siluroids and the Cyprinoids, through *Cobitis*; indeed, he was long in doubt as to which family they actually belonged, and he has been led to assign them a place among the Siluroids chiefly by the absence of subopercula. The want of an adipose fin weighed less with him, as this member is wanting also in some Siluroids; neither does he consider the absence of ventrals of sufficient importance to exclude a genus from a family group. *Trichomycteri* were found by Mr Pentland in the rivulets which fall into that vast alpine sheet of water, Lake Titicaca, which is frequented by the Cyprinoid *Orestias*, also an apodal, and in the affluents of the Apurimac, one of the sources of the Amazon. He discovered them also in Rio de Guatanai, Rio de Pontezualo, and in Lake Compucila, on the Andes, to the west of Cuzco, and at an elevation of 14,000 feet. *Eremophilus* inhabits the waters of the Valley of Bogota, 8500 feet above the sea level.

FAMILY XVIII.—SILURIDÆ, Agass.

Skin naked, or covered with bony shields, without scales. Pre-maxillaries forming the border of the upper jaw, the maxillaries being reduced to mere vestiges, or elongated into barbels; all have barbels; suboperculum wanting. Epicoracoid wanting, or reduced to a mere process of the coracoid. The postfrontal or temporal apparatus has two ossicles less than in most osseous fishes; the pseudo-branchiæ are wanting. The swim-bladder is present in the majority, and is connected by a chain of ossicles with the acoustic organ; no pancreatic cæca; stomach cæcal. In most the first pectoral ray is very strong and serrated; most have an adipose fin upon the back. Branchiostegals nine to eighteen.

ANALYTICAL TABLE OF THE SILURIDÆ (Dum.)

Dorsal, single (<i>Siluroïdes</i> , Dum.)	
Dorsal, containing bony rays.	
Dorsal extending along the whole back, CLARIAS	33.
Dorsal short, with	
Its spinous ray close to the skull.....TRACHELOPTERUS	24.
Its spinous ray on the back.	
Caudal forked.....SCHILBES	2.
Caudal roundedBRONTES	31.

Dorsal sustained by branching rays.	
Eyes lateral.	
Eyes conspicuous.....SILURUS	1.
Eyes scarcely visible.....CETOPSIS	3.
Eyes on the dorsal aspect.	
Tail slender, tapering, trenchant.....ASPEDO	37.
Tail tapering little.....SACCOBRANCHUS	35.
Dorsal on the tail, without bony rays.....MALAPTERURUS	40.
Dorsals two (<i>Dipteronotes</i> , Dum.)	
Second dorsal with bony rays united to the caudal.	
Head protected by a bony helmet.....CHACA	38.
Head clothed with soft skin.....PLOTOSUS	36.
Second dorsal with one bony ray, not united to the caudal.	
Head helmeted; body cuirassed; barbels...CALLICHTHYS	29.
Second dorsal destitute of bony rays; body naked.	
Snout elongated.	
Snout round; lateral line keeled, } DORAS	28.
spinous.....	
Snout broad, flat, arched.	
Eyes lateral, level with the nostrils.....	
trils.....	
Eyes depressed below the nostrils...HYPOPHTHALMUS	25.
Snout short.	
Head covered by a bony helmet.	
Dorsal long; body very long.....HETEROBRANCHUS	34.
Dorsal long; body abbreviated.....SYNODONTIS	27.
Dorsal short; barbels.....BAGRUS	4.
Dorsal short; no barbels.....SILUNDIA	9.
Head naked.	
Caudal round at the end.....PIMELODUS	16.
Caudal forked.	
Barbels more than four.....GALEICHTHYS	7.
Barbels two only.....DIPLOMYSTAX.	
Barbels none.....AGENEISOSUS	26.

OBS.—Dumeril includes *Arius*, No. 13; *Phractocephalus*, No. 5; and *Pangasius*, No. 8, under the genus *Bagrus*, No. 4; and he omits from his table *Astroblepas*, No. 32, and *Eremophilus*, No. 43, together with several other genera characterized by Valenciennes. His genus *Diplomystax* is founded on *Arius papillosus* and *A. raninus* of the *Histoire des Poissons*; and he has instituted a genus *Conostomus* for the reception of the *Pimelodi* that have elongated conical muzzles terminated by a small mouth; and which have moreover very small adipose fins. *Macrones*, another of his genera, embraces several *Bagri* with long slender muzzles, and an adipose fin longer than the anal, together with a very long scaleless body.

GENUS I. SILURUS, Linn. Dorsal short on the fore part of the back, without sensible spines; no adipose fin; a long anal. Raduliform or card-like teeth on the jaws, and a band of vomerine ones behind the premaxillaries. Some have four barbels, and some only two. Sixteen species.

GENUS II. SCHILBES. A strong, denticulated dorsal spine, elevated nape, broad depressed head, greatly compressed body, and very distinct teeth. Barbels eight. Branchiostegals eight to ten.

GENUS III. CETOPSIS, Agass. Eyes almost imperceptible, being nearly covered by skin. Six barbels. One dorsal composed of soft rays. Convex, obtuse, truncated head; moderate mouth; single row of teeth on the mandible and front of the vomer; a band sometimes on the premaxillaries. Gill-opening a small hole; branchiostegals ten.

GENUS IV. BAGRUS, Cuv. and Valenc. (*Mystus*, Artdi.) A rayed dorsal with spine, and an adipose one; a pectoral spine. A band of villiform or card-like teeth on the premaxillaries, behind which, on the roof of the mouth, there is a second arched villiform band, or a single row of teeth, not separated in the middle. They are divided into groups according to the number of their barbels, and subdivided by the forms of the head, the lengths of the adipose or anal, and variations in their dentition. Sixty-one species are described in the *Histoire des Poissons*. In *Bagrus filamentosus* the air-bladder is divided by a septum, in which there is no opening; and in other species, the lateral compartments are subdivided by transverse septa.

GENUS V. PHRACTOCEPHALUS, Agass. (*Siraraci*, Spix.) Incomplete osseous rays, encased in the upper border of the adipose fin. A flat head, with a deeply sculptured bony casque; and an expanded transversely oval shield before the dorsal, free, and altogether detached from the bones of the skull. Nine branchiostegals; six barbels round the mouth.

GENUS VI. PLATYSTOMA, Agass. (*Sorubim*, Spix.) Snout depressed. Branchiostegals numerous. A transverse band of teeth, but more completely divided by the smooth median line of the vomer into two plates on each side, than in the *Bagri*. Thirteen species.

GENUS VII. GALEICHTHYS, Valenc. Head rounded, skinny,

Classification—Malacopteri.

and without a conspicuous casque. First dorsal ray elongated into a flat cutaneous filament. The palatine teeth a narrow band divided by smooth lines into four patches. Branchiostegals six; four or six barbels. Five species.

GENUS VIII. PANGASIUS, Valenc. Four short barbels; no prolongations of the fin rays. Ten branchiostegals. Air-bladder divided into four parts by three contractions. One species.

GENUS IX. SILUNDIA, Valenc. A small smooth head, like that of *Schilbes*. Very small adipose fin; long anal. Only two small (maxillary) barbels; teeth of the jaws hooked, and longer than in other *Siluridæ*; a transverse band in front of the roof of the mouth, as in *Bagrus*. Twelve branchiostegals. Two species.

GENUS X. SCIADES, Müll. and Trosch. A cross band of palatine teeth, and behind them two clusters.

GENUS XI. ARIODES, Müll. and Trosch. Palatine teeth forming two separate patches, and sometimes farther back a single tuft only.

GENUS XII. EUTROPIUS, Müll. and Trosch. One confluent band of teeth on the vomer and palatines. Head small; nape high; the head and adjoining part of the body compressed near the dorsal aspect. Tail long and high, strongly compressed. Anal long; adipose fin very small.

GENUS XIII. ARIUS, Valenc. Teeth on the roof of the mouth disposed in two widely-separated plates, supported for the most part by the palatines only, but in some species encroaching on the angles of the vomer. Branchiostegals five to eight, rarely ten to twelve. The teeth may be villiform or pavement-like, the passage to the pavement-like teeth being gradual; some species have the ordinary nuchal armour of a triangular (interparietal, Cuv.) supraoccipital plate, with the apex truncated, and a small crescentic interspinal plate; others have a very large separate supraoccipital disk, and the barbels vary in number. On combinations of these diversities of structure several groups are established in the *Histoire des Poissons*, in which fifty-one species are described. Air-bladder in some divided lengthwise into two separate sacs.

GENUS XIV. OSTEOGENEOSUS, Bleek. A rayed and an adipose dorsal fin. Conical, acute, curved, crowded teeth on the premaxillaries, and mandibles in many rows; palatine teeth in two oblong arched plates in the fore part; the mesial line of the roof of the mouth smooth; eyes far back. Two premaxillary barbels, bony and rigid. Branchiostegals five. Head cuirassed; gill-openings extremely narrow. Indian Archipelago.

GENUS XV. BATRACHOCEPHALUS, Bleek. Dorsal fins two, the hinder one adipose. Thick, cylindrical, premaxillary and mandibular teeth in many rows; vomer and mesial line of the roof of the mouth smooth; a few crowded cylindrical teeth on the anterior angles of the palatine bones; eyes above. Head cuirassed; no barbels. Five branchiostegals. Indian Archipelago.

GENUS XVI. PIMELODUS, Lacép. Roof of the mouth smooth, edentate. Barbels six or eight. Some species want the casque; others possess it; it is sometimes continuous with the buckler of the first osseous ray of the dorsal; sometimes distinct and not continuous. Forty-three species are described in the *Histoire des Poissons*.

The following two genera have been published since the date of that work:—

GENUS XVII. RITA, Bleek. Dorsals two, the posterior one adipose. Conical teeth in the upper jaw pluriserial; mandibular teeth conical in the anterior rows, granular in the posterior ones; vomerino-palatine teeth granular, disposed in two oblong patches in the fore part of the palate. Branchiostegals eight or ten; barbels six, fleshy, belonging to the nose, premaxillaries, and mandible. Ventrals eight-rayed. (*Arius rita*, Cuv. and Valenc.)

GENUS XVIII. BAGARIUS, Bleek. Dorsals two, the posterior one adipose. Barbels eight, on the jaws bony, rigid; upper jaw teeth pluriserial, acute, placed in a curved quadripartite band; mandibular teeth biserial, with an interior series of canines at the symphysis only; no teeth on the vomer, palatines, or entopterygoids. Branchiostegals twelve. Rays of the ventrals six. No air-bladder.

GENUS XIX. EUANEMUS, Müll. and Trosch. Narrow gill-openings. Body laterally compressed. Cranium covered with skin. Card-like teeth in one band on the upper and under jaw; none on the vomer or palatines. First ray of the dorsal and pectoral fins spinous; dorsal fin wholly anterior and small; a very small adipose fin; rays of the ventrals much more numerous than in other *Siluridæ*. Eyes covered with skin. Barbels six. One species *E. columbetes*.

GENUS XX. KETENGUS, Bleek. Dorsal fins two, posterior one adipose. Cuneiform uniserial teeth on the premaxillaries and mandible; vomer and palatines smooth. Head cuirassed; eyes superior. Five branchiostegals; four fleshy barbels. Strait of Madura.

GENUS XXI. CALOPHYSUS, Müll. and Trosch. No palatine teeth; a row of stronger teeth on the upper jaw and mandible, behind

which, on the one or the other, a row of smaller teeth. The end of the first dorsal and pectoral ray simply jointed, not denticulated; a long adipose fin. Six barbels; narrow gill-opening; seven branchiostegals. A very small swim-bladder, which is bordered behind with an elegant fringe of caecal processes. Two species.

GENUS XXII. ERETHISTES, Müll. and Trosch. Narrow gill-openings. Head big, broad, pointed anteriorly, rough. Besides the occipital process there is always another like it. The scapular girdle has a long bony process above the pectoral, and another beneath it; mouth small. Card-like teeth in the upper and under jaw; none on the palatines. A moveable spine forming the first ray of the dorsal and pectoral fins; an adipose fin; anal small.

GENUS XXIII. AUCHENIPTERUS, Valenc. Siluroid with an adipose fin. Head small; teeth almost imperceptible. Branchiostegals five; no teeth on the roof of the mouth. Dorsal very far forward, or on the nape. Casque united by suture with the dilated bucklers of the first and second interspinals covering the nape to the dorsal, as in *Doras* and *Synodontis*. Seven species.

GENUS XXIV. TRACHELYOPTERUS, Valenc. No adipose fin, yet allied to *Schilbes* and *Pimelodus*. Barbels six. Villiform teeth on the jaws, none on the roof of the mouth. A solid, osseous casque, united, as in *Auchenipterus*, and coming near the dorsal, owing to the shortness of the supraoccipital plate, and the completely obsolete chevron. Pectorals attached under the throat. One species.

GENUS XXV. HYPOPTHALMUS, Valenc. An adipose fin. No teeth; eyes near the ventral aspect. Fourteen branchiostegals. Dorsal fin small, well back, with a bony ray; a strong ray in the pectoral also; ventrals small; anal long. Six barbels. Three species.

GENUS XXVI. AGENEIOSUS, Lacép. Maxillary barbels only, and very short; in one species denticulated and resembling horns. Eyes depressed as in *Hypophthalmus*. Branchiostegals eleven. A bony ray in the dorsal and pectoral; a moderately long anal. Three species.

GENUS XXVII. SYNODONTIS, Geoffroy St Hilaire. Remarkable among the Siluroids having an adipose fin, for the arming of the head, which shows much affinity with that of *Auchenipterus* and *Doras*. Supraoccipital plate large, united by a long transverse suture with the greatly dilated interneural buckler, which is further prolonged along the base of the dorsal by its junction with three interneural plates; very wide strong pointed coracoids attached to the suprascapulars which form the lateral angles of the helmet. Enormous strongly-toothed pectoral spines; a high pointed and trenchant dorsal spine. Snout short, terminated by the nasal which supports very small premaxillaries covered with finely villiform teeth. Mandible composed of two short slender limbs, and carrying in front a bundle of teeth that, individually, are very thin lancets, each supported on a stalk as fine as a hair, and terminated by a small recurved and gold-coloured hook. This dentition resembles that of *Salarias*.

GENUS XXVIII. DORAS, Lacép. *Pimelodi* with the lateral line cuirassed by keeled bony plates, each ending in a spine. Head armed as in *Auchenipterus*, and the coracoid similarly formed. The very thick dorsal and pectoral spines are strongly toothed. In some the snout is depressed, and the mouth at its extremity is furnished with two broad villiform bands of teeth on the jaws; in others, the mouth is a round hole under a conical snout, and having small groups of mandibular teeth only. Ten species.

GENUS XXIX. CALLICHTHYS, Linn., Gronov. *Pimelodi* cuirassed on the lateral line like the *Doras*, and with an adipose fin; but the lateral shields are narrow, embrace the whole height of the fish, and form two rows, somewhat tiled and crossing in the middle. Head covered with a helmet; mouth small, almost toothless; two barbels at each corner of the mouth. Three branchiostegals. Dorsal and pectoral spines often feeble. No air-bladder; intestine frequently doubled back; stomach globular and small. Ten species.

GENUS XXX. ARGES, Valenc. Teeth bifid, and slightly curved at the points, ranged in rows on the jaws and producing a sort of harrow which no other Siluroid, nor any other fish, is known to possess. Roof of the mouth smooth and edentate; two maxillary barbels, and papillæ at the nostrils. First dorsal small, with a weak ray in front; adipose fin long; ventrals well forward. Four branchiostegals. Two species.

GENUS XXXI. BRONTES, Valenc. An *Arges* without the adipose fin. No casque. Eyes, two minute points on the top of the head. Branchiostegals four. One species.

GENUS XXXII. ASTROBLEPUS, Humb. An *apodal* resembling otherwise, externally, *Brontes*; having a depressed head; eyes above. A single dorsal; no adipose fin. First rays ending in filaments. Four branchiostegals. One species.

GENUS XXXIII. CLARIAS, Gronov. Helmet extending to the temples and cheeks; the supraoccipital point more or less rounded, in some semicircular. Nape exposed; no predorsal buckler. Teeth on the jaws and arc of the vomer. Head depressed, obtuse. Body long; caudal truncated. Anal long and low; dorsal without

Classification—Malacopteri.

Classification—Malacopteri.

Classification—Malacopteri.

a spine running along the whole back; its posterior half sometimes replaced by an adipose fin. Pectoral spine small. Branching appendages for holding water attached above the branchiæ; air-bladder divided. Fourteen species.

GENUS XXXIV. HETEROBRANCHUS, Geoff. Dorsal shorter than in *Clarias*, the rest of the back being occupied by an adipose fin; caudal rounded. Head broad and flat; supraoccipital process of the helmet rounded. Short, fine, crowded villiform or bristle-like teeth on the jaws and arc of the vomer; a complex suprabranchial apparatus. Six barbels. Three species.

GENUS XXXV. SACCOBRANCHUS, Valenc. Helmet like *Clarias* and *Heterobranchus*. Villiform teeth on the jaws, and two arched dental plates on the vomer; a complex suprabranchial apparatus. Small dorsal far forward; long anal. Seven branchiostegals; the branchial reservoir different in form from that of *Clarias* or *Heterobranchus*. Eight barbels. One species.

GENUS XXXVI. PLOTOSUS, Lacép. An elongated body, ending in a compressed pointed tail. No hard helmet, the smooth rounded depressed skull being covered with soft skin. Lips fleshy; strong conical teeth on the jaws; pavement-like teeth on the vomer; eight barbels. A short, higher, anterior dorsal, and a long, low, posterior one, uniting with the long anal at the point of the tail, without a distinct caudal. Small trenchant, toothed and pointed dorsal and anal spines; a cauliflower-shaped tubercle in a funnel behind the anus, of unknown use, existing in addition to the genital tubercle at the external opening of the seminal deferent canal. Nine species.

GENUS XXXVII. ASPREDO, Linn. Differ from other fish in the gill-covers being fixed and without motion, there being merely vestiges of the three opercular pieces, soldered to the preoperculum. Mouth peculiar, the premaxillaries being articulated longitudinally under the snout, and carrying teeth on their posterior edge only; and the maxillaries ending in barbels, articulated to the nasal anterior to the premaxillaries. Head flat, anteriorly. Body naked, wide at the pectoral region, tapering into a long slender tail, trenchant beneath, and terminated by a distinct small caudal. Dorsal small, high; strong, flat, serrated pectoral spines; anal long; no adipose fin; cup-shaped suckers on the ventral surface at certain times. Branchiostegals five. Six species, all American. McClelland describes five Indian fish belonging to a genus named *Glyptosternon*, which does not seem to differ from *Aspredo* in the characters that he assigns to it.

GENUS XXXVIII. CHACA, Valenc. Head broad and much depressed, as wide before as behind, thus being quadrangular; tail tapering and much compressed at the end. Two dorsals and two anals; posterior ones uniting to form a caudal at the extremity of the tail, or it may be said, caudal running forward on the dorsal aspect to above the front of the anal, and about half as far on the ventral aspect, in which point of view there would be one anal and one dorsal near the head, supported by a strong osseous first ray. Serrated pectoral spines. The chin cirrhatid by eight filaments. Air-bladder very large, composed of two lobes separated by the spinal column.

GENUS XXXIX. Sisor, Hamilt. Buch. A *Hypostomus* without lateral pieces of mail, its skin being soft; remarkable for the size of its premaxillary barbels, and the prolongation of the upper caudal ray into a filament as long as the rest of the fish. Body slender, long; the chevron in front of the dorsal three-lobed. Mouth edentate, with fourteen barbels in all. Large gill-openings; four branchiostegals. One species, which attains the length of seven feet.

GENUS XL. MALAPTERURUS, Lacép. No anterior dorsal; an adipose fin near the caudal; ventrals beyond the middle of the fish; and an anal occupying about half the distance between them and the rounded caudal; no pectoral spine. Body shaped somewhat like that of a *Cobitis* or *Galaxias*, the tail being thickish, but the head is conical and ends bluntly. Lips fleshy, with six barbels; fine villiform teeth on each jaw; none on the vomer. A short oblique gill-opening; branchiostegals seven. Stomach small, siphonal; air-bladder fusiform, pointed posteriorly with two globular lobes in front, in advance of the ossicles of Weber. Its outer coat is thick and spongy. A double electrical organ.

GENUS XLI. AILIA, Gray. A long, greatly compressed, moderately high fish, with a small head and rounded snout like a *Schilbe*. Back naked, except near the tail, where there is a small adipose fin; a very long, even anal, and forked caudal. Eight barbels. Teeth on the jaws and roof of the mouth minute.

GENUS XLII. TRICHOMYCTERUS, Valenc. Allied to *Malapterurus* by general form, the depression of the head, thinning of the snout, and construction of the cranium, but distinguished by a dorsal placed in the middle of the back, the absence of an adipose fin, and the want of an air-bladder. Branchiostegals eight. Aspect considerably like that of *Cobitis*. Six barbels, one at each anterior nostril, and a pair at the corner of the mouth on each side. Tail thickish. Fine curved teeth in a band on the jaws; palate smoothed. Three species.

GENUS XLIII. EREMOPHILUS, Humb. Closely resembling

Trichomycterus in general aspect, but apodal; connected like that genus to the Siluroids by the absence of subopercula; and to *Cobitis* by the want of ventrals. Jaws armed by a band of long villiform or bristle-like teeth. Branchiostegals eight; no scales. Siphonal stomach and long intestine; no air-bladder.

GONIODONTS.

This family has grown out of the genus *Loricaria* of Linnæus, which, as characterized by him, consisted of fishes whose bodies were mailed in hard angular plates or scales, distinguished from *Doras* and *Callichthys* by the mouth opening under the snout. Müller considers them to be a separate group of the Siluroid family, and as such they are described by Valenciennes, in the *Histoire des Poissons*. Lacépède divided the Linnæan *Loricariæ* into two groups, reserving that appellation for the species that have no adipose fin, and giving the name of *Hypostoma* to those that have a kind of adipose fin but one that is preceded by a hard bony ray. Agassiz, when characterizing and naming the family, adopted Lacépède's generic divisions, and added two others, *Rhinelepis* and *Acanthicus*. The premaxillary and mandibular teeth of the Goniodonts are composed of albuminous tissue, like the teeth of the Chætodons, and have the same elasticity.

In the *Loricariæ* the top of the skull is prolonged backwards by the extension of the supraoccipital, which forms a kind of first scale, that reaches to the two plates developed from the points of the interneurals of the first compound vertebra,—the second of the plates being the chevron, on which the spine of the dorsal stands and moves. The mastoids and suprascapulæ enlarge the sides of the skull, and form the wide osseous vault, which affords the necessary space and breadth for containing the anterior portion of the abdominal viscera. The diapophyses of the great compound vertebra are plates curved like a sabre, and are supported below by the centra, and above by a styloid process resting on the vertical occipital crest. The scapular arch is very strong and shuts up the fore-part of the abdomen by a bony septum, while the coracoids, in form of the letter V, give the firmness necessary to sustain the dermal shields and spines. The coalescent radius and ulna bent horizontally support the pectoral plates. There are only eight abdominal vertebræ, with ribs as fine as bristles, and sixteen caudal ones.

FAMILY XIX.—GONIODONTIDÆ.

Goniodontes, Agass.; *Loricarini*, aliorum. Related to the *Siluridæ*, but differing from them in possessing pseudobranchiæ, and in their intestines. Head and body mailed in hard, angular plates; orifice of the mouth on the ventral aspect under the snout, and bounded by the premaxillaries and maxillaries; long, slender, flexible teeth ending in hooks on the premaxillaries and mandible, which are separated at the symphysis; a broad, circular, cuticular fold surrounds the mouth. Gill-cover mostly immoveable; the styloid epicoracoid absent as in the *Siluridæ*, and represented by a process of the coracoid. The heart lodges in a bony capsule formed by the coracoid. No caecal enlargement of the stomach; intestine long, frequently bent; no pancreatic cæca. Swim-bladder wanting, in which they differ from the *Siluridæ*. There is much phosphate of lime in the scales.

GENUS I. LORICARIA, auct. Body depressed, broader than high. Tail very much compressed. Teeth in both jaws. A single dorsal and no adipose fin.

GENUS II. HEMIODON, Knor. Body very much depressed. Teeth on the mandible only. Premaxillaries rudimentary; toothless.

GENUS III. ACESTRA, Knor. Body elongated, nearly cylindrical. Teeth in both jaws, furnished with a transverse radical process. Dorsal and anal fins opposite.

GENUS IV. RHINELEPIS, Agass. Osseous plates resembling scales, imbricated, rough like a file. A short thick body. Lower lip often dilated into a membranous velum, and fringed with filaments. Three branchiostegals. Hooked teeth surrounding the orifice of the mouth in rows; the front ones notched at the point. A single dorsal. Three species.

Classification—Pharyngognaths.

GENUS V. ACANTHICUS, Agass. Articulated spines on the snout, cheeks, and gill-covers, like those of a hedgehog. Osseous plates on the body, crested and spinous; distinct squamiform bucklers on the belly. Teeth with a double curvature, arranged like those of *Rhinolepis*; mouth encircled by a complete velum. A single dorsal.

GENUS VI. HYPOSTOMUS, Lacép. Second dorsal analogous to an adipose fin, having an osseous ray in front. Body thick and short. Head especially large. Bony armour, like that of *Loricaria*, on the body. A large first dorsal opposed to the ventrals and anal. Pectoral spine rough, long, and strong. Branchiostegals three. Seven species.

ORDER III.—PHARYNGOGNATHS.

This order is founded on the character, common to all its members, of the lower pharyngeals being united to form one bone. In external aspect there is no similarity between the families of *Scomberesocidae* and *Labridae*, which belong to it.

ORDER III.—PHARYNGOGNATHI, Müll.

Endo-skeleton ossified; exo-skeleton in some as Cycloid, in others as Ctenoid scales; inferior pharyngeal bones coalescent. Swim-bladder without an air-duct. Ventral fins in some on the thorax, in others on the abdomen.

SUB-ORDER I.—MALACOPTERYGII.

Fins without spines.

SCOMBERESOCIDÆ.

Of this group of Pharyngognaths we may obtain a correct notion from the Garfish or Greenbones of our coasts, named also by the fishermen Mackerel Guides, because they annually come into shallow waters at the time of the Mackerel fisheries. This fish belongs to the genus *Belone* which contains many species, and among others *B. caudimacula* and *B. cancila*, which inhabit the fresh waters of the peninsula of Hindostan, and afford an instance, in addition to many others, that generic assemblages are independent of habitat, as to the species being marine, lacustrine, or fluviatile. The British seas furnish an example of the genus *Scomberesox*, also, in the Saury Pike or Skipper. The latter name is given in consequence of the habit these fishes have of leaping out of the water, which is also practised by the Belones. Some species of this genus have an air-bladder, while others want it; a remarkable peculiarity in fishes so similar in aspect, but which also occurs among the Mackerel.

The *Exocæti* or Flying Fishes have ever been an object of great interest to navigators. The monotonous and quiet voyage of a ship running before the trade-winds is enlivened by the flights of large bands of these creatures rising before the bows of the vessel, and like a flight of larks or sandpipers glittering in the sun, and often by a simultaneous impulse, changing the direct line for one nearly at right angles, before settling in their native element again. The muscular force by which this progress through the air is effected has engaged the attention of Humboldt. This illustrious and accurate observer states that the Flying Fish move by myriads constantly in a right line, and in a direction opposite to that of the waves. He doubts whether this flight be generally assumed as a means of escape from voracious fishes, and with reason. As we have noticed above, their near allies the Belones and *Scomberesoces* have the habit at certain times of leaping frequently from the water, and we have observed the same thing to occur in the spawning season among the shoals of *Malloti*, which often land themselves in numbers on the dry beach. There seems to be something in the constitution of these fishes which impels them to this movement, and the *Exocæti* are organized

to carry it to the fullest extent by the size of their pectoral fins and the power of the muscles which move them. There are some who assert that the flight of the *Exocæti* is a mere leap, resembling the ricochet of a stone skimming along the surface of the water, but the pectorals are certainly impelled against the air in the course of the flight. The bands frequently undulate in their height above the water before subsiding into it again; and, as mentioned above, it is not rare to see them change their direction, though this is not done till just before the termination of their aerial course. Their flight is rapid, greatly exceeding that of a ship going 10 miles an hour, and we are not inclined to limit it to a distance of 500 feet. It is not easy to form a correct judgment of distance under such circumstances; but having often watched their flights when in a frigate 120 feet long, it appeared to us to exceed the length of the ship many times, and its altitude was such that in the night they frequently fell on board. Many shoals, consisting entirely of small ones, from 2 to 3 inches long, showed a smaller power of sustaining themselves in the air, and more frequently glanced against the summit of the coming wave, but the larger kinds rose vigorously into the air.

FAMILY I.—SCOMBERESOCIDÆ, Müll.

Maxillaries coalescent with or adherent to the elongated premaxillaries at the corner of the mouth, under the nasal, and covered in part or wholly by the preorbital scale bone.

GENUS I. BELONE, Cuv. Upper border of the jaw formed by the premaxillaries, which, together with the mandible, are elongated into a long bill; teeth on these bones forming a narrow stripe, the interior row consisting of taller conical ones; roof of the mouth smooth (except in the species which frequents the Channel); two small patches of teeth in the upper pharyngeals, more pointed than those on the lower pharyngeals, which are short, conical, inclining to the pavement form. Gill-openings large; branchiostegals, twelve. A hard helmet, formed of the cranial bones, is variously sculptured and furrowed. Body elongated. Scales very thin, like those of *Scomber*, and not easily perceptible, except one row of keeled ones on each side. Dorsal and anal opposite each other, and far back. No pyloric cæca; large air-bladder. Twenty-six species.

GENUS II. SCOMBERESOX, Lacép.; *Sairis*, Rafin. Jaws constructed nearly as in *Belone*, but the mandible is always the longest, and the maxillary, instead of being confluent with the premaxillary, is merely in apposition; the teeth are extremely small, and uniserial on the jaws; none on the roof of the mouth or tongue. Shape of the body much as in *Belone*. Dorsal and anal far back, opposite to one another, and followed by detached finlets of variable number, according to the species. A scaly keel, as in *Belone*, but which becomes obsolete near the anal, and does not reach the caudal. No pancreatic cæca; the air-bladder present in some species is wanting in others, as in the species of *Scomber*. Five species.

GENUS III. HEMIRAMPUS, Cuv. The distinctive character of this genus is expressed by the name, and consists in the edentate, pointed projection of the mandibular symphysis, producing a kind of half bill. The upper jaw is formed by the premaxillaries soldered together, and the maxillaries joined to them at the angle of the mouth widen and form a spur which is concealed by the preorbital. A narrow band of small granular teeth exists in both jaws. In other respects these fishes resemble *Belone*, and as in that genus, the intestinal canal is straight, without pancreatic cæca. The air-bladder runs the whole length of the abdomen, between the spine and a tense arch of the peritoneum; and in the species (three) which M. Valenciennes examined, he found its structure cellular, similar to that of *Amia*. Thirty species.

GENUS IV. EXOCÆTUS, Linn. (Sub-Family, *Exocætini*, Bonap.) Recognizable at once by the large pectoral fins that are capable of being used as wings or parachutes. Head and body scaly, with a scaly keel on each flank. Head flattened above and on the sides. Dorsal opposite the anal. Eyes large. Premaxillaries without nasal pedicels, forming the border of the upper jaw; maxillary not soldered to the premaxillary, but having nearly the same position as in *Belone*, and gliding under the preorbital; jaws armed with small pointed teeth, composed of osteo-dentine, and the pharyngeals with crowded teeth, having compressed crowns and several cusps, like those of *Cyprinodon*, *Acanthurus*, and other genera. Branchiostegals ten to twelve. Intestine straight, without pyloric

Classification—Pharyngognaths.

Classification—Pharyngognaths. caeca; upper lobe of the caudal shorter than the other; air-bladder large, closed. Thirty-three species. Some have barbels, and have been made the types of separate genera.

Classification—Pharyngognaths. large tooth arched backwards, and then follow some more card-like teeth. Branchiostegals, five.

CHROMIDIDÆ.

This family is included by Müller among the Pharyngognaths with spinous rays in the fins. It is not treated of in the *Histoire des Poissons*, and the generic characters in the table are from Cuvier's *Regne Animal*, or from Rüppell's works. The members of this group agree with the Ctenoid Labroids in having only one nostril to each nasal sac.

SUB-ORDER II.—ACANTHOPTERYGII.

FAMILY I.—CHROMIDIDÆ, Bonap.

Chromides, Müll. Lateral line interrupted. Teeth villiform. One dorsal. A single nostril to each pituitary sac.

GENUS I. CHROMIS, Cuv. General aspect of *Labrus*, with their lips, protractile premaxillaries, pharyngeal bones, and the filaments of their dorsal rays; but the entire caudal and the soft dorsal and anal to a considerable height are scaly. Their teeth are disposed in two card-like bands on the jaws and pharynx, with, in front, a row of conical teeth. Branchiostegals six. Lateral line ceasing under the dorsal, and not recommencing on a lower level. Stomach caecal; two pancreatic caeca. The *Bolti* of the Nile has no pancreatic caecum, but its stomach is caecal. Its dentition is that of the Mediterranean species.

GENUS II. CYCHLA, Bloch, Schneid. Have the body more elongated than *Chromis*, and their teeth in a broad band, and wholly villiform.

GENUS III. SAROTHERODON, Rüpp. General habit of *Chromis*. Both jaws armed with an outer row of slender chisel-shaped teeth, smaller at their insertion, wider at their edges, behind which a band of brush-like teeth. Palatines and tongue unarmed; at the pharynx fine brush-like teeth, on a single three-cornered plate below, and two roundish transverse plates above. Four gills. Opercula without scales; pretty large scales on the body. Lateral line interrupted. A dorsal fin extending along the whole back, two-thirds of it supported by spines; three spines in the anal; ventrals behind the pectorals. Guinea coast.

CTENO-LABRIDÆ.

A small but very natural family separated from the *Sciænida* by their united pharyngeals, and the want of muciferous cellular structure of the bones of the skull. They are denominated in the *Histoire des Poissons* "Sciænoïdes a moins de sept rayons branchiaux et a ligne latérale interrompue;" and are there said to be beyond the bounds of the Linnæan genus *Sciæna*, and to have analogies with the Labroids. They are small fishes, of a peculiar rounded oval form, and clothed with large scales, a well-marked family likeness pervading the several genera. Their strongly ciliated scales pervade them from the true Labroids, whose scales are cycloid. They are edible, but they do not form the objects of special fisheries, not only from their want of size, but because they do not assemble together in numbers. The *Glyphisodons* and others of the family are prettily banded, and show a pleasing combination and variety of colours.

FAMILY II.—CTENO-LABRIDÆ, Müll.

Compressed oval or oblong fishes, with the head forming part of the general elliptic profile. One dorsal spinous in front; anal also spinous in front, placed with the dorsal on the posterior curve of the oval. Tail between the vertical fins short, moderately high. Scales ctenoid. Air-bladder closed, without appendages. Ovarium closed, with an excretory duct behind the anus. Cranium not cavernous in its outer walls. A single nostril to each pituitary sac.

GENUS I. CAPRODON, Schleg. Teeth card-like on both jaws, before which a row of bigger ones; the three fore teeth of the premaxillary on each side being large cutting teeth; front mandibular tooth very large, and pointing backwards; behind it one somewhat smaller; in the middle of the limb of the mandible there stands a

GENUS II. AMPHIPRION, Schneid. Body oval, compressed. A single dorsal. Lateral line terminating under the end of the dorsal. Head obtuse; uniserial, small, conical, obtuse teeth on the jaws; palate edentate. Five branchiostegals. Preoperculum, operculum, suboperculum, and interoperculum denticulated strongly, and striated on their surfaces. Air-bladder simple. Sixteen species.

GENUS III. PREMNAS, Cuv. Form that of an *Amphiprion*, with interrupted lateral line, and obtuse uniserial teeth, but the opercular pieces are less strongly toothed, and the suborbital scale-bones much more armed, producing under the eye one or two large spines pointing backwards. A few denticulations exist on the ascending edge of the preoperculum, and on the border of the suboperculum; but the opercular pieces are not strongly streaked on the surface, as in *Amphiprion*. Stomach globular, small; three pancreatic caeca; large globular air-bladder. Three species.

GENUS IV. POMACENTRUS, Lacép. Form oblong. Head obtuse; incisorial uniserial teeth. Preoperculum denticulated; operculum entire on the border, and without spines; suborbitals often toothed. Lateral line ending under the soft portion of the single dorsal; four or five branchiostegals. Twenty species.

GENUS V. DASYLLUS, Cuv. Resembling *Pomacentrus*, but the teeth, instead of being trenchant, are in a villiform band, with stronger conical ones in the outer row. Three species.

GENUS VI. GLYPHISODON, Lacép. Having a strong resemblance to *Pomacentrus*, but the preoperculum is not denticulated. Body compressed, oval, covered as well as the head with large scales. Profile rounded. Mouth small; teeth on the jaws only, uniserial, close together, narrow and straight, trenchant at the crown, and often notched. Lateral line ending under the end of the dorsal. For the most part thirteen dorsal spines (rarely twelve), each with a membranous filament at its tip; two anal spines (rarely three). Stomach very large, caecal; three thick pancreatic caeca; ovaries discharging by a tube behind the anus. Thirty species.

GENUS VII. ETROPLUS, Valenc. Oval compressed form of *Glyphisodon*. Eye more elevated than in that genus, and the suborbital scale-bone large and not scaly. Snout also destitute of scales. Dorsal (seventeen or eighteen) and anal spines numerous (eleven to thirteen). Three species.

GENUS VIII. HELIASES, Cuv. Resembling *Glyphisodon* in the oval compressed body. Small mouth. Entire or smooth-edged preoperculum. Large scales and short lateral line, and in the number of spines in the dorsal and anal, but having the teeth of *Dasyllus*. Branchiostegals five, rarely six.

CYCLO-LABROIDS.

The name *Labrus* applied to a fish is cited by Pliny as occurring in a passage of Ovid which has not been pre-

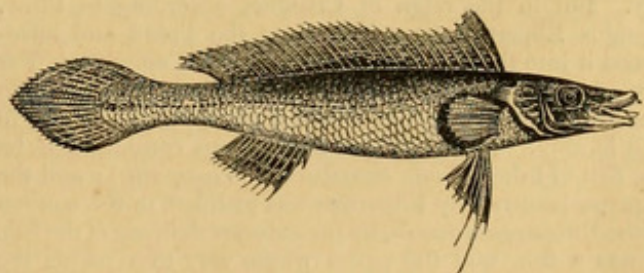


Fig. 86.
Odax lineatus.

served, and the kind of fish it was used to designate cannot now be ascertained. The name was widely and vaguely applied by modern ichthyologists until Cuvier gave the precise characters of the genus which it now distinguishes. Several species occur in the British seas; none of them prized as an article of diet. The Tautog (*Tautoga nigra*) of New York, however, is a fish in great request for the table, and sells at the rate of 8 lb. for a dollar. It is tenacious of life, and is kept in stews to fatten. In great colds it becomes torpid, and will not eat. When the dogwood (*Cornus florida*) comes into flower the Black Tautog is in season.

The *Epibulus* seizes insects by suddenly thrusting out its mouth, and engulfing those that come within the scope of the elongated tube; at least so says Renard; and the

Classification—Pharyngognaths.

accounts of this fish shooting drops of water at its insect prey, like the Chelmons, does not appear to be based on correct observation. *Scarus* was the name given by Forskäl to a group of fishes resembling the *Labri* in all their characters except in dentition, their teeth being incorporated with the substance of their jaws to form convex bones like those of the Tetraodons. The researches of Cuvier prove fully that the fish so named by the ancients was truly of this genus. It was held in high repute either for the address attributed to it of skilfully withdrawing other fishes from the nets in which they were inclosed, or because the epicures greatly esteemed its intestines, or on account of the vast expense incurred in endeavouring to multiply it on the Italian coasts, that it might administer to the extravagant luxury of the world's capital. Aristotle has several passages respecting its rumination. His assertions have been repeated by Pliny, Ælian, and others, without examination; and Ovid and Oppian have spoken of it as a matter beyond doubt, yet no one has verified the observation of Aristotle. It passed also among the ancients as a fish that had a voice; and Suidas says that it produced sounds by ejecting water in blowing, and that it could not make itself heard when it was deep in the water. Athenæus, quoting Seleucus as his authority, states that the *Scarus* is the only fish that sleeps and is never taken in the night. Ælian says that it is the most ardent in love of all fishes, and that many males may be enticed into the nets by the pursuit of a female attached to a line. But still it was the most prudent of fishes, and the most active in showing friendship for its companions. If one was caught by a hook, the others endeavoured to cut the line; or if entrapped in the meshes of a net, they tried to drag it out by the tail!

"Sic et Scarus arte sub undis,
Contextam si forte levi de vimine nassam,
Incidit, assumtamque dolo tandem pavet escam.
Non audet radiis obnixa occurrere fronte,
Aversus crebro veniens sed verbere caudæ,
Laxans subsequetur, tutumque evadit in æquor."

OID.

It was most plentiful and of the best quality in the Carpathian Sea, between Crete and Asia Minor, but was not unknown even in early times on the Italian coast, though Columella says that it seldom passed beyond Sicily in his day. But in the reign of Claudius, according to Pliny, Optatus Elipertius brought it from the Troad, and introduced it into the sea between Ostium and Campagna. For five years all that were caught in the nets were thrown into the sea again, and from that time it was an abundant fish in that locality. In the time of Pliny it was considered to be the first of fishes (*Nunc Scarus datur principatus*); and the expense incurred by Elipertius was justified, in the opinion of the Roman gourmands, by the extreme delicacy of the fish. It was a fish, said the poets, whose very excrements the gods themselves were unwilling to reject. Its flesh was tender, agreeable, sweet, easy of digestion, and quickly assimilated; yet, if it happened to have eaten an *Aplysia*, it produced *cholera morbus*. In short, there is no fish of which so much has been said by ancient writers. In the present day the *Scarus* of the Archipelago is considered to be a fish of exquisite flavour; and the Greeks still name it *Scaro*, and eat it with a sauce made of its liver and intestines. It feeds on fucus; and M. Valenciennes thinks that the necessity for masticating its vegetable diet thoroughly, and the working of it with that intent backwards and forwards in the mouth, may have given rise to the notion of its being a ruminant; and it is certain that its aliment is very finely divided when it reaches the stomach. The adjoining woodcut represents *Callyodon chlorolepis*, a fish of the Australian seas, and number 56, gives views of the teeth of the same species. Woodcut 86 is a representation

of *Odax lineatus*; and figures 25, 38, and 39, are views of

Classification—Pharyngognaths.

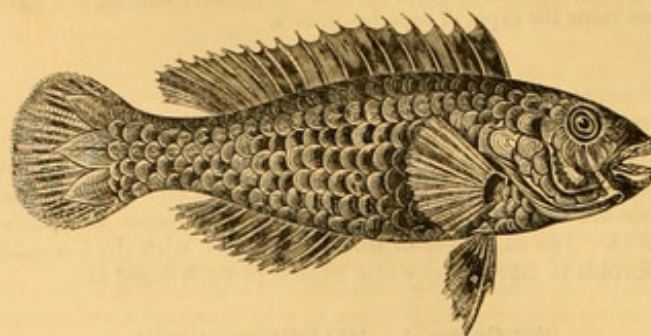


Fig. 87.
Callyodon chlorolepis.

Labroid scales. The family of *Ambiotocidae* was constituted by Agassiz for the reception of a single genus of fishes that frequent the western coasts of North America.

FAMILY III.—CYCLO-LABRIDÆ, Müll.

Oval, elliptical, or oblong scaly fishes, more or less compressed, generally with a proportionally high parallel-sided tail between the vertical fins. Scales cycloid. A single dorsal supported in front by spinous rays, which have frequently membranous processes behind their points. Jaws covered by fleshy lips; palate smooth, toothless. Three pharyngeal bones, viz., two above and one below, armed with teeth, which are in some species pavement-like, in others lamellated, and in others pointed. No pancreatic cæca; a closed, simple air-bladder; shut ovisacs, with an efferent tube behind the anus.

ANALYTICAL TABLE OF THE CYCLO-LABRIDÆ (Dum.)

Cheeks scaly; preoperculum crenulated.	
Dorsal scaly at the base.	
Mouth protactile; teeth even.....	CLEPTICUS 7.
Mouth not protractile; teeth unequal	COSSYPHUS 2.
Dorsal not scaly.	
Mouth protractile.	
Dorsal with short soft rays.	
Scales very large.....	EPIBULUS 21.
Scales of ordinary size.....	CORICUS 6.
Dorsal with long filaments	LACHNOLAIMUS 8.
Mouth not protractile.	
Teeth equal to one another.....	CRENILABRUS 3.
Teeth unequal.	
Dorsal scaly.....	ACANTHOLABRUS 5.
Dorsal not scaly.....	CTENOLABRUS 4.
Cheeks scaly; preoperculum not crenulated.	
Dorsal very long.	
Scales very large; teeth uniserial.....	CHEILINUS 18.
Scales of ordinary size.	
Suboperculum denticulated.....	MALAPTERUS 12.
Suboperculum very entire.....	MALACANTHUS 10.
Dorsal of ordinary length; rays tasselled.....	LABRUS 1.
Cheeks scaleless.	
Snout abnormal, like a beak.....	GOMPHOSUS 15.
Teeth unequal, reclining, diverging.....	ANAMPSES 14.
Teeth equally curved.....	CHEILIO 11.
Snout ordinary, pointed.	
Preorbital denticulated.....	TAUTOGA 9.
Preorbital smooth-edged.....	JULIS 13.
Snout ordinary, smooth and blunt.	
Profile curved, convex.....	XYRICHTHYS 16.
Profile descending, trenchant.....	NOVACULA 17.

GENUS I. LABRUS, Linn., Artedi. Lips large, thick, and as if double. Six branchiostegals. Upper jaw generally considerably protractile; teeth on the jaws simple, conical in one or more rows. Pharyngeals cylindrical, smooth, and rounded on the crowns. No spines on the opercular bones. Lateral line almost straight, continuous. Cheek and operculum scaly. Thirty species.

GENUS II. COSSYPHUS, Cuv. and Valenc. Maxillaries wide and thick. Behind the exterior row of pointed teeth, small, round, granular teeth crowded together. Opercular pieces scaly. Vertical fins sheathed in scales which rise and fall with the rays, but do not form so deep a sheath as those of the Percoids or Sparoids. Almost all have distinct crenatures on the ascending border of the preoperculum, but in some these appear at the angle of the bone only, and are very feeble. Fifteen species.

Classification—Pharyngognaths.

Classification—Pharyngognaths.

GENUS III. CRENILABRUS, Cuv. Upper jaw not protractile; preoperculum deeply toothed; lips thickly fleshy; teeth conical, uniserial, without the granular band of *Cossyphus*, and also without the scaly sheathing of the fins. The continuous lateral line and cycloid scales distinguish them from *Chromis* and *Cichla*. Thirty-six species.

GENUS IV. CTENOLABRUS, Cuv. and Valenc. A band of villiform teeth behind the outer row of conical teeth on the jaws. Other characters those of *Crenilabrus*, such as the finely denticulated preoperculum, three anal spines, &c. Ten species.

GENUS V. ACANTHOLABRUS, Cuv. and Valenc. Dentition of *Ctenolabrus*, but with numerous anal spines, representing the *Percoïd Centrarchus*. Six species.

GENUS VI. CORICUS, Cuv. Conical jaw teeth in one row, as in *Crenilabrus*; jaws greatly protractile, like those of the *Menida*. Premaxillaries with long pedicels, and limbs which are thrust out when the mandible is depressed. Preoperculum rounded at the corner, denticulated on the ascending border, but having a smooth lower one. Pharyngeal teeth small, round grains crowded together. Short intestine; stomach siphonal, without dilatation; no pancreatic caeca. Distinguished from *Epibulus* by its continuous lateral line; representing the Menoid *Smaris* and *Gerres*. Four species.

GENUS VII. CLEPTICUS, Cuv. Protractile mouth, withdrawing beneath the vault of the preorbitals; denticulated preoperculum; continuous lateral line. Teeth in one row, few, and very small; pharyngeal teeth lamellated, the plates serrated. Vertical fins covered in great part by scales like those of the body. One species.

GENUS VIII. LACHNOLAIMUS, Cuv. Resembles *Labrus* in the lips; in general form; in the membrane which descends from the preorbitals; in the scaly cheeks, and in the filamentous tips of the dorsal spines; but the tips of the anterior dorsal spines are flexible. Lateral line continuous. Anterior teeth strong, curved, and standing forwards, followed by a series of small teeth of even height. The pharyngeals, instead of being wholly covered with pavement-like teeth, as in *Labrus*, are only partially so, the rest of the bone being clothed with velvety membrane. No pancreatic caeca. Six species.

GENUS IX. TAUTOGA, Mit. Labroids distinguished by a double row of strong conical teeth on both jaws, and the extent of thick, scaleless integument on the face, which reaches to the operculum, suboperculum, and interoperculum, and even on the preoperculum the scales are few. Branchiostegals five. Lateral line continuous. Nine species.

GENUS X. MALACANTHUS, Cuv. Resembling *Coryphæna* in the length of the dorsal and anal, and in the rays of these fins being nearly as flexible, but allied to *Lachnolaimus* by scaly cheeks, and a continued lateral line. The proper generic character is the long dorsal, with only three or four simple rays in front, the others being branched. Body slightly compressed, long. Scales small. Anal nearly as long as the dorsal. Mouth tolerably large; lips fleshy; a row of teeth on the jaws; large, and curved in front, much smaller towards the angles of the mouth. Palate and tongue smooth; upper pharyngeal teeth card-like; under pharyngeal teeth in some species wholly card-like, in others partly so, partly pavement-like. A pretty strong spine at the angle of the operculum. Stomach siphonal; no pancreatic caeca. Two species.

GENUS XI. CHEILIO, Comm. Premaxillaries widening interiorly into a granular osseous plate peculiar to this genus among the Labroids. Exterior row of teeth triangular, compressed, and trenchant, like those of some *Sphyræna* or *Cybius*; the symphyseal pair hooked, and longer than the others, which are of equal height among themselves, and in the interspaces between all these teeth there are small conical ones. The lateral line is continuous; and there are a few scattered scales on the cheeks. Fin rays flexible. Eight species.

GENUS XII. MALAPTERUS, Valenc. Combines many of the characters of *Malacanthus* and *Cheilio*, having the flexible rays of *Cheilio*, teeth of *Labrus*, scaly operculum of *Malacanthus*, but not the opercular spine. One species.

GENUS XIII. JULIS, Cuv. Lateral line continuous; stiff and pointed spines in the dorsal. Head entirely naked, that is to say the suborbital chain, preoperculum, and other bones of the gill-cover, the under surface of the head, and the jaws, are destitute of scales. Teeth conical in the outer row, longer and stronger the nearer the symphyses; within there are some granular teeth, largest in the old fish, being indications of teeth incorporated with the bone, as in *Cheilio*, and more fully shown in *Scarus*. Some species have a canine at the corner of the mouth pointing forwards, forming the genus *Halichorus* of Rüppell. Pharyngeal teeth as in *Labrus*. One hundred species.

GENUS XIV. ANAMPSES, Cuv. Two teeth on the upper jaw, one on each side of the symphysis, turning from each other, flattened longitudinally; chisel-shaped at the crown and trenchant; the mandibular pair more conical, yet a little flattened at the point; pharyngeals of *Labrus* for bruising. Branchiostegals six. General

form that of one of the higher bodied *Julis*. Head naked. Lateral line continuous. Six species.

GENUS XV. GOMPHOSUS, Lacép. (*Helops*, Comm.) Body oblong, compressed. Scales large. Head quite naked; eye small; nostrils near the orbit; muzzle slender, elongated, cylindrical; orifice of the mouth formed by the premaxillaries and mandible. Uniserial teeth on the jaws, the anterior ones longer; pharyngeal teeth pavement-like, as in *Labrus*. Gill-covers approaching one another under the throat; gill-openings narrow. Branchiostegal membrane adherent to the isthmus; branchiostegals six. Dorsal and anal but slightly elevated, and of uniform height. Lateral line branching and deflexed near the caudal. Stomach and œsophagus straight; no pancreatic caeca; a long, narrow air-bladder. Three species.

GENUS XVI. XYRICHTHYS, Valenc. Form that of a *Labrus*, except that the profile of the face is almost vertical, with the eye high up; this is owing to the growth of the snout directly downwards, while the mandible of ordinary length is horizontal. The resulting aspect is peculiar. Many characters common to it and *Labrus* or *Julis*. Head naked, and, from compression, trenchant in the face, which is sustained by the nasal bone. Dorsal long and of uniform height. Teeth in one row, longest near the symphysis; pharyngeal teeth small, pavement-like; palate and tongue smooth. Lateral line interrupted generally as in *Scarus*, but the tubes on each scale simple. A species of double lip is formed by the edge of the preorbital, which descends to the corner of the mouth. Intestinal tube simple, without any stomachal dilatation, and without pancreatic caeca; air-bladder large, pointed anteriorly, rounded behind. Fourteen species. Two species have the three front rays detached as a separate fin, and form the only instance, except *Novacula*, of a Labroid with two dorsals.

GENUS XVII. NOVACULA, Valenc. Preoperculum scaly under the eye, with the mandible more ascending in other respects, like *Xyrichtys*. Generally the first two dorsal rays are somewhat detached from the others, and connected to them by basal membrane only. Six species.

GENUS XVIII. CHEILINUS, Cuv. Lateral line interrupted under the end of the dorsal. Lips thick; large, uniserial, conical teeth on the jaws. Large scales on the cheek; scales of the body broad and thin, advancing on the base of the caudal, but leaving the dorsal and anal naked as in *Labrus*. Splanchnology also as in that genus, but the bones are green in some, if not in all the species, like those of *Belone*. Twenty-four species.

GENUS XIX. CHEROPS, Rüpp. Both jaws armed with similar tapering stripes of teeth, succeeded posteriorly by small tufts of teeth; four stout conical canines in front of each jaw. Thick lips. Scales of the operculum and preoperculum of moderate size; on the body the scales are larger. Lateral line interrupted. Spines of the dorsal and anal strong and pointed. Java.

GENUS XX. CIRRHILABRUS, Schleg. A toothed preoperculum; an interrupted lateral line. Scaly gill-cover. Ventrals prolonged into filaments. Branchiostegals five.

GENUS XXI. EPIBULUS, Cuv. Protractile mouth, the mechanism of which differs from that of *Coricus*. The nasal pedicels of the premaxillaries play in grooves of the skull, and reach back to the occiput, while the descending branch is attached by a long ligament to the lower end of the maxillary bone, and, consequently, when the mouth opens, draws forward that end of the maxillary together with mandible, which is also connected to the same end of the maxillary. The hypotympanic and mesotympanic unite to form a lever, and assist in this movement. The scales are very large, and cover the cheeks, but are there embedded in the skin, and the face is naked. The large jaws, with the projection of the hypotympanic and angular portion of the mandible, give a peculiar aspect to the fish which otherwise resembles a *Glyphisodon*. Branchiostegals five. Lateral line interrupted. One species.

GENUS XXII. SCARUS, Forsk. Labroids of oblong and rather massive forms, lateral line interrupted under the end of the dorsal, and recommencing lower down. Large scales extending to the gill-covers and cheeks. Jaws resembling those of *Tetraodon*, each divided into halves by a median suture. The teeth are incorporated with the bone, and shine through the glazed surface in crowded quincuncial order; the oldest form the trenchant border of the jaw, and as they are worn away they are succeeded by the lower ranks, new pulps developing at the base of the jaw to keep up the succession. In some species the quincuncial surface is even and polished, in others it is granular from the prominence of the crowns of the teeth, and in some a few pointed canines protrude from the angle of the upper jaw, or from other parts of it. Pharyngeal teeth trenchant and standing up like verticle tiles, producing in the using, narrow, projecting ellipses of dentine surrounded by enamel; the base of each tooth is osteodentine, and it is bound to the others by cement. Each of the superior pharyngeals carries two or three longitudinal ranges, the number varying with the species; the single under pharyngeal is fixed by a thin vertical plate in the angle formed by

Classification—Anacanth. — the last pair of branchial arches, and rests upon the lateral processes of the coracoid. Its concave surface, studded with compressed teeth in quincunces, receives and acts against the upper pharyngeal dental plates; the length of these plates increases with age. On each side of the inferior pharyngeal there are two mucous sacs, papillose within. Stomach without a cæcum, and no pancreatic cæca. General aspect, except in respect of the teeth, that of *Cheilinus*, generally with a higher body than *Labrus* or *Julis*. Ninety species.

GENUS XXIII. CALLYODON, Gronov. *Scari*, whose anterior teeth are tiled in many rows, the lateral ones of the upper jaw being pointed and scattered, while within the jaw there is a row of much smaller ones. Figure 56 represents the teeth of *Callyodon chlorolepis*. Twelve species.

GENUS XXIV. ODAX, Comm. Head and body elongated; snout pointed; lips swollen, and a fold from the cheek and preoperculum makes a posterior lip as in *Labrus*. Lateral line continuous, and composed of simple not branching tubes, as in *Labrus*. Teeth incorporated with the jaw, but the compound dental pieces thus formed are thinner than in *Scarus*, the jaws bulging less; pharyngeals as in *Labrus*, with which they have more affinity than with *Scarus*. Eight species.

FAMILY IV.—AMBIOTOCIDÆ, Agass.

The general aspect of the fishes on which this family is founded is that of *Pomotis*, or of the higher bodied *Sparidæ*; they are compressed and oval, with middle-sized cycloid scales; opercular pieces without spines or serratures. Branchiostegals six. Lips moderately thick; orifice of the mouth formed above by the premaxillaries, to the exclusion of the maxillaries; both these bones somewhat protractile; teeth on the premaxillaries, mandible, and pharyngeals only, none on the vomer or palatines. By their entire gill-covers, they are farther removed from the Perch family than from the Sparoids, but the cycloid scales separate them from the latter, which have all ctenoid scales. By their thick lips they approach the Labroids, but differ in the construction of the mouth. M. Agassiz gives an interesting paper on this family in Troschel's *Arch. für Naturg.*, 1854. The name of *Ambiotoca* is deduced from the mode in which the young are produced, analogous to that of the Kangaroos. The designation of *Holconoti* has also been proposed on account of a naked stripe parallel to the hinder basis of the dorsal fin. Troschel remarks that this family is a peculiar one, nearly allied to the *Labridæ cycloidei*, but that it cannot enter that group on account of the unusual structure of the gills.

GENUS I. AMBIOTOCA.

ORDER IV.—ANACANTHS.

This order was indicated by Müller, and according to the characters which he assigns to it, as given in the table, the only difference that exists between it and the *Acanthopteri* is the absence of spinous or pungent rays in the fins; but many of the *Gobiidæ* have also rays wholly flexible, and that family may be considered as furnishing links between the orders. Indeed, there are some forms which may, with almost equal propriety, be placed in either. The ventral fins, when present, are attached to the thorax or throat.

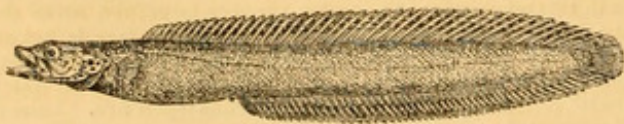


Fig. 88.
Machærium subducens.

On the *Ophididæ* we need not dwell, the members of that family being fishes of small size of little utility to man. The groups composing it have been investigated by Dr Kaup of Darmstadt, and our table gives the results of his labours. Fig. 88 represents the *Machærium subducens*, an



Fig. 89.
Gymnelis viridis.

Australian species, and fig. 89 *Gymnelis viridis*, an inhabitant of the Arctic seas.

ORDER IV.—ANACANTHINI, Müll.

Endo-skeleton ossified; exo-skeleton in some as cycloid, in others as ctenoid scales. Fins supported by flexible or jointed rays; ventrals beneath the pectorals, or none. Swim-bladder without air-duct in the *Gadidæ*, absent in *Ophididæ*, *Echencidæ*, *Macrouridæ*, and *Pleuronectidæ*.

Classification—Anacanth.

SUB-ORDER I.—APODES.

FAMILY I.—OPHIDIDÆ.

Gadus-like fish without ventrals. Body elongated, more or less dagger-like posteriorly; the tail surrounded without a break by the vertical fins.

GENUS I. MACHÆRIUM, Rich. Anus at the termination of the first third part of the length of the fish. Body scaly. Mandible destitute of a barbel; uniserial, incisorial teeth on the jaws. Dorsal beginning somewhat behind the pectoral; anal occupying two-thirds of the length of the body. Six branchiostegals. Lateral line ceasing under the tenth ray of the dorsal. No swim-bladder. Two species.

GENUS II. OPHIDIUM, Lin. Anus at the termination of the first third part, or of the half of the length of the fish. Body scaly. Two pair of barbels attached beneath the point of the glosso-hyal (or lingual) bone. A swim-bladder. Small sword-shaped fish, with lowly developed dorsal and anal fins, supported by simple rays only. Air-bladder large and oviform, with three proper ossicles, the middle one of which is moved by a peculiar muscle. Six species.

GENUS III. GYMNELIS, Reinh. (*Cepolophis*, Kaup.) Ophidia without barbels, and destitute of scales; resembling the proper *Ophidia* in the blunt head. The vomerine teeth do not project forwards, but lie deep in the palate. Anus situated in the fore part of the fish. Pectorals and vertical fins moderately developed. They are distinguished from *Fierasfer* in that the anus is not in the pectoral region, but farther back. The body also is less slim, and the tail not so much dagger-like. Two species.

GENUS IV. FIERASFER, Cuv. (*Echiodon*, Thomp.; *Oxybeles*, Rich., Bleek.) Anus in the pectoral region. Vomer projecting forwards, with blunt or laterally compressed teeth. Seven branchiostegals. No scales. Three species.

GENUS V. ENCHELIOPHIS, Müll. Abrachial as well as apodal; anus behind the gills. Six branchiostegals.

GADOIDS.

This is a most important family, and the fisheries established for the capture of its various members have, more than any other tribe of fishes, been the means of forming great numbers of hardy and able seamen. Its members live in cold or temperate climates, and constitute a very important article of fishery. The greater number are considered wholesome, and form a light and agreeable food,—the flesh separating easily by boiling into white flaky layers. The great sand-bank of Newfoundland is the most famous station of the Cod fisheries, and is resorted to by English fishermen, who chiefly use the hook and line. The fish abound in this place probably on account of the great quantity of the smaller animals which serve as food, viz., mussels, clams, &c.

Morrhua vulgaris, the common Cod (*la Morue*, Fr.; *Kabliau*, Germ.), measures from two to three feet in length. The back is spotted with yellowish brown. It inhabits the whole Northern Ocean, and occurs in vast profusion. This fish dwells in salt water only. It is not found nearer the equator than the 40th degree of latitude. The weight of the common Cod varies from 12 to 80 or even 100 pounds. It is extremely voracious, and its digestive powers are seemingly very great. It feeds upon smaller fishes, such as Herrings, on Mollusca, Worms, and Crustacea, and even on the young of its own species. It has a strong, muscular stomach, and is said to possess the power of rejecting by the mouth substances, such as wood, &c., which it finds indigestible. In spring it comes nearer the shore in order to deposit its spawn. This happens in January in England, in February in Norway, Denmark, and Scotland, and in March in Newfoundland. One female is said to contain from four to nine millions of eggs! The most extensive Cod fisheries

Classification—Anacanth.

on our coasts are off the Western and Shetland Isles, but they are still greater in more northern countries. The Cod has been fished on the coast of Sweden since the year 1368 by the inhabitants of Amsterdam. The English resorted to the fisheries of Iceland before the year 1415; and it is stated that in the year 1792, 200 French vessels, of a burden of 191,153 tons, were employed in the Cod fishery. Every year more than 6000 European vessels are engaged in this fishery.

The flesh of the Cod has a good flavour, and may be easily preserved. The tongue, salted and dried, has been considered a great delicacy. The gills are preserved and used as bait. The liver is eaten, and of late years the oil it yields has brought a high price owing to its importance as a medicine. The swimming-bladder affords a very good isinglass. This important species constitutes a principal article of food to the inhabitants in some parts of Iceland, Norway, and other northern countries. In a dried state it is also much used in some papal kingdoms of the south. In the neighbourhood of the Isle of Man, and elsewhere, there is a variety of the Cod named the Red or Rock Cod, the skin of which is of a brightish vermilion colour. Its flesh is much esteemed.

Morrhua aeglefinus, the Haddock (*l'Egrefin*, Fr.; *Scholl-fisch*, Germ.), is as well known, and almost as important, as the Cod in this country; it is of a smaller size, usually eighteen inches long. The back is brown, the belly silvery, and the lateral line black. There is a blackish spot behind the pectoral fin, which tradition assigns to the impression of St Peter's finger and thumb, when he took the tribute money out of the mouth of a fish, the inventors of the legend never adverting to the improbability of a marine fish living in the fresh-water lake of Gennesaret. The Haddock is found, like the Cod, in the Northern Ocean, but does not enter the Baltic. It annually approaches the British shores in February and March, in order to deposit its spawn. The regularity with which it reappears in some districts, on a stated day, is quite remarkable. On the coast of Yorkshire, since the year 1766, it has made its annual appearance on the 10th of December. To this place it comes in such numbers as to form an immense shoal 3 miles broad, and extending 80 miles in length—from Flamborough Head to the mouth of the Tyne. It is in autumn that they visit the shores of Holland and East Friesland, and the neighbourhood of Heligoland. The Haddock frequents our coasts during the greater part of the year, although the largest are taken in the winter. Its flesh is generally best in the months of May and June, and is greatly superior on the east coast of Scotland than when taken in the southern parts of the English Channel. On the coast of Hampshire it is a very inferior fish.

Morrhua callarias, the Dorse, is smaller than the Haddock, resembles the Whiting in taste, and is by many considered to be the best fish for the table of all this family. It is in great request on the coasts of the Baltic. It frequents the mouths of large rivers, and ascends them with the salt tide in June. The *Morrhua lusca* and *barbata*, Bib and Whiting Pout, are considered by one so well acquainted with the British fishes as Mr Yarrell, to be but one species, and are well known on the English coast, being brought in considerable quantities to the market. They are in best condition for the table in November and December.

Merlangus vulgaris, Whiting (*Merlan*, Fr.), is valued on account of its abundance, and the wholesomeness and fine flavour of its flesh. Its fishery lasts the whole year, but is most plentiful in January and February, and is generally carried on within a mile or two of the shore. *Merlangus carbonarius*, Cole-fish (*Kohlfisch*, Germ.) The flesh of the young is rather delicate; that of the adult is somewhat leathery, but it is used when salted and dried, like the Cod. This is the *Podley*, *Silloch*, *Cuddy*, &c., of our coasts. The

young swarm along the British shores, and form a frequent sustenance of the lower orders of the Western Highlands. On one occasion we killed 33 dozen with the rod in a few hours, using a line with 6 small flies. By giving the line one or two additional turns through the water, we frequently pulled 6 ashore at once. It even constitutes an important article of exportation from our northern coasts. In Norway the poor feed upon it; and oil is made from its liver. The adult fish is taken principally in summer; it deposits its spawn in this country in February and March. The Coal-fish is found in the North Atlantic and Pacific Oceans; and sometimes, though very rarely, in the Mediterranean Sea,—for example, near Nice. *Merlangus pollachius*, the Pollock or Pollack, about 18 inches long; resembles *M. carbonarius* in its general form. Its flesh is considered better than that of the Coal-fish, and inferior only to that of the Dorse and Whiting; it inhabits the Atlantic, and is gregarious. It is commonest on the coasts of Norway and the north of England, and sometimes occurs in the Mediterranean in winter. It is easily caught with a white fly.

Of the *Merluccius vulgaris*, or Common Hake, great numbers are taken in the ocean, and in the Mediterranean. On the coasts of the Mediterranean it is called Merlan or Whiting; and, when dried, it receives in the north the name of Stock-fish, in the same way as the Cod. It is said to be very abundant in the Bay of Galway, on the west of Ireland, and at Penzance in Cornwall. The flesh is white and flaky, and its liver is considered a delicacy.

The *Brosmius vulgaris*, Tusk, or Torsk, is common in the Shetland seas, but seldom comes so far south as the Firth of Forth. It is a most excellent fish for the table when newly caught, being far superior to the Cod, but rarely appears in the southern markets. It cures well. *Molva*, or *Lota molva*, is the only fresh-water fish of this family which exists in England, and is very local, being confined to a few rivers mostly of the midland counties. It is named the Burbot and Coney-fish, and its flesh is said to be good. One, or perhaps two species frequent the northern waters of the American continent, but their flesh, though wholesome, is lightly esteemed in a country which abounds in Coregoni and Trout of the richest flavour. The roe, which is remarkable for the smallness of its eggs, makes a substantial bread when pounded and mixed with a proportion of flour. The American fish is named Methy, and furnishes names for many rivers and lakes of that country. It is voracious, and feeds much on fresh-water Cray-fish.

The Gadoid family is scarcely known near the equator, but reappears again in the higher southern latitudes in the same generic forms though differing in species, and doubtless fisheries of these useful fishes will hereafter be established on the Australian coasts, when the submarine sandbanks come to be known, and the increase of population raises a greater demand for fish. The subjoined woodcut represents the *Lota breviuscula* from the Bay of Islands, New Zealand.

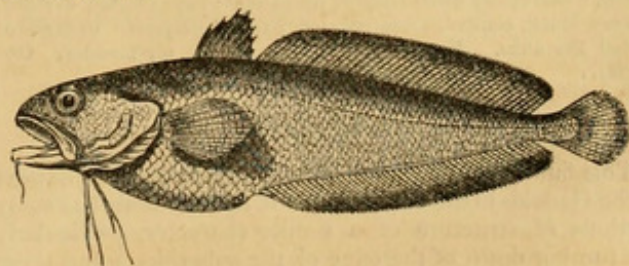


Fig. 90.
Lota breviuscula.

SUB-ORDER II.—THORACICI.

FAMILY I.—GADIDÆ.

Body moderately elongated. Scales small, soft. Head naked.

Classification—Anacanth.

Classification—Anacanth. No spines in the fins. Jaws and front of the vomer with pointed teeth, of unequal height, producing card-like or raduliform patches. Branchiostegals seven. One or more dorsal fins. Stomach capacious, caecal; pancreatic caeca numerous. A large air-bladder with strong walls, often denticulated at the sides; a large branch of the caeliac artery perforates the fibrous coat of the air-bladder, and divides into a dense network inclosing long corpuscles with fine villiform processes, producing together one of the organs named vaso-ganglion, which exists in the air-bladders of many other fishes.

ANALYTICAL TABLE OF THE GADIDÆ (Dum.)

Dorsal single.			
Vertical fins separate.....	BROSMIUS	7.	
Vertical fins united.....	BROTULA	8.	
Dorsals several.			
Dorsals two.			
Barbels three; one rostral.....	MOTELLA	6.	
Barbels one.			
Jugulars of many rays.....	LOTA	5.	
Jugulars of one forked ray.....	PHYCIS	10.	
Barbels none; one anal.....	MERLUCCIUS	4.	
Dorsals three.			
Anal two.			
Barbels conspicuous.....	{ GADUS L. MORRHUA C. }	1.	
Barbels none.....	MERLANGUS	3.	

GENUS I. GADUS, Linn. *partim*. (*Morrhua*, Cuv.) Three dorsal fins; two anals; a symphyseal mandibular barbel.

GENUS II. GADICULUS, Guich. Resembles *Morrhua* in the fins, but the barbels are wanting, as in *Merlangus*. Body elongated, compressed. Head small, scaleless; jaw teeth pointed, ranged in many rows. Chiefly distinguished by the bigness of the eyes, and the want of vomerine teeth; the mandible projects a little. Algiers.

GENUS III. MERLANGUS, Cuv. *Gadi*, without barbels.

GENUS IV. MERLUCCIUS, Cuv. Two dorsal fins; one anal fin. No barbels.

GENUS V. LOTA, Cuv. Two dorsal fins; one anal fin. Barbels.

GENUS VI. MOTELLA, Cuv. Number of fins as in *Lota*, but the first dorsal scarcely perceptible.

GENUS VII. BROSMIUS, Cuv. A single long dorsal reaching very near to the caudal.

GENUS VIII. BROTULA, Cuv. Vertical fins uniting at the end of the tail to form one pointed fin.

GENUS IX. ATELEOPUS, Schleg. Snout very thick over the mouth, which is protrusive beneath. A band of card-like teeth above and below; vomer and palatines toothless. Ventrals on the throat one-rayed; a small dorsal over the pectorals; anal very long; caudal small. Japan.

GENUS X. PHYCIS, Artedi, Schneid. Ventrals of a single ray, which is often forked. Head large. A symphyseal mandibular barbel. Two dorsals, the second one long.

GENUS XI. RANICEPS, Cuv. Head more depressed than in other genera of this family. Anterior dorsal almost concealed in the thickness of the skin.

GENUS XII. BYTHITES, Rein. Body compressed, thicker anteriorly. Profile of head bluntly rounded. Tail ensiform, tapering to a point. Scales minute, round, imbricated. Lateral line interrupted over the anus. Teeth acute on the premaxillaries, mandible, vomer, and palatines. Branchiostegals eight, the membranes uniting under the isthmus with a free edge; gill-openings very large. Ventrals jugular, of one filiform ray, each very long; vertical fins united, without any distinction of the caudal; rays jointed, divided. A very thick, conical, three-pointed papilla projected backwards behind the anus. No pneumatic tube to the air-bladder. One species.

MACROURIDS.

This family consists of a single genus, which stands next to the Gadoids in the *Regne Animal*, and certainly has many portions of structure of a similar character, particularly the turning down of the edge of the suborbitals, but these bones are much more developed than in *Gadus*, and their reverted plates appear on the surface of the cheek covered with rough scales. The Macrourids are inhabitants of deep water like most of the Gadoids, and have not been discovered near the equator, though they exist in both the northern and southern hemispheres, and in the Pacific as well as

Atlantic divisions of the ocean. Figures 30, 32, 33, and 34 represent the scales of several *Macrouri*, remarkable for their discal spines, but differing from the ciliated scales named Ctenoid. The subjoined woodcut represents *Macrourus australis*.

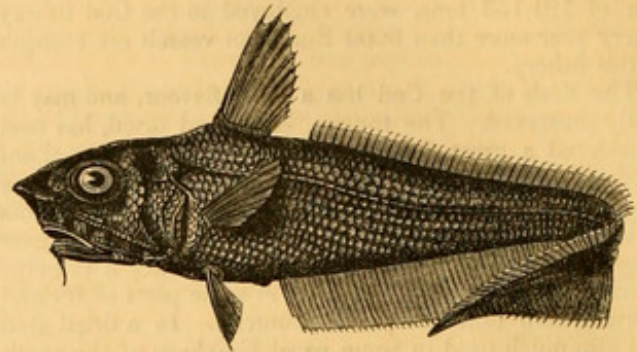


Fig. 91.
Macrourus australis.

FAMILY II.—MACROURIDÆ.

Turbinals largely developed, forming, by apposition of their plates, a thin, high, mesial crest, and a lateral wing-like process on each side; these, in conjunction with the reverted plate of the preorbital, support a more or less elongated snout, which is generally, perhaps always, acute. Body highest and fullest at the pectoral region, compressed and dagger-shaped posteriorly, or tapering to an acute point. Ventrals, pectorals, and first dorsal, in a vertical line; first dorsal short and high; anal and second dorsal long and even, uniting at the point of the tail without any distinction of caudal. Anus in the anterior quarter of the fish. Teeth fine, villiform on the jaws; palatines, vomer, and tongue edentate; mouth horizontal, inferior behind the projecting snout; premaxillaries forming the border of the upper jaw, and protractile directly downwards, their long pedicels moving under a vault formed by the turbinals; maxillaries behind the premaxillaries, gliding partially under the reverted edge of the preorbital. Scales studded with acute spines, varying in form and number with the species. Eye large; head encased by the scaly surfaces of muciferous bones. Branchiostegals six. Stomach globular; numerous pancreatic caeca.

GENUS I. MACROURUS, Bloch. (*LEPIDOLEPRUS*, Risso.) Nine or ten species in the temperate and colder seas of the northern and southern hemispheres.

REMORA FAMILY.

The *Echeneididæ* stand in Cuvier's *Regne Animal* next to the *Discoboles*, but Müller has transferred the latter to *Gobiidæ*, making them a subordinate tribe under the appellation of Cyclopedi, and associating with them generally the fishes that have disks which can be used as suckers. Bonaparte places the *Echeneides* as a group subordinate to his *Gadi*. The absence of spinous rays seems to point out the Anacanthini as their most appropriate order, but the same reason might bring several Gobioid genera with them. One species, however, of *Echeneis* has bony compressed rays in the pectoral, terminated by a little crenulated disk, and some have considered the disk on the head in this genus to be a modified first dorsal fin.

The extraordinary power possessed by this fish (*Echeneis remora*), of adhering tenaciously to any flattish surface, was known to ancient writers, as well as to the curious inquirers of modern times. Pliny luxuriates upon it with his usual discursive verbosity, and the reader may possibly be amused by Philemon Holland's translation of the passages in question:—"Having so far proceeded in the discourse of nature's historie, that I am now arrived at the very height of her forces, and come into a world of examples, I cannot chuse but in the first place consider the power of her operations, and the infinitnesse of her secrets, which offer themselves before our eyes in the sea: for in no part else of this

Classification—Anacanth.

universal frame is it possible to observe the like majestic of nature: insomuch, as we need not seeke any farther, nay, we ought not to make more search into her divinitie, considering there cannot be found any thing equall or like unto this one element, wherein she hath surmounted and gone beyond her own selfe in a wonderfull number of respects. For, first and foremost, is there any thing more violent than the sea; and namely when it is troubled with blustering winds, whirlepuffs, storms, and tempests; or wherein hath the wit of man been more employed (seeke out all parts of the known world) than in seconding the waves and billows of the sea, by saile and ore? Finally, is there ought more admirable than the inerrable force of the reciprocall tides of the sea, ebbing and flowing as it doth, whereby it keepeth a current also, as it were the stream of some great river?

“The current of the sea is great, the tide much, the winds vehement and forcible; and more than that, ores and sailes withall to help forward the rest, are mightie and powerfull: and yet there is one little sillie fish, named *Echeneis*, that checketh, scorneth, and arresteth them all. Let the winds blow as much as they will, rage the storms and tempests what they can, yet this little fish commaundeth their furie, restraineth their puissance, and, maugre all their force, as great as it is, compelleth ships to stand still: a thing which no cables, be they never so big and able as they will, can perform. She bridleth the violence and tameth the greatest rage of this universall world, and that without any paine that she putteth herselfe unto, without any holding or putting backe, or any other meanes save only by cleaving and sticking fast to a vessell: in such a sort as this one small and poore fish is sufficient to resist and withstand so great a power both of sea and navie, yea and to stop the passage of a ship, doe they all what they can possible to the contrarie. What should our fleets and armadoes at sea make such turrets in their decks and forecastles? what should they fortifie their ships in warlike manner, to fight from them upon the sea, as it were from mure and rampier on firme land? See the vanitie of man! alas, how foolish are we to make all this adoe? When one little fish, not above half a foot long is able to arrest and stay per force, yea, and hold as prisoners, our goodly tall and proud ships, so well armed in the beakehead with yron pikes and brazen tines; so offensive and dangerous to bouge and pierce any enemy ship which they doe encountre. Certes, reported it is, that in the naval battaile before Actium, wherein *Antonius*, and *Cleopatra* the queene, were defeated by *Augustus*, one of these fishes staid the admirall ship wherein *M. Antonius* was, at what time as he made all the hast and meanes he could devise with help of ores to encourage his people from ship to ship, and could not prevaile, untill he was forced to abandon the said admirall, and go into another galley. Meanwhile the armada of *Augustus Caesar*, seeing this disorder, charged with greater violence, and soone invested the fleete of *Antonie*. Of late daies also, and within our remembrance, the like happened to the roiall ship of the Emperour *Caius Caligula*, at what time as he rowed backe, and made saile from Astura to Antium; when and where this little fish detained his ship, and (as it fell out afterward) presaged an unfortunate event thereby: for this was the last time that ever this emperour made his returne to Rome: and no sooner was he arrived, but his own souldiours in a mutinie fell upon him and stabbed him to death. And yet it was not long ere the cause of this wonderfull staie of his ship was knowne: for so soon as ever the vessel (and a galliace it was, furnished with five bankes of ores to a side) was perceived alone in the fleete to stand still, presentlie a number of tall fellows leapt out of their ships into the sea, to search what the reason might be that it stirred not; and found one of these fishes sticking fast to the very helme: which being reported unto *Caius Caligula*, he

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fumed and fared as an emperour, taking great indignation that so small a thing as it should hold him back perforce, and check the strength of all his mariners, notwithstanding there were no fewer than foure hundred lustie men in his galley that laboured at the ore all that ever they could to the contrarie. But this prince (as it is for certain knowne) was most astonied at this, namely, that the fish sticking only to the ship, should hold it fast; and the same being brought into the ship and there laid, not worke the like effect. They who at that time and afterward saw the fish, report that it resembled for all the world a snaile of the greatest making: but as touching the form and sundrie kinds thereof, many have written diversly, whose opinions I have set downe in my treatise of living creatures belonging to the waters, and namely in the particular discourse of this fish: neither doe I doubt but all the sorte of fishes are able to doe as much: for this we are to believe, that *Pourcellans* also be of the same vertue, since it was well knowne by a notorious example, that one of them did the like by a ship sent from *Periander* to the Cape of *Gnidos*: in regard whereof, the inhabitants of *Gnidos* doe honour and consecrat the said *Porcellane* within their temples of *Venus*. Some of our Latin writers doe call the said fish that thus staieth a ship, by the name of *Remora*.”

Another species, *Echeneis naucrates*, Linn., commonly called the Indian *Remora*, has usually twenty-two plates upon the head. In its habits it resembles the preceding; but it seems to be more frequent in the seas of India and America than in those of Europe. The manuscripts of *Commerson*, as quoted by *Count Lacépède*, inform us that it is common along the coasts of *Mosambique*, where it is made use of in a singular way for the purpose of catching turtles. A ring is first fastened round its tail, and then a long cord is attached to the ring. When thus accoutred, the fish, placed in a vessel of sea-water, is carried out in a boat; and as soon as the fishermen perceive a sleeping turtle, they row gently towards it, and throw the *Remora* into the water, with a sufficient length of cord. It seldom fails speedily to attach itself to the unconscious turtle, which by the tenacity of its adherence is immediately drawn towards the boat and captured.

FAMILY III.—ECHENEIDIDÆ, Bonap.

Remarkable and peculiar in having a flat head occupied on the dorsal aspect by a laminated disk that forms an adhesive sucker by which the *Echeneis* can attach itself to ships or other fishes, most commonly to the large Sharks. Body elongated, tapering much towards the tail; scaly. Dorsal single, malacopterous opposite to the anal. Eyes lateral. Mouth small, horizontal; mandible projecting; teeth on the premaxillaries and mandible villiform or fine card-like; a row of hair-like teeth on the edge of the maxillaries, which form the sides of the upper jaw; villiform teeth on the front of the vomer and the surface of that bone, and of the tongue rough. Branchiostegals eight. Stomach cæcal, large; a wide, short intestine; no air-bladder. The laminae of the disk are spinous on the edges, the spines being in most species very short and slender; the number of laminae varies in different species.

GENUS I. ECHENEIS, Linn.

FLOUNDER FAMILY.

Though the *Pleuronectide* do not require the same armaments for deep-sea fishing that the *Gadoids* do, yet they are of great importance to our maritime population, and give employment to large bodies of fishermen at most parts of the coast. These fish abound in comparatively shallow water, where the bottom is sandy, though some of the largest, as the *Turbot* and *Holibut*, are taken further out to sea. As they feed habitually at the bottom, the *Flounders* are chiefly captured by trawlers. *Mr Yarrell* states that London alone pays L.15,000 a-year to the Danes for lobster-stew to make sauce for the *Turbots* brought to the London

Classification—
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market, which amount, according to the same authority, to 88,000 in a season. Pennant has particularly described the extensive Turbot fishery at Scarborough. There are three men in each of the fishing-boats, each man having three lines, and each line 280 hooks. All the nine lines are fastened together, and then extended to about three miles in length; they are laid across the current, and are allowed to remain for six hours before they are hauled in. This fish is called the Water or Sea Pheasant, by the French common people, on account of its fine flavour.

FAMILY IV.—PLEURONECTIDÆ.

Peculiar among fishes in showing a want of symmetry in the head, the eyes being turned to that side, which is uppermost when the animal swims, and is always darker-coloured than the other side. Body extremely compressed, so that the ventral and dorsal aspects are mere edges, the sides forming disks, round, oval, ovate, or elliptical, differently coloured, the paler one simulating the belly, and being beneath in the usual position of the fish. Dorsal extending along the whole back, and in some running forwards to the nostrils; anal fringing in the same way the ventral edge; jaws and ventrals generally unsymmetrical, being smaller on the pale side. Branchiostegals six. The presphenoid is twisted to one side, and the mid-frontal is one of the most distorted bones in the cranium of these fishes. There is no want of symmetry in the spinal column and its processes posterior to the scapular arch; the inter-neural and interhæmal spines are in pairs, supporting one dermo-neural or dermo-hæmal spine. No air-bladder.

ANALYTICAL TABLE OF THE PLEURONECTIDÆ (Dum.)

Body rhomboidal.

Dorsal over the eyes which are dextral.

Teeth broad, trenchant..... PLATESSA 1.

Teeth villiform..... HIPPOGLOSSUS 2.

Dorsal over the upper lip; eyes sinistral..... RHOMBUS 3.

Body oval, or much elongated.

Pectorals very distinct, on both sides..... SOLEA 4.

Pectorals distinct on one side only..... MONOCHIR 5.

Pectorals wanting.

Vertical fins separated..... ACHIRUS 6.

Vertical fins united..... PLAGIUSA 7.

GENUS I. PLATESSA, Cuv. Obtuse, trenchant, uniserial teeth on the jaws; most frequently pavement-like teeth on the pharyngeals. Dorsal not coming further forward than the centre of the upper eye; caudal separated by intervals from the dorsal and anal. Form rhomboidal. Eyes generally on the right side. Pancreatic cæca three, small.

GENUS II. HIPPOGLOSSUS, Cuv. Fins of *Platessa*, with generally a more oblong form. Teeth card-like, often strong and pointed on the jaws and pharyngeals.

GENUS III. RHOMBUS, Cuv. Teeth on the jaws and pharyngeals villiform, or card-like, as in *Hippoglossus*, but the dorsal comes forward to the border of the upper jaw, and extends like the anal to near the caudal. Eyes for the most part on the left side.

GENUS IV. SOLEA, Cuv. Mouth curved and turned almost wholly to the blind side of the head; teeth situated on that side only, finely villiform; form oblong; snout round, and almost always advancing before the mouth. Dorsal commencing at the mouth and extending like the anal to the caudal. Lateral line straight. Blind side of the head often garnished with cutaneous shreds like villi. Intestine long, often doubled; no pancreatic cæca. In some the caudal is not distinct from the other two vertical fins. These form the genus *Brachirus* of Swainson, or *Synaptura* of Cantor.

GENUS V. MONOCHIR, Cuv. Soles destitute of a pectoral on the blind side, or having merely an almost imperceptible vestige of one, the pectoral on the side of the eyes being very small.

GENUS VI. ACHIRUS, Lacép. Abrachial Soles, with the vertical fins distinct.

GENUS VII. PLAGIUSA, Brown. Abrachial Soles, with the vertical fins united.

ORDER V.—ACANTHOPTEROUS FISHES.

This order, the most extensive of all for the variety of forms and number of species, includes fishes under every condition that a fish can exist, whether it be with regard to the freshness or saltness of the water it inhabits, its tem-

perature, depth, altitude above the sea, or other circumstances. There is certainly some connection between the ciliated scales with which the great majority of fishes of this order are clothed, and the spinous terminations or serrated edges of many of the bones of the head and shoulder which appear on the surface, and assume more or less the conditions and functions of dermal productions. The ctenoid scale, however common it may be in the order, is not universal, and the first family, the Uranoscopes have chiefly cycloid scales. The absence of a pneumatic tube to the air-bladder is perhaps a more constant character, but the viscus itself is not always present. The ventral fins are, when they exist, placed, in the majority, near the pectorals.

ORDER V.—ACANTHOPTERI, Müll.

Endo-skeleton ossified; exo-skeleton as *ctenoid* scales. Fins with one or more of the first rays unjointed or inflexible spines; ventrals in most beneath or in advance of the pectorals. Swim-bladder without air-duct.

URANOSCOPIDÆ.

The Uranoscopes are remarkable for their power of raising their eyeballs out of their sockets, and of retracting them again within the level of the orbits. They frequent the bottom of the sea, and, like many ground fish, some of them have organs of touch developed in form of barbels, and they have also a peculiar membranous filament under the tongue, which they can protrude at pleasure. The Mediterranean Uranoscope was named *Agnus* and *Callionymus* by the ancient Romans, and Pliny says that the same fish was called *Callionymus* and *Uranoscopus*. Aristotle remarks correctly that the gall-bladder of this fish is attached to the right lobe of the liver, and is of greater size than in other fishes; and the dramatic poets referred to it proverbially when alluding to an angry man. Its gall was supposed to have some power of rendering the sight more clear, of removing deafness, and of depressing the fungus growths of old sores. The species are more numerous in the Australian seas than in any other quarter of the ocean. *Trachinus* has some resemblance in external characters to the *Sclerogenidæ*, especially in the simplicity and thickness of the lower pectoral rays, and in the projection of the tips of the anal rays beyond the membrane, but they are distinguished by the second suborbital not crossing the cheek to the preoperculum. The Uranoscopes, indeed, make an approach to this peculiar structure, but in them the suborbital articulates with the upper limb of the preoperculum, and does not buttress its angle, as in the true *Sclerogenids*. The projecting tips of the anal rays occurring in many ground fishes are seemingly organs of touch. The family generally, as here assembled, corresponds with Cuvier's group of Jugular Percoids, but we have brought into it *Hemero-cætes*, which is placed at the end of the Gobioids, next *Callionymus*, in the *Histoire des Poissons*, and also an Australian fresh-water genus *Gadopsis* not described in that work. The internal structure of several of the genera must be investigated before the correctness of this grouping can be ascertained. None of the family are of importance as articles of food. The woodcut No. 46 represents *Uranoscopus macropygus*, an Australian species, which has no first dorsal; the head of *Bovichthys* is represented by No. 45, drawn to show the branching mucoducts; a scale of *Gadopsis* is shown by No. 26; and one from the lateral line of *Hemero-cætes* by No. 43.

FAMILY I.—URANOSCOPIDÆ.

Trachinidæ, Bonap. Ventrals composed of a spine and five jointed rays, situated before the pectorals (in *Trichodon* and *Sillago* a little behind the pectorals). Scales cycloid, or wanting, acanthoptery-

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gii. Anus generally before the middle of the fish, and the tail often considerably longer than the body. One or two dorsals; edges of the preorbital and preopercular pieces entire; not serrated; sometimes a strong spine from the surface of the operculum, or from the shoulder. Mouth formed above entirely by the premaxillaries, with the maxillaries in the membrane behind them; teeth on the jaws and vomer; palatine teeth in some present, in others none. Branchiostegals six or seven, rarely five. Abdominal cavity sometimes prolonged past the anus; no air-bladder; caecal stomach; pancreatic caeca three to twelve, or more, sometimes none (*Hemeroctetus*).

GENUS I. TRACHINUS, Linn. Head compressed; a strong opercular spine. Villiform teeth on the jaws, on the anterior point of the vomer, on the fore end of the palatines, on the entopterygoid, on the pharyngeals, and on the short tubercles of the branchial arches. Cranium more or less rough, and the suprascapular finely denticulated. A small spinous dorsal far forward, and not connected to the soft dorsal. Abdominal cavity of small extent. Four species.

GENUS II. PERCIS, Bloch. *Trachini*, with the head more depressed and the spinous and soft dorsal joined; vomerine, but no palatine teeth; somewhat of a Labroid aspect. Some were described as *Labri* by Schneider, and Bloch named another *Enchelyopus*, conceiving it to be a Gadoid fish. Cavity of the abdomen not extensive. Fifteen species.

GENUS III. PINGUIPES, Cuv. The Labroid aspect of this genus is striking. Lips thick, covering the strong, conical, and somewhat curved teeth. A single dorsal spinous in front, without a notch between. Vomerine and palatine teeth. Three species.

GENUS IV. URANOSCOPUS, Linn. Head large, cubical, bony, rough, and sculptured, depressed with the protractile eyes on the dorsal aspect. Mouth cleft vertically, so that the mandible forms the extremity when it is closed against the abbreviated snout. Suborbitals large, cuirassing the cheeks, but attached to the temples, and not forming a fulcrum to the spinous preoperculum as in the *Sclerogenidae*. Scales small, cycloid. Nominally two dorsals, but some species want the spinous one. A humeral spine, which in some is large and crenated. Some have a barbel at the symphysis of the mandible externally, and some have a filament under the tongue within the mouth. Branchiostegals six. Stomach caecal; pancreatic caeca numerous (twelve). Seventeen species.

GENUS V. BOVICHTHYS, External aspect of *Cottus*. Head large, depressed, rounded, with large eyes near the dorsal plane. Mouth terminal; villiform teeth on the jaws, vomer, and palatines, the outer row on the jaws being thicker and taller. No scales. Skin very porous, mucoducts disposed in branching lines on the head, and strongly prominent along the lateral line. Branchiostegals seven. Fins large, the two dorsals contiguous; five lower pectoral rays, and all the anal rays, except the two posterior ones, simple and projecting beyond the notched membrane; the pectoral resembling that fin in *Cottus*, and the anal that of *Trachinus*. Operculum ending in a large flat spinous point, clothed with skin; no other particular armature of the head; a curved spine from the front of the operculum being quite hidden by the soft parts.

GENUS VI. PERCOPHIS, Cuv. A long slender fish resembling *Sphyrana*. Head pointed; mandible prominent; teeth strong, curved ones in front of villiform bands in the jaws; teeth also on the vomer and palatines. Anus at the end of the anterior third of the whole length. First dorsal posterior to the base of the pectorals at a little distance from the long soft dorsal; anal longer than the latter. A small opercular spine. Branchiostegals seven. Scales ciliated. Abdominal cavity prolonged to a considerable distance beyond the anus; stomach caecal. One species.

GENUS VII. HEMEROCETES, Cuv. Form elongated, slender, roundish, tapering but slightly towards the tail, with a long even dorsal and anal separated from the caudal. Dorsal rays all simple and jointed; anal rays branched at the tips, like those of *Trachinus*; ventrals before the pectorals of one spine and five jointed rays. Head depressed; eyes large, prominent, partly on the dorsal aspect, near together; mouth protractile, and when thrust out the upper ends of the maxillaries project upwards like spines. Branchiostegals seven. Teeth setaceous, in villiform bands on the premaxillaries, mandible, anterior corners of the vomer, pharyngeals above and below, and palatines. Tongue and isthmus of the gills smooth. Head unarmed, together with the body, scaly. A row of pores on the preoperculum. Stomach caecal; intestine short, making but one flexure; no pancreatic caeca. One species.

GENUS VIII. GADOPSIS, Rich. Aspect of *Gadus*. Scales cycloid, extending to the cheeks and gill-covers. A single dorsal with spinous rays in front; anal with three spinous rays; one bifid, jointed ventral ray without a spine, situated far forward on the throat. Head unarmed. Branchiostegals six. Teeth card-like on the premaxillaries, vomer, palatines, and mandible. A fresh-water Australian fish.

GENUS IX. APHRITIS, Cuv. and Valenc. Body elongated. Dorsals two, separated. Mouth rather small; close, short, villiform teeth on the jaws, palatines, and chevron of the vomer. The absence of strong-pointed teeth distinguishes this genus from *Percophis*; the presence of palatine teeth separates it from *Percis*, and the two dorsals from *Gadopsis*; the scales appearing to be ciliated when viewed through a lens rather throws a doubt of the propriety of placing the genus in this group. Branchiostegals six. Stomach caecal; four pancreatic caeca. A fresh-water Tasmanian fish.

GENUS X. TRICHODON, Stel. General aspect of *Uranoscopus*. Five preopercular spines; operculum ending in a flat point. Head flat above; mouth descending almost vertically, and, when shut, having the mandible in front; eyes lateral, not on the dorsal aspect as in *Uranoscopus*. No scales. Ventrals thoracic. Cheek not cuirassed by the suborbitals; teeth in card-like bands (individually slender, pointed, and recurved) on the jaws and front of the vomer, but the palatines are toothless, as is also the tongue. Two dorsals separated by a short interval; several of the lower pectoral rays simple. Five branchiostegals. One species.

GENUS XI. SILLAGO, Cuv. *Acanthopteri*, with a long conical head and rather depressed snout, terminated by the fleshy lips of a small mouth. Two continuous dorsals, the second long and low. Upper jaw somewhat protractile, and the mandible articulated considerably before the eye; teeth on the jaws villiform, with an outer row of conical ones. A villiform band on the front of the vomer; preoperculum denticulated on the ascending edge, curving over the throat, so as nearly to touch its fellow. Six branchiostegals. Scales ciliated, covering the opercula, cheeks, and upper part of the head behind the eyes. Caecal stomach; pancreatic caeca from two to four; a large forked air-bladder. Ten species. Cuvier is uncertain about the proper position of this genus, but thinks that it is most allied to the *Sciænidæ* with which it might be placed were it not for its vomerine teeth. It is put here at the end of the *Uranoscopidæ* chiefly because no more eligible situation offers.

PERCOIDS.

Few families of fish have been more fully investigated by ichthyologists than this one, yet the vast number of species that belong to it is embarrassing to students, and the strong external characters which many possess have withdrawn the attention from the more important varieties of structure, to slight serratures of the opercular bones, or the greater or smaller size of the scales on some parts of the head, and other slight modifications of the surface, which are obvious to the eye indeed, and therefore useful for subdividing a genus containing many species, but are not of themselves sufficient to establish generic groups or other divisions of higher importance. These comparatively unimportant external characters have however been too generally employed for this purpose, and the importance of the want of teeth on the roof of the mouth having been too rigidly insisted upon, as a variety of structure of family rank, has caused the wide separation of species nearly connected by aspect, habits, and general conformation. Many Percoids have been placed with the *Sciænoids* merely because the minute teeth of the palate are early deciduous. On the other hand, forms have been brought together by a few technical characters which have comparatively little natural affinity, and an ichthyologist who is intimately acquainted with ichthyic anatomy has a wide field before him where he may render great service by reducing the at present heterogeneous assemblages to more fitting order. In the mean time we shall, with a few exceptions, follow our principal authorities—Müller for the general arrangement, and the *Histoire des Poissons* for the generic groups. We have found it convenient to introduce into our table, as distinct families, the Percoids of Cuvier which have more or fewer branchiostegals than seven; or whose ventrals vary in composition from the normal number of five articulated rays, or depart from their usual position in this family under the pectorals. The useful analytical table given in the *Histoire des Poissons*, abbreviated by the removal of these groups, will remain as follows:—

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TABLE OF GENERA.

Two dorsals, or one dorsal notched to its base.

All the teeth villiform.

PERCA, LATES, ENOPLIUS, DIPLOPRION, NIPHON, LABRAX, CENTROPOMUS, HURON, GRAMMISTES, ASPRO, AMBASSIS, APOGON, CNIDON, PSAMMOPERCA, PRIOPIS, MICROICHTHYS, BOGODA, POMATOMUS.

Canine teeth among the others.

CHEILODIPTERUS, LUCIOPERCA, ETELIS.

A single dorsal.

Canine teeth among the others.

SERRANUS, PLECTROPOMA, DIACOPE, MESOPRION, APRION.

Teeth all villiform.

CENTROPRISTES, GRYSTES, POLYPRION, PENTACEROS, ACERINA, RHYPTICUS, AULACOCEPHALUS, APSILUS, GLAUCOSOMA.

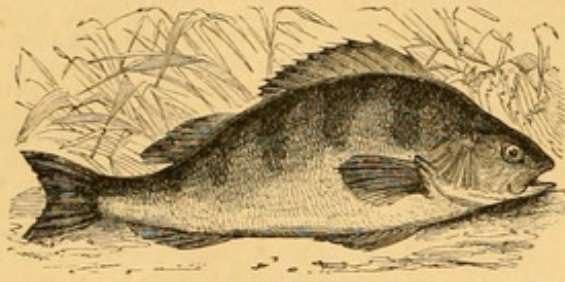


Fig. 92.
Perca fluviatilis.

The common Perch (*Perca fluviatilis*, Linn.), one of the most beautiful of the fresh-water fishes of Europe, is too familiarly known to require description. It inhabits both lakes and rivers, but shuns salt water. As an article of food it is still in some estimation, although the character given of it in that respect by Ausonius is higher than accords with modern views. The female deposits her ova, united together by a viscid matter, in lengthened strings, a peculiarity noted by Aristotle. The number of these eggs sometimes amounts to nearly a million. The Perch occurs over all Europe, and most of the northern districts of Asia. Pennant alludes to one said to have been taken in the Serpentine River, in Hyde Park, which weighed nine pounds. But even one half of that weight would be regarded as extraordinary, and Pennant reports the fact on the authority of another.

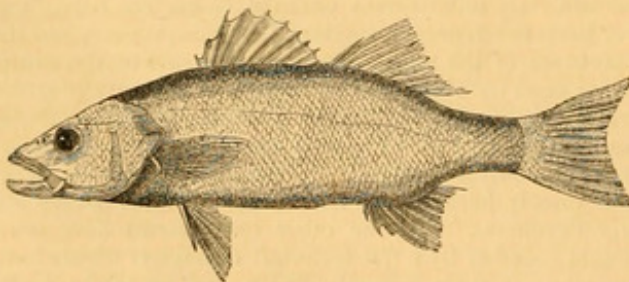


Fig. 93.
Labrax lupus.

The fish here represented is the *Labrax lupus*, Basse or Sea Perch, a fish of a chaste and pleasing aspect, though destitute of the more strongly contrasted colours of the fresh-water species. Its upper parts are gray, with bluish reflections, which gradually shade away into a silvery whiteness on the under surface. The pectoral fins are slightly tinged with red. It occurs along the Dutch and British shores, but is much more abundant in the Mediterranean. It is a voracious fish with a remarkably large stomach, and received from the ancient Romans the appropriate cognomen of *lupus*. By the Greeks it was highly esteemed: Arcestratus, even termed a large kind taken near Milet, "offspring of the gods." They attributed to

the *lupus* a tender regard for its own safety; and Aristotle says that it is the most cunning of fishes, and that when surrounded by a net it digs for itself a channel of escape through the sand.

"Clausus rete *lupus* quamvis immanis et acer
Dimotis cauda submissus sidit arenis,
Atque ubi jam transire plagas perentis in auras
Emicat atque dolos saltu diludit inultus."—OVID.

The Basse sometimes attains the length of 3 feet, though it is seldom met with much above half that size.

There is little that calls for attention from the other Percoids with two dorsals. Though interesting from the variety of forms they display, we must leave these to be studied in their leading features as given in the annexed table, and give the space we can allot to species of more importance, either objects of commerce or of large fisheries, or from the associations connected with them.

In the *Histoire des Poissons*, the Percoids with a single dorsal form a second great division of the family; and, were it not for the break in the close affinities between the two groups that would be caused by making this division a separate family, the number of species that it contains might render such a proceeding expedient as a mere matter of convenience. Cuvier remarks that the Percoids, in which the spinous portion of the dorsal is connected with the soft one by a sufficiently even border, is much more numerous in species than the typical division with two dorsals; and he found it necessary, therefore, in arranging them, to have recourse to characters of a sufficiently minute kind. Bloch drew his from the denticulations of the preoperculum and the spines of the operculum; but he has frequently used them without judgment, and we frequently meet in his arrangement with Labroid and Sciaenoid fishes stuck in among the Percoids. The same errors exist, in greater or smaller numbers, in the works of his successors, because they attended more than they ought to have done to external characters, passing over the more essential conformities of internal structure. "Our (Cuvier's) precautions in separating fish whose teeth are supported by different parts of the mouth have saved us from much of this confusion, but yet there remained a considerable number of species which we could divide into groups only by employing subordinate characters. We characterized the primary divisions by the teeth, which in some are villiform and of even height, as in *Perca* and *Labrax*; sometimes interspersed with canines, or teeth a little higher and more pointed than the rest of the villiform band. Next we looked to the operculum, the edge of whose bony piece is sometimes smooth or rounded, sometimes terminated by two or three points more or less acute. Next we attended to the preoperculum, whose edges may be either smooth or denticulated, or armed in various ways with spines. Lastly, the bones of the jaws, smooth or scaly, furnish the final subdivisions; and to distinguish certain genera, we take characters from striking configurations of other parts of the fish." These are the rules which the greatest of ichthyologists, whether ancient or modern, framed for his guidance in the distribution of this portion of the finny tribes. Since his labours were brought to a close many new species have been discovered, and not a few new forms described; and we have therefore, as intimated above, relieved the overloaded Percoid group by removing some of the minor assemblages made by Cuvier himself, and placing them under distinct family appellations. It must be kept in mind, however, that the great mass of *Acanthop-teri*, though exceedingly numerous in species, and presenting a great variety of generic forms, vary very little in the more essential parts of structure; and that the subdivisions which their numbers have made necessary are not of the same value in the animal scale as others containing perhaps only one or two species in other parts of the table.

The *Serrani*, called also Sea Perches, are numerous,

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Classification—
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and many of them very beautiful. They abound in all the warmer seas. *Anthias* and *Merou* are mere subdivisions of the genus framed on the existence of scales on the jaws, and their greater or smaller size. In *Esox*, and many other genera, subdivisions, founded on the greater or smaller extent of the head covered by scales, would be as numerous as the species; but in *Serranus* some such plan of grouping is necessary to enable the ichthyologist to describe the multitude of species he has to deal with. Some of the *Serrani* were known to the ancients by the name of *Perca*, and

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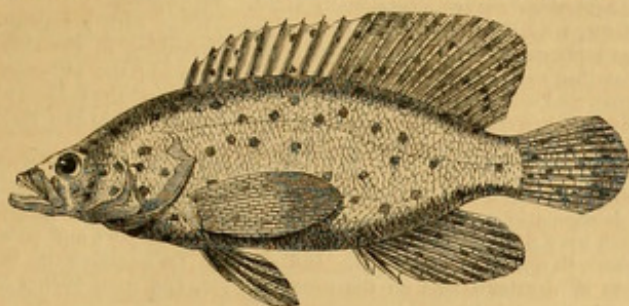


Fig. 94.
Serranus altivelis.

still are called by the Roman fishermen by that of *Percia*, and by the Venetians by that of *Sperga*. The *Anthias* was more renowned in classical times. Aristotle says that the fishers of Sponges called it "sacred," because no voracious fishes came to the places which it frequented, and the diver might descend with safety. Pliny reports a singular story regarding it: The fishermen of the Chelidonian Isles, he says, practise the feeding of this fish, always presenting themselves in the same dress until its apprehensions are lulled, and then they introduce a hook into the paste they had daily given it. As soon, however, as an *Anthias* was deceived so as to allow itself to be hooked, its companions came to its aid, and endeavoured to relieve it by cutting the line with their dorsal spines, shaped like a saw.

"Anthias his tergo quæ non vidit utitur armis.
Vim spinæ novitque suo verso supinus
Corpore lina secat fixumque intercepti hamum."

OPP., *Halieut.*, 46.

The modern Greeks give the name of *Anthias* to the *Gymnetrus*; and it is probable that the *Anthias* of Ælian was the *Scomberoid alalonga* of the modern Italians.

FAMILY II.—PERCIDÆ.

Genus Perca, Artedi and Linn. Body oblong, scaly; scales ctenoid; opercular bones variously armed. Seven branchiostegals. Teeth on the vomer, and most frequently on the palatines. No barbels; cheek not cuirassed. Ventrals of five jointed rays, thoracic or subbrachian. Fins always amounting to seven in number, often to eight. Stomach cæcal, that is, the pyloric opening lateral; pancreatic cæca few in number and not bulky; intestinal canal little folded.

(a.) Two dorsals, or one dorsal with a notch extending to its base; all the teeth villiform; no canine teeth.

GENUS I. PERCA, Cuv. Preoperculum denticulated; operculum spiniferous; suboperculum feebly denticulated. Tongue smooth. Fourteen species.

GENUS II. LATES, Cuv. Suborbital and coracoid strongly denticulated; coarse denticulations at the angle and lower border of the preoperculum. Three species.

GENUS III. CNIDON, Mull. and Trosch. Agrees with *Lates* in the almost total want of pseudobranchiæ, but is distinguished therefrom by the entirely smooth under border of the preoperculum, whose hinder border is toothed and sends out a spine beneath. Nostrials remote from each other. Scapula with only one spine and the suborbital scale bone nearly smooth.

GENUS IV. PSAMMOPERCA, Rich. Body a handsome and regular ellipse, the rather small head forming the acute anterior end of the curve. Ctenoid scales rather large. Dorsal notched nearly to the base, moving in a scaly sheath. Teeth on the jaws; vomer and pa-

latine bones crowded, rounded, granular; tongue smooth; cheeks and gill-covers scaly; preorbital entire on its edge, smooth; angle of the operculum running out horizontally into a short strong spine, above which the edge of the bone is set with teeth like a comb; under limb of the bone smooth; a small spine on the operculum. Differs from *Perca* in the form of the teeth and by the absence of a well-marked preopercular disk; from *Percolabrax* by its smooth tongue and solitary opercular spine; and from *Lates* by the absence of angular teeth on the lower limb of the preoperculum, and by the perfectly entire preorbital. This genus might enter the group having a single dorsal. One species, Australia.

GENUS V. LABRAX, Cuv. (*Percolabrax*, Schlegel.) Suborbitals and coracoid not denticulated; two opercular spinous points. A disk of villiform teeth on the tongue. Eight species.

GENUS VI. CENTROPOMUS, Lacép. Operculum without spinous points. Dorsals separated by a small scaly interval. Preoperculum denticulated on its posterior border, with some teeth in the raised anterior edge of its disk. One species.

GENUS VII. ENOPLUSUS, Cuv. Suborbital denticulated. Preoperculum denticulated and armed by a strong spine; operculum and coracoid without spines. Body and vertical fins greatly elevated.

GENUS VIII. DIPLOPRION, Kuhl and Van Hass. Trispinous operculum; operculum obtuse at the angle, with a denticulated line on the surface of its limb and coarse denticulations on its edge; preorbital entire. One species.

GENUS IX. GRAMMISTES, Bloch. Scales minute, enveloped in mucoid epidermis. Dorsals near each other. Spinous preoperculum and operculum; no apparent anal spines. Two species.

GENUS X. ASPRO, Cuv. Body elongated. Dorsals at a little distance from each other. Snout thick, smooth, and projecting beyond the mouth. Two species.

GENUS XI. AMBASSIS, Commer. (*Chanda*, Hamilt. Buch.) Both the anterior and the posterior edges of the preopercular limb denticulated; a recumbent spine pointing forward in front of the dorsal; operculum ending in a point; distinguished from *Apogon* by the contiguous dorsals, and the recumbent spine before the dorsal fin. No pancreatic cæca, in which the genus departs from the ordinary Percoid structure. Fourteen species.

GENUS XII. PRIOPIS, Kuhl and Van Hass. Frontal border of the orbit serrated; in other respects like *Ambassis*. One species.

GENUS XIII. MICROICHTYS, Rüpp. General aspect and the form and position of the fins as in *Ambassis*. Free border of the preoperculum not denticulated; an acute ridge extending from the eye dorsal above the scaly operculum. Lateral line commencing under the first rays of the second dorsal; only two stiff rays in the anal. Mandible projecting a little beyond the upper jaw; orifice of the mouth moderately large, armed by a row of wholly fine teeth; no teeth visible on the palate. Gill-openings large; branchiostegals seven. Large scales on the body, easily detached. One species, Sicily.

GENUS XIV. BOGODA, Bleek. Separated from *Ambassis* by their entire preorbital scale-bones and conical jaw-teeth, which are bigger on the fore part of the mandible. Dorsals two, united at the base; ventrals thoracic. Teeth on the jaws, vomer, and palatines. A recumbent spine before the dorsal. Branchiostegals six. Anal spines three. Pseudobranchiæ. Six species, Bengal.

GENUS XV. NIPHON, Cuv. Strong pointed spine at the angle of the preoperculum; fine denticulations on the vertical limb, and coarse teeth on the horizontal edge of that bone. Three strong, sharp opercular spines; serrated preorbital. Long subelliptical body. Dorsals connected at the base; three anal spines.

GENUS XVI. POMATOMUS, Risso. Somewhat of the aspect of *Mugil*. Eye very large. Two short dorsals near the middle of the back, separated from each other; anal posterior to the last one, also short; back a little keeled in front of the dorsal. Scales ciliated as in the rest of the family, covering the cheeks and gill-covers. Caudal deeply forked. Stomach cæcal; twenty-two pancreatic cæca, long, and forming two groups; air-bladder very large, simple, with red elliptical granular bodies interiorly. One species.

GENUS XVII. APOGON, Lacép. Scales large, readily deciduous. General aspect of *Mullus*. Dorsals two short, widely separated. Villiform teeth. A double preopercular border finely denticulated. Pancreatic cæca few.

(b.) Two dorsals, or one dorsal deeply notched. Long canine teeth accompanying the villiform bands on the jaws.

GENUS XVIII. CHELODIPTERUS, Lacép. Have the characters of *Apogon*, with the addition of long pointed more or less curved teeth on the jaws, along with the fine villiform bands, which exist also on the vomer and palatines. Preoperculum with a finely den-

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ticated line round the fore part of its limb, as well as serratures on its hinder edge; operculum entire, without spines. Large, readily deciduous scales, and the dorsals well separated. Stomach large, caecal; about three pancreatic caeca. Three species.

GENUS XIX. LUCIOPERCA, Cuv. Some of the teeth on the jaws long and pointed. Border of the preoperculum with a single line of denticulations only, which are on the posterior edge of the limb. Scales rough. Large caecal stomach; four pancreatic caeca. Five species.

GENUS XX. ETELIS, Cuv. A single short pungent point on the operculum; very minute serratures on the preoperculum. Curved canine teeth on the jaws, but not on the palatines. Dorsals contiguous. Scales large. Stomach a large caecal bag; five pancreatic caeca; a large air-bladder, with its vasoganglions in little red stripes.

(c.) *A single dorsal; canine teeth among the others.*

GENUS XXI. SERRANUS, Cuv. Preoperculum rounded at the angle, denticulated on the horizontal portion of the curve, as well as on the ascending one; two or more spinous points on the operculum. *Jaws not scaly.* Twenty-six species.

GENUS XXII. ANTHIAS, Bloch. *Serrani* of small size, and generally brilliant colours. Head and jaws *scaly*, the maxillary being densely covered with conspicuous scales. Six species.

GENUS XXIII. MEROU, Cuv. *Serrani* of larger size generally than *Serranus* proper, or *Anthias*. Operculum with two, or mostly three, spines. Very small scales on the mandible. One hundred and forty species.

GENUS XXIV. PLECTROPOMA, Cuv. Serratures on the lower border of the preoperculum turned obliquely forwards, and somewhat resembling the denticulations of a cock's comb. Upper border mostly entire. In other characters *Serrani*. Operculum spinous. Sixteen species.

GENUS XXV. DIACOPE, Cuv. Characterized by a rounded notch above the angle of the preoperculum which receives a small knob of the interoperculum. In other characters *Serrani*. Forty species.

GENUS XXVI. MESOPRION, Cuv. *Serrani* in fins, teeth, and preopercular denticulations, but with an unarmed operculum, ending in a smooth point, not spinous, nor pungent. Nearly allied to *DiaCOPE*, and many species have even the knob of the interoperculum and corresponding notch in the preoperculum, but never so distinctly formed. From *Dentex*, which they resemble in external form, they are distinguished by their vomerine teeth and denticulated preoperculum. Fifty-four species.

GENUS XXVII. APRION, Cuv. Canines on both jaws; short villiform teeth on the vomer and palatines. Operculum with two very small spinous points; but the preoperculum smooth-edged. It would be almost an *Etelis* if its dorsal were not single; or a *Grystes*, if it wanted the canines. Air-bladder ample. One species.

(d.) *A single dorsal, with villiform teeth only, and no canines.*

GENUS XXVIII. ACERINA, Cuv. Whole head destitute of scales. Muciferous excavations in the bones of the cranium; five or six in the suborbital chain, and more on the limbs of the mandible; small spinous points with sinuses between, but no serratures on the border of the preoperculum. Two anal spines. Two species.

GENUS XXIX. PENTACEROS, Cuv. Body oval, high. Pre-orbitals, opercular pieces, cranium, and coracoid, coarsely striated. Cheek scaly. Blunt conical tuberosities over the eye and on the occiput. Scales of the body striated and granulated, and strongly adherent. Villiform teeth on the jaws and front of the vomer. Ventrals wide apart, their spine very large; five anal spines. Caecal stomach; nine pancreatic caeca; a large air-bladder. One species.

GENUS XXX. CENTROPRISTIS, Cuv. Analogous to the *Serrani* in the union of characters derived from a spinous operculum, and a serrated preoperculum. Differs from *Polyprion* in the absence of a denticulated crest on the operculum, and the want of denticulations on the preorbital. The snout, jaws, and gill-membranes are destitute of scales, but the cranium, cheeks, and opercular pieces are scaly, the scales on the operculum being larger than those of the cheek. Fourteen species.

Bonneville divides this genus into three groups: *Centropristis* proper, having bigger conical teeth mixed with the granular ones on the jaws, and an interior band of vomerine teeth in a chevron. It comprehends *C. atrarius*, *tabaccarius*, *atrobranchus*, *hirundinaceus*, and *brasiliensis*. *Homodon* (*Arripis*, Jenyns) has card-like teeth on the jaws; an oblong, three-cornered group of vomerine teeth, and a more elongated body. *C. truttaceus*, *georgianus* (Australian

fish). *Myriodon*, all the jaw-teeth equally minute; vomerine teeth in a chevron. *C. scorpenoides*.

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GENUS XXXI. AULACOCEPHALUS, Schleg. Three spines on the operculum; preoperculum strongly serrated on its horizontal border. Caudal fin rounded. One species.

GENUS XXXII. GLAUCOSOMA, Schleg., Rich. Aspect *Sciænoïd*. Low spinous part of dorsal, peaked soft part. Head, except the lips and gill-membrane, densely scaly. Scales on the basal half of the soft-rayed vertical fins. Technically *Centropristis*, but having a very different general appearance. Card-like teeth on the jaws, vomer, and palate. Scales moderately large, ctenoid. Preoperculum crenulated; two flat, bony points to the rounded operculum. Branchiostegals seven, occasionally eight. Two species.

GENUS XXXIII. GRYSTES, Cuv. *Centropristis*, with a smooth-edged preoperculum. Scales small, thin, embedded in the skin, extending over great part of the fins, and covering the gill-rays, throat, and all parts of the head, except the lips and the folds that shut up when closed. Notch between the dorsals equal to half their height.

GENUS XXXIV. APSILUS, Cuv. Belonging to the Percoids, with a single dorsal, but distinguished by the total absence of true spines or denticulations on the opercular bones, or those of the shoulder. Teeth very fine villiform, in a narrow band on the jaws and palatines. Seven branchiostegals. Differs from *Centropristis* in the want of denticulations on the preoperculum, and from *Grystes* in having no opercular spine. Scales thin.

GENUS XXXV. RHYPTICUS, Cuv. No denticulations on the operculum or preoperculum, but short spines on both. Head smooth, without scales. Scales deeply imbedded in a muciferous skin. In other characters much like *Serranus*. Few spines in the dorsal. A long caecal stomach, pointed at the end; six or seven pancreatic caeca; air-bladder oval, not large. Two species.

GENUS XXXVI. POLYPRION, Cuv. Preoperculum strongly and irregularly denticulated, and the anterior border of its limb rough. A strong spiny crest traverses the middle of the operculum longitudinally, and there is a less prominent point below it; the edges of the suboperculum and interoperculum are finely denticulated. The preorbital is also slightly crenated, and there are denticulated crests and tubercular eminences on the upper border of the orbit and top of the cranium, with serratures on the suprascapulars and coracoid bones, giving the head some resemblance to that of a *Scorpena*. Stomach caecal, obtuse; two pancreatic caeca. One species.

THERAPONIDÆ.

The preceding family of Percoids contains the genus *Perca*, as sketched out by Artedi and Linnæus. The numerous species discovered subsequent to the days of these naturalists, and accumulated in the rich Parisian museum, brought to the knowledge of Cuvier many new Percoid forms which departed more or less from the typical *Perca* of the older ichthyologists. In the *Histoire des Poissons* these are mostly introduced as appendages to the normal Percoids, and contain fishes with fewer branchiostegals than seven, or with more soft ventral rays than five, or with some other striking external peculiarity by which they can be distinguished as minor groups, but which differ little from the true Percoids in essential internal structure. We have separated one large group of these Percoid allies as they may be called, to form the family of *Theraponidæ*, distinguished from the more typical Percoids by the characters indicated in the table. But in the family thus brought together, there are several minor groups very natural in themselves, but which do not retain a general family likeness, extending to all the groups. The first three genera are distinguished from the others by the lower rays of their pectorals being simple, and formed evidently as organs of touch, and the next three genera are American fresh-water fish, of much beauty and neatness of aspect. These are followed by five or six genera, with generally well-armed opercular bones; then there are several newly proposed genera, in which a family aspect is less recognisable; and, lastly, we have placed at the end of the family *Macquaria* and *Latilus*, two genera associated by Cuvier with the *Sciænoïds*, but which, notwithstanding the absence of teeth on the palate in the one, and the wholly toothless mouth of the

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other, seem to be more nearly allied to certain members of this group than to any other family in this system.

FAMILY III.—THERAPONIDÆ.

Thoracic scaly fishes. Branchiostegals six. Two dorsals, or the spinous and soft dorsals united to form one fin. Scales ctenoid or cycloid. Teeth on the jaws, and most generally on the palatines and vomer. Opercular pieces variously denticulated or spinous, or some of them unarmed. Five soft rays in the ventrals, with one spine; lower pectoral rays in some genera unbranched, jointed, and prolonged beyond the membrane, but in most of the ordinary form. A rather heterogeneous assemblage of Percoids, brought together by the single character of six branchiostegals, but differing in some having cycloid, others ctenoid scales, and even in the same genus in the presence or absence of teeth on the palate, the teeth of that part falling out when the fish is still young.

GENUS I. CIRRHITES, Comm. Resemble *Mesoprion* in their scales, fins, and in having a denticulated preoperculum, and the operculum ending in a flat, smooth corner, but are distinguished by the lower pectoral rays being thickened, simple, though jointed, and elongated beyond the membrane, seemingly to serve as organs of touch, such as exist in many of the *Sclerozenidæ*. The vomer is armed with villiform teeth, but there are none on the palatines. Stomach rather short; pancreatic cæca four; no air-bladder. Eight species.

GENUS II. AFLODACTYLUS, Cuv. Lower pectoral rays thick, fleshy, jointed, but not branched, and protruding beyond the narrow membrane at the tips. Teeth thin narrow plates lobed at the crown, in many rows on the jaws, the outer row taller than the interior ones, the newest of which are very short, and to the naked eye raduliform. General aspect of *Grystes*. Scales small, striated on the edges, covering most of the head and fins. Interoperculum scaleless; preoperculum smooth-edged. A small, flat, smooth opercular point. Branchiostegals six. Ventrals posterior to the pectorals, in consequence of the elongation of the pubic bones, which are attached to the coracoids. Stomach small, cæcal, with an ascending pyloric branch exceeding it greatly in size; two short pancreatic cæca; a large, simple air-bladder. Three species. Distinguished from *Cirrhites* by its teeth, like those of *Crenidens*.

GENUS III. CHIRONEMUS, Cuv. Differs from the Sciaenoid *Cheilodactylus* in having vomerine teeth on the fore-part of the bone; teeth generally setiform, few and feeble. Scales cycloid; opercular pieces and cheeks covered with scales, not greatly smaller than those of the body. Preorbital high, like that of a Sparoid. Preoperculum smooth-edged, rounded at the angle; operculum with two flat points, scarcely pungent. Cæcal stomach, pretty large; four pancreatic cæca. One species.

GENUS IV. CENTRARCHUS, Cuv. (*Ichthelis*, Rafin.) Oval, compressed body. A single dorsal. Villiform teeth on the jaws and front of the vomer; on the palatines in two patches, and on the base of the tongue; no canines. Preoperculum generally entire; angle of the operculum divided into two flat points. Anal spines from three to nine. Scales ctenoid. Nine species.

GENUS V. POMOTIS, Cuv. A rounded, skinny, coloured lobe prolonging the operculum, whose bone ends in an obtuse angle. Pharyngeal teeth cylindrical, with flat tops, disposed in a pavement-like manner; villiform teeth on the jaws, and a row across the front of the vomer, but none on the tongue. Three anal spines. Stomach cæcal, obtuse; pancreatic cæca six. Ten species.

GENUS VI. BRYTTUS, Cuv. *Pomotis* with a narrow band of villiform teeth on the tongue. Three anal spines. One species.

GENUS VII. POMANOTIS, Guich. Body compressed, oval, high, covered with ciliated scales. Snout short and conical, but obtuse; a moderate-sized mouth; teeth on the jaws crowded, conical, acute, the exterior ones somewhat curved. Preoperculum, interoperculum, suboperculum, serrulated at the corners. Tongue smooth. Operculum spinous, without a membranous border. Dorsal single; ventrals thoracic. Branchiostegals six. Fresh water, Aleppo. Near *Centrarchus*, *Pomotis*, and *Bryttus*.

GENUS VIII. PRIACANTHUS, Cuv. Angle of the preoperculum projecting in form of a flat spine, which is denticulated or crenulated on the edges like the rest of the bone; resembling *Anthias* in the whole snout and jaws being covered with strongly ctenoid scales, which extend along the median line of the throat. No canines, but narrow bands of villiform teeth on the jaws, the chevron of the vomer, and along the palatines. Mandible projecting at the chin. Eyes large. Six branchiostegals. Posterior orifice of the nostril a vertical slit; anterior one a small round hole. Form oval; the dorsal and anal rounded. Stomach large, cæcal, rounded posteriorly; five thick pancreatic cæca; air-bladder of moderate size, rounded anteriorly, pointed behind. Eighteen species.

GENUS IX. DULES, Cuv. *Centropristis* by external form and interior structure, but their six branchiostegals have caused us to

place them in a separate group. Some have a single dorsal, and three opercular spines; others a notched dorsal, and only two spines on the operculum. Vestiges of serratures on the suborbital, and some very fine and little apparent ones on the preoperculum. Teeth coarsely villiform on the jaws, chevron of the vomer, palatines, and tongue. Twelve species.

GENUS X. THERAPON, Cuv. Villiform teeth on the jaws; denticulated preorbitals; preoperculum, and often the suprascapular or coracoid, also denticulated. Six branchiostegals. No scales on the cranium, snout, or jaws. Spinous part of the dorsal folding back into a scaly furrow. Air-bladder always divided into two distinct sacs by a contraction as in the *Cyprinidæ*, the *Characini*, and *Myripristis*. The palatine teeth are in some deciduous at a young age. Some have the outer row of jaw-teeth stronger than the others. Stomach cæcal, pointed; about twelve pancreatic cæca; anterior division of the air-bladder globular. Twelve species.

GENUS XI. DATNIA, Cuv., are a group merely subordinate to *Therapon*, and differ in having a more elevated body, a straight or concave profile, a pointed snout, and by the dorsal spines being stouter, and occupying a greater length of the back, though not more numerous. The dorsal is slightly notched, and they have no teeth on the palate. Stomach cæcal, rounded behind. Three species.

GENUS XII. PELATES, Cuv., is a third division of *Therapon*, and is distinguished by a more even dorsal, less notched, and by the operculum ending in two feeble points, scarcely to be felt through the integument. Snout somewhat obtuse; mouth small; jaws equal; teeth villiform in three or four rows, but none on the vomer or palate. Three species.

GENUS XIII. HELOTES, Cuv. A fourth division of *Therapon*, having like the first one a deeply-notched dorsal, and an opercular spine. Body oblong. Head small; mouth narrow, as in the third division; exterior row of teeth minutely tricuspid; no palatine teeth. Two species.

GENUS XIV. DATNIOIDES, Bleek. Distinguished from *Therapon*, *Datnia*, *Pelates*, and *Helotes*, by the suborbital scale bones not being notched, and by a simple swim-bladder. Dorsal fin simple. Premaxillary and mandibular teeth simple, pluriserial; no canines. Vomer and palate smooth. Preoperculum denticulated, without larger spines; suborbitals edentate. Branchiostegals six; lips membranous, entire, not fimbriated. Head scaly above; snout scaleless.

GENUS XV. BADIS, Bleek. Separated from *Nandus* by the entire preoperculum and toothless tongue. Dorsal fin single. Teeth on the jaws, palatines, and entopterygoids; tongue smooth; suborbital scale bones and preoperculum not toothed. A single opercular spine. Branchiostegals six. Lateral line interrupted. Upper jaw protractile; inferior pharyngeals oblong, contiguous, but not united.

GENUS XVI. NANDUS, Cuv. Mouth protractile; teeth villiform, very close and short on the jaws, palatines, and chevron of the vomer. Preoperculum and interoperculum finely denticulated on the edge; opercular spine so small as to be easily overlooked. Scales smooth, cycloid. Intestines resembling those of a Labroid; stomach siphonal, with a very short ascending branch; no pancreatic cæca; air-bladder simple. One species.

GENUS XVII. CATOPRA, Bleek. Dorsal solitary. Setaceous teeth on the jaws, palatines, and vomer; pterygoid and lingual teeth granular, in an oblong patch. Preorbital scale bone and preoperculum denticulated; two flat spines on the operculum. Branchiostegals six. Lateral line interrupted; upper jaw protractile. Bleeker makes a family group of this genus and *Nandus*, and indeed the position of *Nandus*, with its siphonal stomach, and want of pancreatic cæca, does not seem to be with *Therapon*.

GENUS XVIII. ANOPLUS, Schleg. Distinguished from *Datnia* by having vomerine teeth; from *Nandus* by the want of palatine teeth. Branchiostegals six. One species, *A. banjos*.

GENUS XIX. BOLEOSOMA, Dekay. Two dorsals. Smooth-edged preoperculum; operculum scaly, with a spine. Branchiostegals six. Nape narrow, compressed. Rivers, New York.

GENUS XX. PILEOMA, Dekay. Two separated dorsals. Smooth preoperculum. A flat, weak, opercular spine. Ventrals with five soft rays. Teeth of equal size. Lake Champlain.

GENUS XXI. LEPISOMA, Dekay. Body and fins scaly. Fleshy appendages along the lower edge of the head and round the eyes. One dorsal. Branchiostegals six. Teeth on the jaws, vomer, and palatines. Ventrals before the pectorals. One species. Florida.

Not having access at present to the works in which Dr Dekay has described these three fresh-water genera, we merely give the generic characters, as quoted in the *Archiven für Naturgeschichte* for 1844; and cannot therefore, without more data, fix their proper place in the system. Along with these genera, ranged in the family of *Theraponidæ*, we place part of the Sciaenoids, "with fewer than six branchiostegals," described in the *Histoire des Poissons*. Their abstraction from the Sciaenoids renders the characters of that group more precise, and they are separated from the *Theraponidæ*

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more by the toothless palate than any difference of form or general structure.

GENUS XXII. LOBOTES, Cuv. Branchiostegals six. A single dorsal; thoracic ventrals with five soft rays. Body, opercular pieces, and cheeks scaly. Snout short; prominent mandible; profile of face somewhat concave. Very coarse denticulations on the preoperculum. Soft portions of the anal and dorsal prolonged in such a manner that posteriorly the fish appears to be trilobate, the rounded caudal forming the middle and longest lobe; entire form oval and thickish. Spines of the fins strong, and those of the back reclining in a scaly furrow when at rest. Four pores, or four groups of minute pores towards the end of the mandible. Scales ciliated. Lateral line continuous. Stomach cæcal, very large, and fleshy; three pancreatic cæca; large oblong air-bladder. Four species.

GENUS XXIII. SCOLOPSIDES, Cuv. Connected with the Sciænoïds, and especially with *Pristopoma* and *Diagramma* by the denticulations of the preoperculum; but there are either no pores on the end of the mandible or only very minute ones, easily overlooked. The peculiar generic character consists in the second suborbital scale bone ending in a spinous point, close under the orbit, pointing backwards; and the third bone of the chain frequently sends out one in the opposite direction which meets it. Body oval or oblong. Dorsal continuous in outline. Eye large. Mouth moderate. Scales pretty large, extending to the occiput, opercular pieces, cheeks, and throat. Dorsal spines reclining on a scaly furrow, and having their broader sides turned alternately to the right and left, as in many Sciænoïds and Sparoïds. Caudal notched or forked. Stomach cæcal, rounded, very small; pancreatic cæca six thick, as long as the stomach; air-bladder simple. Twenty-two species.

GENUS XXIV. HETEROGNATHODON, Bleek. Scaly fishes. Dorsal solitary. Branchiostegals five. Rays of the pectoral entire. Suborbital scale bones smooth, without spines. Preoperculum denticulated; a solitary opercular spine. Premaxillary teeth bristle-shaped, pluriserial, with four canines anteriorly; mandibular teeth also pluriserial and bristle-shaped, with two canines, and a row of conical teeth behind. Batavia.

GENUS XXV. MACQUARIA, Cuv. General form Percoid, with the muciferous excavations of the bones of *Acerina*. No teeth. Branchiostegals five. A pit and two small pores beneath the end of the mandible as in many Sciænoïds. Preoperculum, suboperculum and interoperculum, suprascapular and coracoid, finely denticulated or serrated; operculum terminated in two thin, flat, bony points. Scales rough, ciliated. Stomach cæcal; eight pancreatic cæca; air-bladder either absent or very small. One species.

GENUS XXVI. LATILUS, Cuv. Forms in the division of Sciænoïds, with an undivided dorsal, as given in the *Histoire des Poissons*, a genus remarkable for its arched profile descending almost vertically, the very short snout and large eye, near the profile. Horizontal mouth reaching the front of the eye, and a general form of the tapering body, resembling *Coryphæna*. Teeth, a cross band in front of the vomer, none on the palatines; four or five larger curved teeth in front of the villiform band on the jaws. Branchiostegals six. Preoperculum very finely denticulated; operculum ending in a single point. Suprascapular smooth. Dorsal rays slender, flexible. Scales minutely ciliated. Lateral line straight, continuous. Stomach cæcal; one pancreatic cæcum only observed; air-bladder simple, large. One species.

POLYNEMIDS.

This small family has relations with the first group of the *Theraponidæ*, in the existence of long feeler-like rays in the pectorals. In one species of *Polynemus*, the long free pectoral rays have obtained for it the appellation of Paradise-fish, from the resemblance these filamentous rays bear to the tail-feathers of a bird of Paradise. *Polynemus* is also remarkable as being a genus, otherwise natural, of which the species exhibit great varieties in the form of the air-bladder. In some, that viscus is lobed posteriorly, and fringed on the sides with many pointed processes; in other species, the air-bladder, though large, is quite simple, and in others there is no air-bladder at all, just as it is wanting in some species of *Scomber*. The *Polynemus indicus*, which has a large air-bladder with from twenty-eight to thirty-five of these lateral appendages springing from it, and also a very great number of pancreatic cæca divided into two bundles, furnishes most of the isinglass that is procured at Penang. The weight of this fish is commonly from 4 to 6 lb., and seldom exceeds 20 lb. The air-vessel of a good-sized fish when dried and ready for the

market weighs upwards of two ounces, and the isinglass is considered to be very good, and fetches from 25 to 30 Spanish dollars the pikul. The prepared air-vessels are known in eastern commerce by the name of "Fish-maws," and in 1842 between 12,000 and 13,000 dollars worth were exported from Prince of Wales Island (Singapore). They are not obtained exclusively from the *Polynemus*, though its isinglass is among the best. Dr Cantor, from whom these particulars are quoted, says that the fishery is carried on in a very rude manner, chiefly by the Chinese, and might be almost indefinitely extended by European capital and skill.

FAMILY IV.—POLYNEMIDÆ.

Acanthopterygians with abdominal ventrals, a position resulting from the elongation of the pubic bones which are suspended to the coracoids. Teeth on the jaws, front of the vomer, and palatines. Two dorsals; scaly appendages in the axillæ of the pectorals and ventrals. Scales ctenoid, feebly ciliated. Pancreatic cæca.

GENUS I. POLYNEMUS, Linn. Body oblong. Head covered, even to the branchiostegal membrane, with deciduous scales. Preoperculum denticulated. Villiform teeth on the two jaws, front of the vomer, and on the palatines; tongue short and broad, smooth. Wide gill-openings; seven branchiostegals. The two openings of each nostril near to one another and near the end of the snout. Dorsals widely separated, the second one being distant also from the caudal, and corresponding in position with the anal; caudal forked, generally unequal. Small scales on the three vertical fins, and on the base of the pectoral; a number (varying with the species) of the under pectoral rays free, long, and filiform, separated from the rest of the fin by a scaly space. Anal spines, one, two, or three. Stomach obtusely cæcal; several pancreatic cæca (six or more); air-bladder large, pointed, and entering among the muscles of the tail; in some species the air-bladder is wanting, in others that viscus has many (from twenty to thirty) processes on the ventral surface. Sixteen species.

With this we associate a Sciænoïd genus, which has had no other more appropriate place assigned to it as yet, and which has many characters in common with *Polynemus*.

GENUS II. CHEILODACTYLUS, Lacép. Sciænoïds with an oval compressed body; small mouth; villiform teeth, or conical, scarcely acute, on the jaws only, and not on the palate. Preorbitals and preopercula without denticulations. Numerous dorsal spines, and ventrals attached under the middle of the pectorals, but with the pubic bones suspended from the coracoid. Branchiostegals six, more rarely five only. Stomach cæcal; pancreatic cæca two, short; rectum dilated, muscular. The lower pectoral rays, to the number of six or seven, are simple, and one of them commonly thicker than the rest, is elongated into a filiform tip, which often reaches the end of the anal. Caudal forked. Many have a slight prominence before the orbit, and in one or two species it rises in a conical form. Eight species.

GENUS III. LATRIS, Rich. A division of *Cheilodactylus*, with generally more-elongated elliptical bodies, and none of the simple rays of the pectoral passing the membrane. The ascending limb of the preoperculum is minutely serrated in some, and smooth in others. Three Australian species.

SURMULLET FAMILY.

The fishes of this family were denominated *πρίγλη* by the Greeks, and *mullus* by the Romans. The Greek name is said to have originated in the three spawning seasons attributed to the Surmulletts, and they were dedicated to the tergeminous or tricpitous goddess Hecate. The Latin name had another origin according to Pliny—a *colore mulleorum calceamentorum*, from the red-coloured shoes or buskins worn by the kings of Alba, and afterwards by the consuls, prætors, and curule ediles. By the luxurious Romans, the Surmulletts were held in such repute that they sought for them far and wide, and without regard to expense. They seldom exceeded 2 lb. in weight, and the purchase of a large one, the price augmenting in a greater ratio than the size, was considered to be an act of magnificence. A Surmullet of 3 lb. weight was an object of admiration, and one of 4 lb. entailed ruin on the purchaser.

Classification—
Acanthop-
terous
Fishes.

Classification—
Acanthop-
terous
Fishes.

“Mullus tibi quatuor emptus
Librarum, cœnæ pompa caputque fuit,
Exclamare libet, non est hic improbe, non est
Piscis: homo est; hominem, Calliodore voras.”
MARTIAL, l. x. 31.

Classification—
Acanthop-
terous
Fishes.

Seneca relates the history of a Surmullet that was presented to Tiberius, and which that emperor, in a fit of economy, sent to the market. Apicius and Octavius were competitors for it, and the latter became the purchaser at the cost of 5000 sesterces, or upwards of L.40 sterling. Asinius Celer paid 8000 sesterces for one in the reign of Caligula. The high-priced fish were brought from a distance, as they did not thrive in ponds, and increased little there in weight, though extraordinary pains and expediture were employed in the endeavour to rear them. It was one of the luxuries of a giver of feasts to cause these fishes to swim down streams led through the banqueting room, that his guests might enjoy the sight of their brilliant colours during their repast, or to let them die in glass vessels, that all the varying hues of the expiring fish might glut their eyes. Seneca says the fish swim under the very couches of the guests, and they are caught under the table that they may be the sooner placed upon it, for no Surmullet was considered to be fresh unless it expired in the hands of the guests. They were exposed in vessels of glass, that the different colours they assume during a slow and painful agony may be noticed. Nothing was considered to be more beautiful than a dying Mullet. The struggles of the fish to escape death bring out the most brilliant scarlet tints, which are followed by a general paleness; and in the passage from life to death these two extreme tints mingle, says the author from whom we borrow, in the most agreeable manner. The liver of the Surmullet was considered to be the most delicious part, and was bruised in wine to make a *garum* for the flesh. Even in the present day the Surmullet is considered to be one of the best of sea-fishes—its flesh being white, firm, tender, of an agreeable flavour, and easily digested because it contains little fat. The scales of the Surmullets are strongly ciliated.

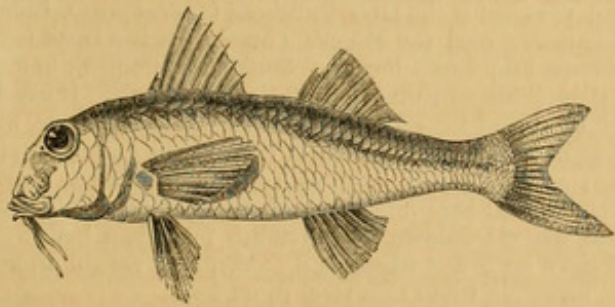


Fig. 95.
Mullus barbatus.

FAMILY V.—MULLIDÆ.

Les Mullus, Cuv. A perfectly natural family, distantly allied to the Percoids, but readily distinguishable from other *Acanthopterygii* by the two dorsals, widely separated from one another, by the large and easily-detached scales of the head and body, and by the pair of symphyseal barbels of the mandible which retire between the limbs of that bone when not in use. Body oblong, little compressed. Fins of moderate spread. Profile more or less convex above and below. A high narrow preorbital; small mouth, with feeble teeth. Gill-opening wide; four branchiostegals. Mucoducts forming the lateral line divided into a cluster of branches on each scale. Siphonal stomach; numerous pancreatic cœca.

GENUS I. MULLUS, Linn. No teeth on the upper jaw; a disk of pavement-like teeth on the front of the vomer. No spine on the operculum. No air-bladder. Two species.

GENUS II. UPENEUS, Cuv. Short teeth on both jaws, sometimes closely villiform (*Upeneoides*, Bleek.) sometimes distinct and uniserial (*Upeneus*, Bleek.) Some have villiform teeth on the palate or vomer; in most these bones are destitute of teeth. Thirty-eight species.

GENUS III. ACROPOMA, Schleg. General aspect of *Mullus*, but distinguished by the want of barbels. Anus nigh the ventrals, at a wide distance from the anal fin. Jaw-teeth pointed, the foremost being canines. Branchiostegals seven.

Holocentrides.

This small family consists of that division of Cuvier's Percoids whose members have more than seven branchiostegals, and whose soft ventral rays exceed five. The group is a natural one, all the species having a common likeness which is very recognisable. They are the only *Acanthopteri* which have this unusual number of rays in the ventrals, and are fishes remarkable for the brilliancy of their colours, the neatness of their forms, and their very ctenoid scales. They are not the objects of any special fishery.

FAMILY VI.—HOLOCENTRIDÆ.

Holocentrini, Bonap. Acanthopterygians, with more than five branching rays in the ventrals, and seven branchiostegals. A natural group, recognisable by the large, very strongly-toothed or serrated scales, the furrows and streaks on many of the bones of the cranium, face, and gill-cover, the serratures on the edges of the opercular pieces, and the general stoutness of the spines of the fins. Cheeks scaly. Dorsals single, or deeply notched, or two contiguous dorsals. Small spines above and below the caudal; dorsal spines falling back into a furrow. Otolites large. Air-bladder connected with the otocrane by an ossicle and a tympanum closing the orifice; stomach cœcal; numerous pancreatic cœca (eight to twenty or more).

GENUS I. MYRIPRISTIS, Cuv. Somewhat of the aspect of *Aponogon*. Cranium sculptured. Dorsals two, contiguous, or one deeply notched. Preoperculum with its border serrated, and also a serrated line in front of the limb, but no spine at its angle, by which it is distinguished from *Holocentrum*. Villiform teeth on the jaws and front of the vomer, with a few bigger ones in front of the jaws of a short obtuse conical form. Tongue smooth. An acute opercular spine. Stomach cœcal, reaching the middle of the cavity of the abdomen; nine pancreatic cœca; a fibrous exterior coat of the air-bladder, which is large, and divided into two by a contraction. Fourteen species.

GENUS II. HOLOCENTRUM, Cuv. *Myripristis* with a strong spine at the angle of the preoperculum. Dorsal slightly notched. Third anal spines generally very large. Otolites not always connected with the air-bladder, which is simple and extends the whole length of the belly, and is not forked anteriorly. Stomach cœcal; eight pancreatic cœca. Twenty species.

GENUS III. BERYX, Cuv. *Holocentra* with a very large eye, but differing in having a single dorsal, with only slender spinous rays in front, and without any notch of separation. Anal spines not remarkable for size. Stomach cœcal, cylindrical, obtuse; ascending branch fleshy. Long, slender, numerous pancreatic cœca; air-bladder wide, and running the whole length of the abdomen. Four species.

GENUS IV. RHYNCHICHTHYS, Cuv. General habit of *Holocentrum*, but with the cranial crests prolonged anteriorly into an acute snout, somewhat resembling that of *Macrourus*. A projecting spine at the angle of the preoperculum; strong denticulations on its borders, and also round the posterior edge of the operculum, but no strong spine in the latter. Two species.

MAILED CHEEKS.

The three Linnæan genera, *Trigla*, *Cottus*, and *Scorpena*, are the foundations of this numerous family, so remarkable for the variety of forms it offers; for the beauty of some, from the splendour of their colours, the elegant arrangement of their tints, or the gracefulness of their fins; and for the ugliness of others of disagreeable shapes, and having loose disgusting skins. Few fishes are so handsome, or more delicate in appearance than *Pterois*, whose fins resemble the long feathers of the gayest birds, while *Pelor* and *Synanceia* are about as ugly as a fish can be. The following table of the genera is taken from the *Histoire des Poissons*.

Classification—
Acanthop-
terous
Fishes.

TABLE OF GENERA.

No free rays in advance of the dorsal.

Two dorsals.

A parallelopiped head.

Free rays beneath the pectoral.

TRIGLA, PRIONOTUS, PERISTEDION.

Long rays beneath the pectorals, united to form great fins used as wings.

DACTYLOPTERUS.

No detached rays under the pectorals.

CEPHALACANTHUS.

A round or depressed head.

Ventrals under the pectorals.

COTTUS, HEMITRIPTERUS, BEMBRAS, ASPIDOPHORUS.

Ventrals behind the pectorals.

PLATYCEPHALUS.

A single dorsal.

A compressed head.

Villiform teeth on the jaws, vomer, and palatines.

HEMILEPIDOTUS, BLEPSIAS, APISTES, SCORPENA, SEBASTES.

Teeth on the jaws and front of the vomer, but not on the palatines.

PTEROIS.

Some small teeth on the jaws only.

AGRIOPUS.

A large head; monstrous in appearance; eye on the dorsal aspect.

Villiform teeth on the jaws and front of the vomer.

PELOR.

Free spines replacing the first dorsal.

Body scales large and imbricated; eight branchiostegals.

MONOCENTRIS.

Body mailed by plates on the lateral line; three branchiostegals.

GASTEROSTEUS, SPINACHIA.

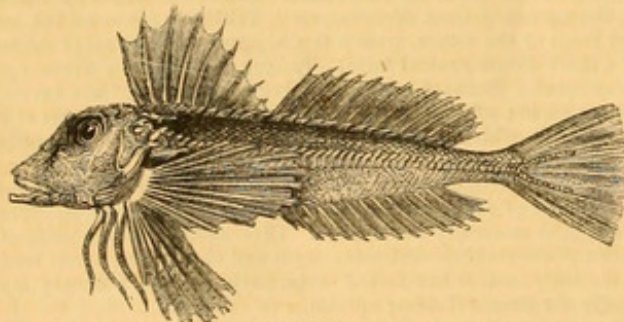


Fig. 96.

Trigla pleuracanthica.

The *Trigla* or Gurnards are too well known to need a description; at the same time they convey a good idea of the general form of one of the leading tribes of the family, and one in which the characteristic development of the second suborbital scale bone is well seen. This bone in all the *Sclerogenoids* either covers the whole cheek, or sends a process across it to the curve of the preoperculum opposite to the spine at the angle, to which it serves as a point of resistance when the spine is used as a weapon. This elongation of the suborbital is often crested by an acute ridge, and is most commonly armed with spinous points. The air-bladders of the Gurnards are variously lobed, and some of the species have been noticed to emit a grunting noise when caught, which some observers have supposed was produced by that organ; but it is the character of the order to have no air-duct to the swim-bladder. The flesh of the Gurnard is very white, firm, and wholesome.

The common *Dactylopterus* or Flying-fish of the Medi-

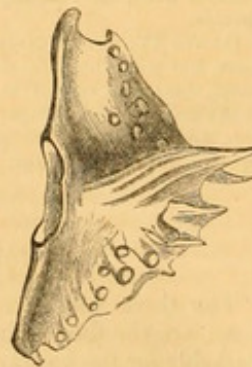


Fig. 97.

Trigla pleuracanthica
scale from the lateral line.

terranean (*Trigla volitans*, Linn.), is a species too remarkable for its functions, so opposite to those of its class in general, not to have attracted from an early period the attention of mankind. It is extremely common, and has been mentioned by all the authors who have treated of the fishes of that inland sea. The ardour with which it is pursued by the Dolphins and Bonitos, the sudden effort which it makes to escape these predaceous creatures by vaulting into the air, the new and probably unthought of dangers which there await it from gulls and other aquatic birds, render it an object of the highest interest to the unaccustomed landsman, somewhat wearied with the monotony of a sailor's life. "It is by the extension of the pectoral rays and membrane that the fish is enabled to raise itself from its proper element to the regions of the air, though this is by no means a continual flight, for the utmost it can do is to describe an arc over the surface of the water extending to a distance of about 120 feet, and sufficiently elevated for the fish sometimes to fall on the deck of a large vessel. This power of flight or momentary suspension would be much greater if the pectoral membrane could preserve its humidity longer, but it is soon evaporated in the heat of the tropics; and the membrane, as it becomes dry, loses its buoyant power, and the fish falls. They are sometimes so numerous as to afford much pleasure to the spectator by their repeated flights; and at particular times, especially on the approach of rough weather, in the night, numbers of them may be seen, by the phosphoric light they emit, marking their arched passages in apparent streams of fire." Such is the current account of the flights of this interesting fish, and of the causes of it; but it is probable, as has already been observed of the *Exoceti*, that the Flying-fishes do not soar into the air merely when pursued by their enemies, for this would only be *incidere in Scyllam cupiens vitare Charybdim*, but also to subserve some purpose in their economy.

The *Cotti* are characteristic members of another group of the Mailed Checks. The fresh-water species of this genus have the head almost smooth, and only a single spine to the preopercle. Their first dorsal is very low. The most common is the river Bull-head (*Cottus gobio*, Linn.), sometimes called the Miller's Thumb. It is a small dark-coloured fish, 4 or 5 inches in length, and frequent in most of the streams of Europe and the north of Asia. It usually lies concealed beneath stones, from whence it darts with great rapidity upon its prey. It is said to be extremely prolific; and the female, when with spawn, becomes so greatly enlarged, that her ovaries protrude like mammae. The Bull-head, like the Salmon, has a reddish hue when boiled. It affords a good and wholesome food, much sought after by the mountain tribes of several countries.

The *Scorpenae* are found in all seas in considerable numbers, and present a great variety of aspects, some being nearly as ugly as a *Pelor*, while others passing, as it were, into the nearly allied genus *Sebastes*, have a Percoid neatness of appearance. The species here figured is an Australian one, *Scorpena Stokesii*.

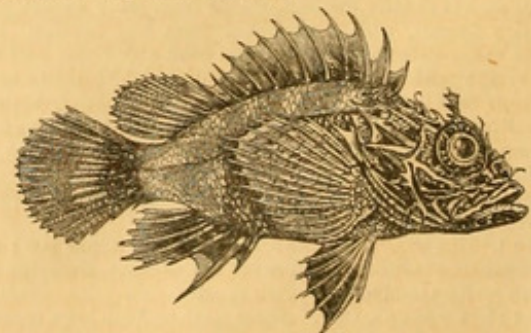


Fig. 98.

Scorpena Stokesii.

The *Platycephali* may be considered as elongated and

Classification—
Acanthop-
terous
Fishes.

Classification—
Acanthop-
terous
Fishes.

greatly depressed *Scorpenæ*. The subjoined representation of *Platycephalus cirrhonusus* will give a good idea of the

Classification—
Acanthop-
terous
Fishes.

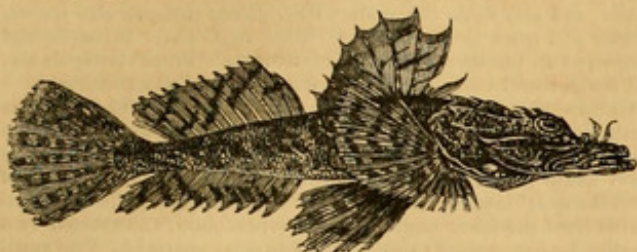


Fig. 99.

Platycephalus cirrhonusus.

form of one, which, however, is not so flatly depressed as many others of the genus. They are common ground-fish in the southern hemisphere. Fig. 42 gives a view of a scale from the lateral line of the same species. *Synanceia horrida*, as the title implies, exhibits by no means an inviting aspect. It is named *Ihan-swangi*, or Sorcerer-fish, by the Malays. *S. brachio* of Cuv. is the species called *Fi-fi*, or *Hideous*, by the Negroes of the Isle of France, who hold it in great abhorrence. In fact, nothing can be conceived more frightful. At first sight no one would consider it a fish, but rather as a mass or unformed lump of corrupted jelly. "Totum corpus," says Commerson, "muco squalidum et quasi ulcerosum." Its head and members seem enveloped in a sack of thick, soft, spongy skin, warty and wrinkled like that of a leper, and irregularly blotched over with various tints of brown and gray. Sometimes it appears entirely black; but it is always gluey and disgusting to the touch. The little eyes are scarcely discernible in the large cavernous head. This species is said to possess great tenacity of life, and survives for a long time out of the water. The skin, in fact, forms a little ring like that of *Pelor* above the point of the operculum, through which the fish can respire at pleasure, leaving the remainder of the gill-opening closed, and the gills consequently little exposed to exsiccation. The inhabitants of the Isle of France regard this fish as a reptile, and dread its sting, meaning the wounds inflicted by its spines, more than that of snakes or scorpions.

The genus *Apistes* was so named by Cuvier from the treacherous way in which these fishes conceal the moveable pre-orbital spine, by laying it along the cheek, and on any one attempting to seize them, raising it suddenly so as to inflict a disagreeable wound. The Greek word from whence the name was derived signifies "perfidious." Since Cuvier's time several species have been discovered possessing this sub-orbital weapon, but varying considerably in the rest of their form from *Apistes*, as described by him. One of these new forms is *Choridactylus multibarbus*, of which a figure (fig. 9) has been given. Some of these *Apistes*, having large pectorals, are able to sustain themselves in the air for a time, as Flying-fishes. One of the remarkable forms of the family is represented by fig. 14. It is the *Monocentris Japonica*.

The *Gasterosteii* differ from the rest of the family in having the spines of the dorsal free and detached. The species are small fishes familiarly known under the name of Sticklebacks (Scotice, *Benticles*), and extremely common in all the fresh waters of Europe. Gesner indeed asserted that they did not occur in Switzerland; but the contrary has been long since ascertained. Our most common species is *G. aculeatus* (Linn.), under which name, however, it is supposed that more than a single kind has been confounded. It is an active and greedy little fish, extremely destructive of the fry of other species, and consequently injurious in ponds where these are sought to be preserved. Mr Henry Baker informs us that it will spring not less than a foot perpendicularly out of the water and to a much greater distance in an oblique direction, when it

desires to overcome any opposing obstacle. "It is scarcely to be conceived," he adds, "what damage these little fish do, and how greatly detrimental they are to the increase of all the fish in general among which they live; for it is with the utmost industry, sagacity, and greediness that they seek out and destroy all the young fry that come in their way, which are pursued with the utmost eagerness, and swallowed down without distinction, provided they are not too large; and in proof of this, I must assert that a bannicle which I kept for some time, did, on the 4th of May, devour, in five hours' time, seventy-four young dace, which were about a quarter of an inch long, and of the thickness of a horse hair. Two days after it swallowed sixty-two; and would, I am persuaded, have eat as many every day, could I have procured them for it." The Stickleback sometimes swarms in prodigious numbers. Pennant states that at Spalding, in Lincolnshire, there are once in seven years amazing shoals, which appear in the Welland, coming up the river in the form of a vast column. This concourse is supposed to arise from the multitudes which have been washed out of the fens by the floods of several years, and which collect in deep holes, till, overcharged with numbers, they are obliged to attempt a change of place. The quantity may perhaps be conceived from the fact, that a man employed in collecting them, gained for a considerable time four shillings a-day by selling them at the rate of a half-penny a bushel. Some of the *Gasterosteii* live indifferently in salt or fresh water, and the one represented by figure 13 was taken by Sir Edward Belcher, in the sea at the north end of Wellington Sound, in Lat. 77° N. M. Coste, who studied the manners of these small fishes in the Mediterranean, relates that on the approach of spawning time, the male builds a nest of stalks of grass and other matters in a hollow of the bottom, a little above three feet wide and about six inches and a half deep, creeping over the materials on his belly and cementing them with the mucus that exudes from his skin. The bottom of the nest is first laid, then the sides are raised, and lastly, the top is covered over. A small hole is left on one side for an entrance. When the erection is complete, he seeks out a female, and conducting her, M. Costa says, with many caresses, to the nest, introduces her by the door into the chamber. In a few minutes she has laid two or three eggs, after which she bores a hole on the opposite side of the nest to that by which she entered, and makes her escape. The nest has now two doors, and the eggs are exposed to the cool stream of water which entering by one door flows out at the other. Next day the male goes again in quest of a female, and sometimes brings back the same, sometimes finds a new mate. This is repeated until the nest contains a considerable number of eggs, and each time the male rubs his side against the female and passes over the eggs. Next the male watches a whole month over his treasure, defending it stoutly against all invaders, and especially against his wives, who have a great desire to look at the eggs. When the young are hatched and able to do for themselves, his cares cease. Mr Lecoq made similar observations at another place, but the Italian society to whom the papers of the two observers were transmitted, after inquiring fully into the case, decreed that the right of priority belonged to M. Coste. (*Archiven für Naturg.*)

FAMILY VII.—SCLEROGENIDÆ.

Joues cuirassées, Cuv.; *Cataphractoridæ*, Cant.; *Trigidæ*, Bonap.; *Cataphracti*, Heck.; *Scleroparci*, *Buccaloricatores*, &c.

The distinctive character of this group is the prolongation of the second suborbital scale-bone across the cheek to be articulated with the preoperculum in its curve, so as to serve for a fulcrum to the spine, which issues from the angle of that bone. Forms exceedingly variable, but having a family resemblance in their prevailing monstrous character. Several genera have fewer than five rays in the ventrals, an uncommon occurrence among *Acanthopteri*.

Classification—
Acanthop-
terous
Fishes.

GENUS I. TRIGLA, Linn. Cheek wholly covered by the enormous second suborbital, which is articulated by an immoveable suture to the preoperculum, the two moving together; sides of the head almost vertical. Body scaly. Two dorsals. Three free unbranched articulated rays under the pectoral. Snout formed by the union of the prefrontals, turbinals, and point of the nasal, by suture; the preorbital making a more or less salient projection before them. Branchiostegals seven. Branchial rakers in form of tubercles; villiform teeth on the jaws and pharyngeals, but the palate and tongue are edentate. Lateral line straight to the caudal, on which it forks; it is variously armed. Stomach caecal; pancreatic caeca numerous (eight to twelve), dividing into two or three lobes anteriorly. Eighteen species.

GENUS II. PRIONOTUS, Cuv. *Trigla* with very large pectorals and villiform palatine teeth. Body scaly. Eight species.

GENUS III. PERISTEDION, Lacép. Body clothed in scaly armour. A long projection of the preorbital on each side of the snout. Mouth beneath; destitute of teeth, as are also the vomer, palatines, and pharyngeals. Under lip bearded. Body octagonal, with tapering spines on its eight angles. Two free rays under the pectoral. Pancreatic caeca seven; air-bladder pretty large, simple. Two species.

GENUS IV. DACTYLOPTERUS, Cuv. Head flat above, rounded off into a nearly vertical face; helmet granulated. Eye very large. A very long spine continued from the lower border of the preoperculum. Suprascapula emitting a long spine; articulation of the suborbital and preoperculum moveable. Teeth pavement-like on the jaws; no teeth on the vomer or palatines. Branchiostegals six; four articulated rays only in the ventrals in addition to the spine. No free rays in the pectoral, but the fin is divided into a smaller anterior part, and a posterior very broad and long part with the tips of the rays going beyond the membrane; some of the anterior dorsal rays are free. Scales of the body hard and firm, those on the flanks keeled, forming, by their close succession, trenchant crests. Stomach caecal; about thirty pancreatic caeca in two bundles; air-bladder small, deeply bilobate. Two species.

GENUS V. CEPHALACANTHUS, Lacép., is a *Dactylopterus* without the wing-like supplementary pectoral, or a *Trigla* without the free rays. Head and body like *Dactylopterus*, of which it is said by Dumeril to be merely the young. An acute and very long spine from the angle of the preoperculum, and another from the suprascapula, both serrated. Pectoral divided into two nearly equal lobes by a fissure. A pointed caecal stomach; innumerable pancreatic caeca; no air-bladder. One species.

GENUS VI. COTTUS, Linn. A large rounded or depressed head, variously armed with spines and tubercles. No scales. Two dorsals. Teeth on the fore-part of the vomer; no teeth on the palatines. Six branchiostegals. Five, four, or fewer rays in the ventrals; inferior rays of the pectoral unbranched as in *Trachinus*. Pancreatic caeca few in number; no air-bladder. Thirty-six species. Various dismemberments of this genus have been made, and the fresh-water and marine species have been separated—*Uranidea* being the name given to an American fresh-water species, and *Acanthochothus* to the marine ones.

In the fully armed head of a *Cottus* there are ten spinous points more or less produced on each side of the head; one on the turbinal; five on the preoperculum, the one at the angle being a long spine, and the others angular points of the inferior limb; one on the inferior anterior angle of the suboperculum; a spine at the point of the operculum, and acute points or spines on the suprascapula and coracoid. There are also four eminences placed in a quadrangle on the top of the head, one behind each orbit, and another on the occiput on each side. In some these are blunt and smooth; in others spinous; in others rough tubercles, much elevated or even branched. In other species many of the spinous points are obsolete.

GENUS VII. TRACHYDERMIS, Heck. (*Centridermichthys*, Rich.) General form that of *Cottus*; head less depressed. Turbinals, preoperculum, and inferior angles of the suboperculum spinous; the principal preopercular spine hooked. Beneath it two acute spines and a blunt point; operculum and preorbital unarmed. Villiform teeth on the jaws, palatines, and chevron of the vomer; pharyngeal teeth rather coarser, the upper ones forming a tuft on each side. Dorsals contiguous; pectorals like those of *Cottus*, with simple rays below (seven); ventrals having four jointed rays and one spine. Branchiostegals six. Body covered with slender setaceous spines, each springing from a minute cuticular tubercle. Head, belly, axillæ of the pectorals, and a narrow line along the base of the anal, smooth. A genital papilla; pancreatic caeca. Species *Tr. ansata*, China.

Cottus asper (Fauna Bor. Amer.) seems to be a second species of *Trachydermis*, with the spines on the same bones of the head, but less prominent, so as to be concealed in the recent fish by the integuments, and the point of the principal preopercular spine not hooked. It is the type of the genus *Cotopsis*, Girard.

GENUS VIII. TRIGLOPSIS, Gir. Head smooth. Many mucif-

ferous canals developed in the bones of the skull and face, as in *Acerina*. First dorsal shorter and much lower than the second one, and distant from it. No palatine teeth; teeth on the chevron of the vomer, and also down the median line. Four preopercular spines, shorter and more slender than is usual in *Cottus*. Gill-openings connected on the throat without an isthmus. Branchiostegals six. All the pectoral rays undivided. One species, Lake Ontario.

GENUS IX. PHOBETOR, Kroy. *Cotti* destitute of vomerine teeth; resembling *Cottus Scorpius* in general aspect. Acute small turbinal spines. Principal preopercular spine snagged; three acute points on the bone beneath it; operculum destitute of both the usual median rib and spine. A small spine pointing downwards from the lower angle of the suboperculum, and crossed by a smaller interopercular spine. Suprascapula unarmed. Two small cranial tubercles on each side. No orbital ridges. Lateral line composed of cutaneous mucoducts. Fins large.

GENUS X. ICELUS, Kroy. Body somewhat compressed, higher than thick. Head large; destitute of scales; armed with spines on the snout, preoperculum, and nape. Teeth minute, setaceous on the jaws, vomer, and palatines. Branchiostegals six. Two dorsals, separated; ventrals of four rays under the pectorals; rays of all the fins undivided. On each side from the nape to the caudal fin a continuous series of bony shields, running near the dorsals. Lateral line composed of bony tubercles. Ciliated scales on the sides and belly, few and scattered; the rest of the skin naked. Three species, *I. hamatus*, *I. bicornis*, *I. uncinatus*.

GENUS XI. CARACANTHUS, Kroy. Body higher than in other genera of the family, greatly compressed, oval. Snout very short, truncated; small slender teeth on the premaxillaries and mandible. Branchiostegals six. Preorbital scale bone armed with a spinous point anteriorly. Two low dorsal fins; short pectoral fins, with simple rays; ventrals entirely rudimentary; two spinous anal rays, set apart from the soft portion of the fin. No scales, but many cutaneous papillæ. One species, Otaheite.

GENUS XII. PODABRUS, Rich., 1848. Scaleless. Lateral line of simple cutaneous mucoducts, arched abruptly over the pectorals. Ventrals of a spine and two soft rays; two dorsals approximated; rays of all the fins, except the caudal, unbranched; none free. Villiform bands of subulate teeth on the jaws, vomer, and palatines, and in hemispherical tufts on the pharyngeals, also on the tubercular rakers. Tongue smooth. No armature on the preorbital, suboperculum, or interoperculum, nor on the cranium or suprascapula. Slight unevenness of the skull concealed by the soft parts. A narrow, thin process projects from above the corner of the preoperculum; and the operculum ends in a thin flexible point, but there is no pungent corner, and the integuments of the cheek conceal the second preorbital as it crosses to the hollow of the preoperculum. One species has the aspect of *Centropomus*, another of *Cottus*, both are more compressed than *Cottus*. Two species, China seas.

GENUS XIII. ASPIDOPHORUS, Lacép. PHALANGISTA, Bloch., Schneid. Many of the characters of *Cottus*, such as the depressed head, simple rays, six branchiostegals, but with the body cuirassed by a series of large bony scales that extend from the head to the caudal fin, forming a pyramid with many faces. No vomerine teeth. Ten species.

GENUS XIV. PLATYCEPHALUS, Bloch. Head very much depressed; spiny. Body more or less depressed; elongated; scaly. Acute teeth on the palatines. Seven branchiostegals. A spine and five articulated rays in the ventrals, which are under the middle of the pectorals, and therefore abdominal in position, and are widely apart from each other laterally, owing to the breadth of the pubic bones. Dorsals contiguous or approximated. Thirty species.

GENUS XV. OPLICHTHYS, Cuv. Head depressed, and with the operculum very spinous as in *Platycephalus*. Body cuirassed as in *Aspidophorus*. Ventrals more jugular, and having a spine and five soft rays. One species, Japan.

GENUS XVI. HEMITRIPTERUS, Cuv. Two dorsals, the first one deeply notched. Many cutaneous filaments on the uneven head and mandible. Large pectorals advancing far under the throat; the lower rays thickened, but none free; ventrals jugular of a spine, and three soft rays; rays of all the fins, including the caudal, simple. Teeth on the jaws, vomer, palatines, and pharyngeals in villiform bands. Tongue smooth. Branchiostegals six. Two species.

GENUS XVII. HEMILEPIDOTUS, Cuv. Somewhat of the aspect of *Cottus*, but with the dorsals united, though notched between the spinous and soft portions. Teeth on the jaws, vomer, and palatines. Two ranges of scales on the sides with soft integument between them; scales round, finely denticulated, and rising into a little crest. Stomach small; pancreatic caeca five.

GENUS XVIII. BEMBRAS, Cuv. Head, serrated crests, and spines, nearly as in *Platycephalus*, but not depressed. Ventrals rather before the pectorals, with five articulated rays and the usual spine, and as in *Scorpena* there are villiform bands of teeth

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on the jaws, vomer, and palatines. Dorsals separated, as in *Cottus*. Two species.

GENUS XIX. SCORPÆNE, Linn. Resemble the *Cotti* in many particulars, but are distinguished by their single dorsal. Head compressed laterally, and teeth on the palatines as well as on the vomer and jaws. Head large and very spiny, enveloped generally in a spongy skin; pungent or spinous points on the side of the head, and gill-cover generally on the same bones as in *Cottus*, and they vary in size and acuteness with the species. There are besides a spinous ridge on the second suborbital, and crests on the top of the cranium, more or less prominent and acute. No scales on the head. Seven branchiostegals. A scaly body. Cutaneous filaments depending from various part of the head and flanks, and simple though jointed rays in the lower part of the pectorals. Eight or more pancreatic cæca; no air-bladder. Thirty species.

GENUS XX. SEBASTES, Cuv. Percoids, except for the connection of the suborbital with the operculum and the simple inferior rays of the pectorals. *Scorpenæ*, but for the presence of scales on the snout, maxillaries, cheeks, and gill-covers, or on most of these parts. The head is less armed than that of *Scorpenæ*, and the cutaneous filaments are absent, or very sparingly present. Transitional species exist, which may be placed in either of these two genera. Eighteen species.

GENUS XXI. PTEROIS, Cuv. Head compressed and strangely shaped. Cutaneous filaments on the snout. Preorbitals and preoperculum simple. Very long rays in the pectorals, with the membrane deeply notched; long slender dorsal spines. Teeth on the jaws and front of the vomer, but none on the palatines. Seven branchiostegals. Small scales on the body and various parts of the head, smooth and round (cycloid?). Pores on the limbs of the mandible. Ventrals with five forking soft rays in addition to the spine. Three pancreatic cæca; a pretty large oval air-bladder. Ten species.

GENUS XXII. TENIANOTUS, Cuv. Body extremely compressed. Dorsal very high, and united to the caudal, from which the anal is distinct; ventrals under the base of the pectorals of five soft rays and one spine. Scales very small. Cutaneous filaments on the orbit, nostril, and tip of the snout. Spinous points on the turbinals, three on the orbit, two on the cranial crest, one on the suprascapula, two on the operculum. Three teeth on the preoperculum, a small one on the crest of the second suborbital. Radiating lines on the preorbital, and teeth on its edge.

GENUS XXIII. BLEPSIAS, Cuv. Allied to *Scorpenæ* by its compressed head, cheek cuirassed by the suborbital, palatine teeth, simple fin-rays, short, and half free in the lower part of the pectorals, and cutaneous filaments on the snout and mandible; but distinguished from that genus by the five branchiostegals and high dorsal, divided into three unequal lobes like that of *Hemipterus*: from the latter genus its compressed head separates it. All the rays of the fins, including the caudal, unbranched. Obtuse corners on the preoperculum, and acute turbinal spines, but no other sharp points on the head.

GENUS XXIV. AGRIOPUS, Cuv. One of the least armed of the family, and the second suborbital does not articulate opposite the angle of the preoperculum, but to the upper part of the ascending limb of that bone. A long single dorsal, with strong spines advancing on the cranium to between the orbits, with its anterior rays flanked by elevated uneven cranial crests. Mouth projecting, small, furnished with scarcely perceptible teeth; no teeth on the palate or tongue. Five branchiostegals. Pectorals low down, the membrane between the lower rays deeply notched; ventrals with a spine and five soft rays; caudal rays subdivided; rays of all the other fins simple. Skin scaleless, smooth, or finely tuberculated. Stomach siphonal, without a dilatation to distinguish it from the œsophagus; no pancreatic cæca; air-bladder oval, occupying half the length of the abdomen. This genus and *Patacus* seem to link the *Sclerogenidæ* and *Gobiidæ* to each other. Four species.

GENUS XXV. APISTES, Cuv. *Scorpenæ*, having for their distinctive character one long spine on the preorbital, and another on the preoperculum, which, from the mobility of these bones, can be raised to a right angle with the long axis of the fish, and become dangerous weapons. Soft part of the dorsal not separated from the spinous portion, but in some species rays are detached from the front, and form small separate fins. Some have a naked skin like *Cottus*, others are scaly like *Scorpenæ*, and some have one or more free rays under the pectoral. Cuvier kept these various forms in one genus, merely giving the name of *Minous* to those which have some detached pectoral rays: subsequent ichthyologists have made genera of the groups that were indicated in the *Histoire des Poissons*. Stomach cæcal; four pancreatic cæca; pretty large air-bladder, swollen at the extremities, and somewhat depressed in the middle. Eighteen species, of which three are wholly without scales.

GENUS XXVI. MINOUS, Cuv. *Apistes* with one free ray under the pectorals, and thereby allied to—

GENUS XXVII. CHORIDACTYLUS, Rich. (*Voy. of the Sulphur*, 1848). This genus combines the characters of various *Sclerogenidæ*: in union with the preorbital spines of *Apistes* or *Minous*, it has the hollow cheeks, prominent orbits, tall, slender dorsal spines, filaments of the fins, three free pectoral rays, and ventrals adnate to the belly, and composed of five soft rays and a spine, all as in *Pelor*. It has not, however, the elongated body, depressed head, and horizontally protruding muzzle, nor the vomerine teeth of *Pelor*, and of the *Scorpenæ* generally; it is distinguished from *Synanceia* by its free pectoral rays, but resembles that genus in general form. Skin scaleless. Many filaments on the head, mandible, and fins. One species.

GENUS XXVIII. STHENOPUS, Rich. (lib. supra cit.) Aspect of *Pelor*, with a less extraordinary-shaped, though large head, and three higher rays of the dorsal, advanced to the orbits, but connected at the base by membrane to the remainder of the fin. Only two soft rays and a spine in the small ventrals, which are under the base of the pectorals. No pungent points on the bones of the head and face, which are clothed with soft, thick, loose integuments. Skin of the body destitute of scales, but covered in many parts, especially along the lateral line, with small cutaneous filaments, which extend also to the head, pectorals, and dorsal. Pectorals attached differently from those of *Synanceia*. Teeth on the jaws and chevron of the vomer; none on the palatines. The second suborbital, which traverses the cheek, is a narrow plate that descends from under the eye to the curve of the preoperculum; the preorbital is subulate with a cartilaginous tip. One species.

GENUS XXIX. PELOR, Cuv. Head as it were broken down above, with prominent orbits approximated to each other. High and almost isolated dorsal spines. No scales. Bands of fine villiform teeth on the jaws and front of the vomer; none on the palatines or tongue. Two free rays under the pectorals. The large moveable spine of the preorbital of *Apistes* is absent, by which they are separated from the species of that genus with naked skins, but there are angular points on the preorbital, and still more prominent ones on the preoperculum, operculum, suprascapula, and coracoid. Stomach cæcal; four thick pancreatic cæca; an air-bladder scarcely as big as a pea placed near the pylorus. Seven species.

GENUS XXX. SYNANCEIA, Bloch., Schneid. Destitute of spines on the head, which is not more compressed than that of many *Cotti*. Teeth on the jaws, but none on the vomer or palatines; no free rays under the pectoral, but the tips of some of the rays project considerably in some species. Mouth vertical as in *Uranoscopus*, the mandible being in front when shut; this form of the mouth, five soft rays in the ventrals, and the want of vomerine teeth, distinguish the genus from *Sthenopus*. Skin scaleless, smooth and slippery. Eyes in some lateral, though high on the head; in *S. asteroblepa* very small, and on the dorsal aspect of the head. Stomach oval, cæcal; four thick pancreatic cæca; air-bladder simple, small in the fore part of the abdomen. Twelve species.

Synanceium (Müll., Acad. Berl. 1839) is *Synanceia* with vomerine teeth. *S. trachynis* (Rich.) is an Australian species.

GENUS XXXI. APLOACTIS, Schleg. Intermediate among the *Cotti*, *Synanceia*, *Apistes*, and *Agriopi*, resembling *Cottus* in dentition and in its ventrals, with two soft rays and one spine; *Synanceia* in the want of armature of the head and general physiognomy; *Apistes* in the compressed head and shape of the dorsal; and some *Agriopi* in its skin being studded with bristles springing from small tubercles. Two species.

GENUS XXXII. MONOCENTRIS, Lacép. Very different in aspect from the other members of the family, but having the distinguishing character of the group in the suborbital crossing the cheek to the preoperculum. Body thick and short, cuirassed by enormous rough angular and keeled scales. Four or five thick spines not connected with membrane form an anterior dorsal; ventrals having one enormous spine, and a few small, almost invisible rays in its axilla; Face bulging. Villiform teeth on the jaws and palatines; none on the vomer. Eight branchiostegals. Soft dorsal and anal opposite, and far back. One species.

GENUS XXXIII. TRACHICHTHYS, Shaw. (*Hoplostethus*, Cuv.; *Hist. des Poiss.* iv., 470, and iii., 229.) Form oval, to which the tail behind the anal is to be added. Face very convex; mouth terminal, descending obliquely. Eye very large. Top of the head and cheeks cellular, from the prominence of branching bony crests, which on the cheeks radiate from the suborbitals. Operculum and disk of the preoperculum striated; a spine from the angle of the latter; a small spine terminating a ridge on the upper part of the operculum; a flat rough spine on the suprascapula, and one on the mastoid. One dorsal; ventrals under the pectorals of six soft rays and a spine; the soft rays of all the fins branched. Belly serrated behind the ventrals. Caudal deeply forked. Two species.

GENUS XXXIV. CHIRUS, Stel. Pretty long compressed scaly fishes, with a small unarmed head. Scales ciliated. Cheek traversed

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by the second suborbital, as in the other *Sclerogenidæ*; distinguished by having several (generally five) lateral lines at various heights. Mouth small. Dorsal nearly even, extending all along the back; its spinous rays slender; ventrals of five rays and a spine. No pancreatic cæca. Frequently a tufted filament on the eye-brows. Ten species. Pacific.

The genus *Stichæus* of Reinhardt (*Oversigt over det Kongelige, Danske, Vid. Sels. &c.*, 1835-6) should come in here, but we have not at present access to Reinhardt's paper.

SCIÆNOIDS.

Several genera have been removed from this family as it was presented in the *Histoire des Poissons*, particularly the groups which have a lateral line broken or interrupted under the distal end of the dorsal fin. These form the *Ctenoid Labroids* in the order of Pharyngognaths already treated of. We have also associated the genera that have fewer branchiostegals than seven with the *Theraponidæ*, and *Cheilodactylus* with the *Polynemidæ*. These being removed, the remainder present a more perfect family aspect.

TABLE OF GENERA.

Two dorsals, or one dorsal deeply notched.

No mandibular barbels.

No strong canines.

Denticulated preopercula.

No large smooth rounded teeth.

Snout convex, bulging.

SCIÆNA, CORVINA, LEIOSTOMUS, JOHNIUS.

Snout not convex nor high and rounded.

LARIMUS, LEPIPTERUS.

Large pavement-like teeth on the jaws.

BORIDIA, CONODON.

Preopercula not denticulated.

NEBRIS, ELEGINUS.

Strong canine teeth.

OTOLITHUS, ANCYLODON.

One or more mandibular barbels.

UMBRINA, LONCHURUS, POGONIAS, MICROPOGON.

One dorsal only.

HEMULON, PRISTIPOMA, DIAGRAMMA.

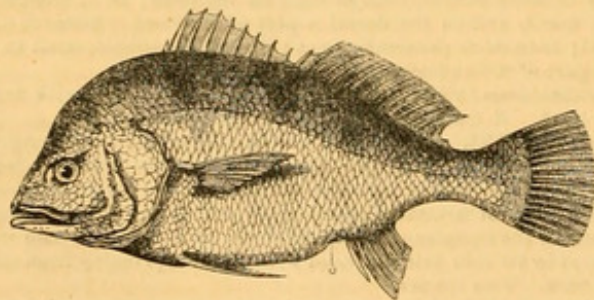


Fig. 100.
Corvina richardsonii.

This woodcut represents a fresh-water *Corvina*, common in Lake Huron. We have, however, some suspicion of its belonging more properly to the *Theraponidæ* than to the *Sciænidae*, notwithstanding Cuvier's weighty authority. It has only six branchiostegals.

Many members of this family have curious air-bladders with fringe-like appendages. The subjoined woodcuts represent that of *Corvina acoupa*, and of *Pogonias chromis*. One of the most remarkable of the *Sciæna* is the *aquila*, called *Umbrina* by the Romans, and held in high esteem in the Mediterranean even at the present day. It is very rare on the British coasts. Dr Patrick Neill records one instance of its capture off Ugea in Northmavine, Shetland, in November 1819. When first seen, it caught the attention of the fishermen by its endeavours to elude the pursuit of a seal. It measured five feet four inches, and when lifted into the boat made its usual "purring

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sound." Mr Yarrell mentions some subsequent instances of its being taken on the Northumberland and Kentish coasts. It is much more common in the Mediterranean, and Paul Jovius says that many were taken at the mouth of rivers in the Roman states, along with Sturgeons. They swim in troops, and are said to utter at times a low bellowing sound. On one occasion, the fishermen, guided by this sound, dropt their net with such success as to secure twenty fine fish at a single cast. The noise may be heard from the depth of twenty fathoms, and is often very perceptible when the ear is placed upon the gunwale of the boat. Its tone seems to vary, as some have compared it to a dull buzzing, others to a sharp whistle. Some fishermen allege that the males alone are musical during spawning time, and that it is quite possible to capture them without any bait, merely by imitating this peculiar sound. One alluded to by Cuvier as having been entangled in a net spread along the shore at Dieppe, was at first found sleeping; but on being handled it roused itself so suddenly, and with such violence, as to precipitate the fisherman into the water, and force him to call for assistance before he could become its master. High, though of course imaginary virtues, were formerly attributed to the stones which occur in the ear of this, as of other osseous fishes. They were worn on the neck, set in gold; and Belon says they were called *colic-stones*, being renowned for the cure, and even prevention of that complaint. It was necessary, however, that they should be received as a gift,—such as were purchased being found to lose their virtue.

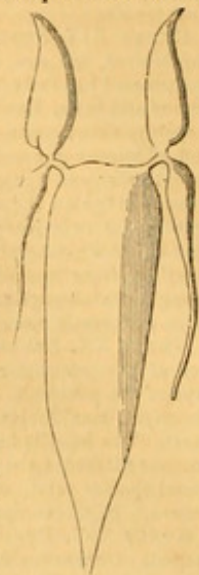


Fig. 101.
Air-bladder,
Corvina acoupa.

The *Pogonias* grow to a great size, some of them weighing occasionally above a hundred pounds, and the singular sounds uttered by them have gained them the vulgar name of *Drums*. Mr John White, an American lieutenant, who (in 1824) published *A Voyage to the China Seas*, relates, that being at the mouth of the River Cambodia, himself and crew were greatly astonished by certain extraordinary sounds, which were heard from around and beneath the vessel. They resembled a combination of the bass of an organ, the sound of bells, and the guttural cries of a large frog, with certain tones which the imagination might

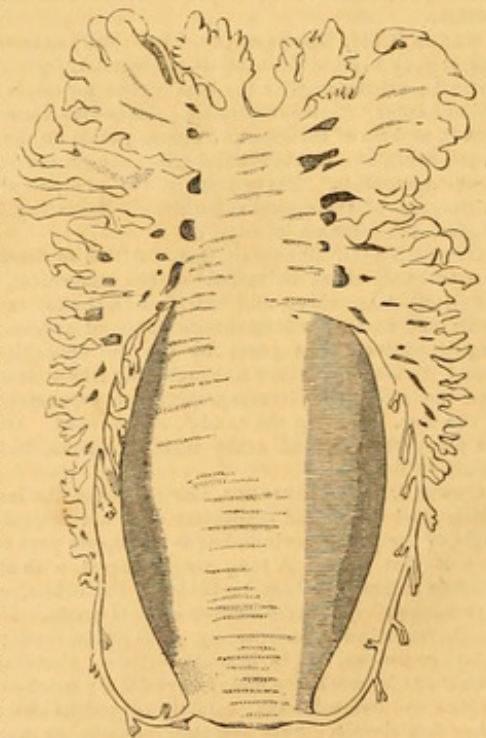


Fig. 102.
Air-bladder, *Pogonias chromis*.

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attribute to a gigantic harp. It might almost have been said that the vessel trembled at those uncertain sounds. For some time they increased, and finally formed a loud and universal chorus, the entire length of the vessel, and on either side. In proportion as they ascended the river the mysterious sounds diminished, and finally altogether ceased. The interpreter gave the information that they were produced by a troop of fishes of a flattened oval form, which possess the faculty of adhering firmly to various bodies by their mouths. A similar phenomenon was noticed by the illustrious Humboldt in the South Seas, although he was unable at the time to divine the cause. It would, as Cuvier has remarked, be an object of curious research to discover by what organ these sounds are produced. Lieutenant White need not have left his own country to become acquainted with the loud noises produced by the "Drums" or "Grunts," as *Pogonias chromis* is named in the United States. This fish, or a species similar to it in appearance and habits, abounds in the winter and spring on the coasts of Georgia and Florida, and drums so loudly on the bottoms of vessels that anchor there, as utterly to deprive the sailors of sleep, until several nights' use has accustomed them to the loud and disagreeable noise. The sound is better expressed by the word drumming than by any other, and is accompanied by a tremulous motion of the vessel. We caught several of the fish, and found them excellent food, but their tails were rejected as being full of parasitic *filaria*. It appeared to us that the uneasiness produced by these parasites might cause the fish to beat their tails against the bottom of the vessel, and that many individuals were employed in keeping up the sound which continued without the slightest intermission all the night through. The teeth of *Plectropoma dentex* have been shown by fig. 60. Fig. 103 represents a Sciænoid of the group having a single dorsal fin. This group corresponds in external appearance with the Percoids that have a single dorsal, being seemingly as much allied to them as to the typical Sciænoids with the two dorsals, and differing from the analogous Percoids chiefly by the presence of teeth on the roof the mouth, and a few pores on the mandible. The latter character, however, exists in some Percoids also.

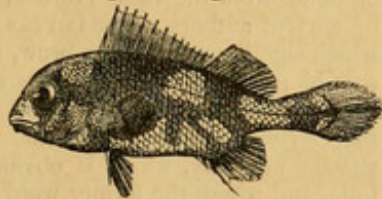


Fig. 103.
Diagramma orientale.

FAMILY VIII.—SCIÆNIDÆ.

(*Les Sciænoïdes*, Cuv.) With many of the exterior characters of the Percoides, such as a spinous or denticulated operculum, a variously armed preoperculum, scaly body, a simple or double dorsal, or one deeply notched, and the same varieties in the combination of these characters, they have more or less of a peculiar family physiognomy, and differ from the Percoids in having no teeth on the vomer or palatines. The bones of the head and face are often full of muciferous cells or hollows, with external porous openings; and the face and snout are frequently gibbous. The vertical fins and parts of the head are occasionally scaly. Scales ctenoid, generally obliquely ranged. In their internal anatomy there is more variety than in the Percoids, and their air-bladders especially have branching appendages in many genera. The diagnostic characters are,—denticulations or spines on the opercular pieces; cheeks not cuirassed by the suborbital; mouth little protractile; vomer and palatines toothless; seven branchiostegals.

(a.) *Two dorsals, or one deeply notched.*

GENUS I. SCIÆNA, Cuv. Head convex, with cellular bones. Two dorsals, or one dorsal deeply notched, and the soft part much longer than the spinous one; a short anal. Preoperculum denticulated; operculum ending in points. Seven branchiostegals. Otolites larger than in most fishes, and the air-bladders large and complicated. The proper *Sciæna* have feeble spines in the anal, and are destitute of canines and barbels. Stomach cæcal; ten pancreatic cæca or more. Four species.

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GENUS II. OTOLITHUS, Cuv. *Sciæna* also with feeble anal spines and no barbels, but having long curved teeth or canines among the others. Air-bladder having a horn-like projection on each side in front; four pancreatic cæca. Eighteen species.

GENUS III. ANCYLODON, Cuv. *Otolithes* with a very short snout, excessively long canines, and a pointed tail. Two species.

GENUS IV. CORVINA, Cuv. *Sciæna* with wholly villiform teeth and no barbels, but differing from *Sciæna* and *Otolithus* in the great size of the second anal spine. Nineteen species.

GENUS V. JOHNIUS, Bloch. Considered by Cuvier to be like *Corvina* and *Otolithus*, a subdivision of *Sciæna*, and distinguished chiefly by the second anal spine being weak and shorter than the soft rays of that fin. Eighteen species.

GENUS VI. LEIOSTOMUS, Cuv. *Johnii* in having a small anal spine or feeble denticulations in the preoperculum; but the teeth of the jaws so fine as to be with great difficulty seen; pharyngeal teeth pavement-like. Scales ciliated. Horns of the air-bladder smaller and more slender than in *Otolithus*. Two species.

GENUS VII. LARIMUS, Cuv. One of several anomalous *Sciænoïd* forms, which have characters different from those of the foregoing groups. Two dorsals. Villiform teeth. Forehead not arched; snout short; preoperculum slightly denticulated. Stomach cæcal, narrow; eleven pancreatic cæca; air-bladder large, simple. Two species.

GENUS VIII. NEBRIS, Cuv. *Sciænoïd*s with two dorsals. Villiform teeth. Profile nearly straight; snout short; mandible ascending. Limb of the preoperculum membranous, and merely striated, and the fins all more or less scaly. One species.

GENUS IX. LEPIDPTERUS, Cuv. *Sciænoïd*s with villiform teeth, prolonged snout, profile rather concave, and very scaly vertical fins. One species.

GENUS X. BORIDIA, Cuv. *Corvina* with smooth blunt teeth on the jaws. One species.

GENUS XI. CONODON, Cuv. *Sciænoïd*s distinguished from the others by having a row of conical teeth on the two jaws. One species.

GENUS XII. ELEGINUS, Cuv. *Sciænoïd*s with an entire preoperculum. Mouth small. Anal long. Two short conical horns in the fore part of the air-bladder. Three species.

GENUS XIII. EQUES, Bloch. Resemble *Sciæna*, *Corvina*, *Johnius*, in their convex snout, scaly throughout, like the rest of the head; in the mucous pores and pits of the lower jaw; in the upper jaw being able to retire under the edge of the preorbital; in the length of the second dorsal, and the shortness of the anal, both of them scaly as well as much of the caudal. Teeth villiform, and not elongated like those of the *Chatodons*. In *Eques* the body is compressed, and by the convexity of the nape assumes a cuneiform outline. Branchiostegals seven. Faint crenatures on the preoperculum; the bony frame of the operculum ends in two flat points. The first dorsal is high and peaked with mostly flexible rays; second dorsal low and long; caudal rhomboidal; ventrals longer than the pectorals. A small membrane in front of the snout, with a pit on each side between it and the high preorbital. A small pore beneath the mandible on each side of the median line. A large silvery air-bladder; cæcal stomach; four pancreatic cæca. Three species.

GENUS XIV. UMBRINA, Cuv. *Sciænoïd*s having one barbel under the mandibular symphysis. Thirteen species.

GENUS XV. LONCHURUS, Cuv., Bloch. *Umbrina* with two mandibular barbels and a pointed caudal. Two species.

GENUS XVI. POGONIAS, Lacép. *Umbrina* with many small mandibular barbels. Lower pharyngeal teeth and middle upper ones large like those of *Labrus*. Two species.

GENUS XVII. MICROPOGON, Lacép. *Sciænoïd*s with a prominent nape like *Corvina*. Moderate-sized anal spine, and very small and numerous barbels. Distinct denticulations on the ascending limb of the preoperculum, those at the angle being larger; operculum ending in two flat points. Membrane at the end of the snout four-lobed. Mouth moderately protractile; pretty broad bands of villiform teeth; pharyngeal teeth villiform, the middle ones being larger, with obtuse summits. Under the mandible at the symphyses two large pores and three small ones; three or four little barbels attached to the limb of the mandible. Scales slightly rough and oblique as in the *Sciænoïd*s in general. Dorsal spines not very strong; slender ventral spine, and the anal spine shorter than the soft rays; caudal nearly even at the end. Three species, America.

(b.) *A single dorsal; preoperculum always denticulated.*

GENUS XVIII. HEMULON, Cuv. Body oblong, pretty high anteriorly, somewhat compressed. Profile descending almost in a straight line, and forming a snout that projects tolerably. Preorbital large, but not denticulated, covered with skin and scales, joining the cheek as in the *Sciæna* in general, and forming a ledge under which the moderately protractile upper jaw retires. Lips fleshy. Mandible articulated under the eye, having an oval pit

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under the symphysis, and two small pores in advance of it. Villiform teeth on the jaws, with some bigger than the rest in the outer row (but much less so than in *Dentex*, which, moreover, has an entire preoperculum). Operculum ending in two flat obtuse angular projections, which do not show through the membrane; and the gill-cover is sometimes quite rounded. Palate without teeth; tongue smooth and free. Seven branchiostegals, the last three slender. No denticulations on the suprascapula. A triangular scaly appendage in the axilla of the ventrals; dorsal moderately notched; caudal forked, and covered with small scales like those on the soft parts of the dorsal and anal. Scales of the body large, finely ctenoid; none on the lips or snout before the eyes. Stomach caecal, small, and pointed; seven pancreatic caeca; a long simple air-bladder. Fourteen species.

GENUS XIX. PRISTIPOMA, Cuv. Resembling *Hæmulon* in most characters, and in the mandibular pores, but having a more bulging snout, smaller mouth, less moveable mandible, and no scales on the dorsal or anal. Operculum ending in a smooth point, hidden under the skin. Villiform teeth, with the exterior row generally stronger. (Distinguished from *Diagramma* by the latter having four or six large pores on the mandible, and from *Lobotes* by the presence of mandibular pores and of seven branchiostegals.) Forty species.

GENUS XX. DIAGRAMMA, Cuv. Wants the symphyseal pit on the mandible, which exists in *Pristipoma*, but has the two small pores, and in addition, two large pores on each limb of the bone. Fins as in *Pristipoma*, together with the denticulated preoperculum, and the operculum destitute of a spine. Twenty-two species.

GENUS XXI. PRIONODUS, Jenyns. Aspect of *Serranus*, but without the palatine and vomerine teeth. It enters the group of *Hæmulon*, *Pristipoma*, and *Diagramma*, from all of which it is distinguished by the want of pores under the mandibular symphysis.

GENUS XXII. PRISTIPOMOIDES, Bleek. Single, undivided, dorsal fin. Branchiostegals seven. Dorsal and anal without scales; caudal scaly. No conspicuous mandibular pores. Lateral jaw teeth uniserial; anterior ones pluriserial; the internal ones minute and setaceous; the external row formed of two to four larger conical canines. Preoperculum denticulated. Sumatra.

GENUS XXIII. CHEILO TREMA, Tschudi. Upper lip protractile, with eight pores. Mandible with five pores. Operculum toothed; preoperculum having two spines. Peru.

SPAROIDS.

The *Histoire des Poissons* contains the following table of the genera:—

TABLE OF GENERA.

Teeth in part conical or molar.

Cheeks scaly.

SARGUS, CHARAX, CHRYSOPHRYS, PAGRUS, PAGELLUS, DENTEX, PENTAPUS.

Cheeks scaleless.

LETHRINUS.

Teeth wholly villiform.

CANTHARUS.

Trenchant teeth, no molars.

BOX, OBLATA, SCATHARUS, CRENIDENS.

By their dentition they may be arranged in tribes in the following order:—

TRIBE I.—Round molars and trenchant front teeth.

SARGUS, CHARAX, CHRYSOPHRYS, PAGRUS, PAGELLUS.

TRIBE II.—Conical teeth with canines.

LETHRINUS, DENTEX, PENTAPUS.

TRIBE III.—Teeth all villiform.

CANTHARUS.

TRIBE IV.—Trenchant jaw teeth, with or without villiform bands.

BOX, OBLATA.

The *Sargi* in general feed on shells and the smaller Crustacea, which they easily crush with their molar teeth, but Cuvier found fuci in the stomachs of some brought from the Red Sea and the Atlantic. *Ælian* and *Oppian* inform us that the male is polygamous, and fights with great fury with his own sex for the possession of many females. The same authors attribute to it a feeling still more extraordinary,—a lively passion for goats, which it exhibits by always swimming with great rapidity towards those animals, and indulging in playful gambols before them. So blind was this passion, that a fisherman (it was so alleged) might

catch as many as he pleased by disguising himself with the skin and horns of a goat, and scattering in the water flour steeped in goats' broth.

The best-known species inhabits the Mediterranean. It is the *S. Rondeletii* of Cuv. The American shores produce several others, one of which (*S. ovis*) is called the *Sheep's-head* by the Americans. Dr Mitchell speaks in the most eulogistic terms of the superexcellence of its flesh, and of the high esteem in which it is held at the tables of New York. It yields in his opinion to few fishes, and is worthy of being served at the most sumptuous entertainments. The price varies from a dollar to a dollar and a half for a middle-sized individual, and above that size the price ranges even so high as from L.4 to L.7 sterling. They sometimes weigh from 14 to 15 lbs. The fishery of this species forms an object of importance along the coasts of the state of New York. It approaches those of Long Island in the hot season from the month of June till the middle of September, after which it seems to seek retirement in the deep abysses of the ocean. As they swim in troops, they may be advantageously fished for with the net, and many hundreds are sometimes taken at a single cast. With the great nets used at Rayner Town, and the two islands, thousands are drawn ashore. They are immediately packed in ice, and despatched during the cool of the night to the markets of New York. It is difficult to take the *Sheep's-head* with a line, because it contrives to snap the very hooks asunder with its cutting teeth.

The species of *Chrysophris* are numerous, and extended through many seas. Those of the Mediterranean are only two in number, and are called *Daurades* by the French, no doubt from the Latin *Aurata*, a term applied to them by ancient authors. The Greeks named them *Chrysophris*, which signifies golden eye-brow, in allusion to the brilliant spot of gold which the common species bears between its eyes. That the *Aurata* of the Latins was identical with the *Chrysophris* of the Greeks, may be inferred from a passage in Pliny, which is obviously borrowed from Aristotle, and where the former word is used as the translation of the latter. According to Columella, the *Aurata* was among the number of the fishes brought up by the Romans in their *vivaria*; and the inventor of these *vivaria*, one *Sergius Orata*, is supposed to have derived his surname from the fish in question. *Ælian* tells us that the *Chrysophris* is the most timid of all fishes, and that branches of poplars planted in the sand so terrified a party of these fishes which had been carried upwards by the flood, that in the succeeding reflux they did not dare to pass the poplars, but allowed themselves to be taken by the hand. The *Chrysophris aurata*, or *Gilt-head*, seldom quits the vicinity of the shore, and grows extremely fat in the salt ponds. We owe to Duhamel whatever information we possess regarding its habits. The fishermen informed that author that it agitates the sand forcibly with its tail, so as to discover the shell-fish which may lie beneath concealed. It is extremely fond of mussels, and its near presence is sometimes ascertained by the noise which

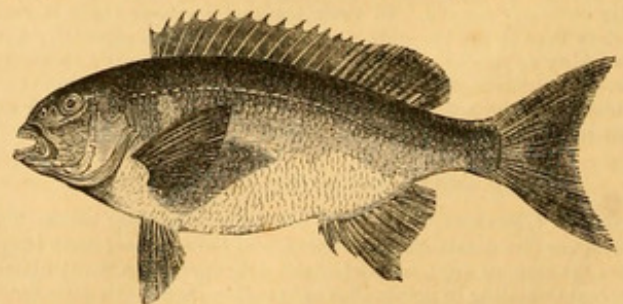


Fig. 104.

Crenidens tephroptus.

it makes while breaking their shells with its teeth. It greatly

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dreads cold, and many were observed to perish during the severe winter of 1766. The Gilt-head is a British species, but of extremely rare occurrence.

The *Dentex vulgaris*, a fish of a silvery hue, shaded into blue upon the back, with reddish pectoral fins, and sometimes attaining to the weight of 20 lbs., has occurred upon the Sussex coast. The specimen figured by Donovan (pl. 73) was obtained in Billingsgate market.

Fig. 31 represents a scale of *Lethrinus cynocheilus*, and may give some idea of the general character of a Sparoid scale, alluded to in the table of genera at the bottom of the page.

FAMILY IX.—SPARIDÆ.

Sparoid scales; a large elongated scale in the axilla of the pectoral. Gill-cover shining, without proper spines or denticulations. Maxilla capable of being received in part under the preorbital scale bone, which is generally high. Spinous rays of the dorsal and anal fins bare, mostly lodging in a furrow; pectoral and ventral fins sharp pointed; caudal fin notched in an angle at the end. The Sparoid scales are generally thin, broader than long, and the centre of growth is near the posterior border, the lines being parallel to the anterior border, and becoming straight laterally. Their peculiar structure is described more fully in Agass. *Poiss. Foss. i.*, p. 86, and in Troschel's *Arch.* for 1849, p. 382. Snout not projecting nor protractile, destitute of palatine teeth, and distinguished from the Sciaenoids by the want of any denticulations or armature of the gill-covers, and of cavernous or cellular structure in the cranium; from the *Chatodontidæ*, by the want of scales on the vertical fins; and by the size and nature of the scales from the *Scomberidæ* (*Hist. des Poissons*). Branchiostegals generally six, sometimes five, rarely seven.

(a.) Round molar teeth, with trenchant or conical front ones.

GENUS I. SARGUS, Cuv. Several rows of molars; incisorial front teeth. Cheek scaly. Sixteen species.

GENUS II. CHARAX, Risso. One row of very small molars almost granular; incisorial front teeth. Cheek scaly.

GENUS III. CHRYSOPHRYS, Cuv. Several rows of rounded molars; front teeth conical. Cheek scaly. Twenty-four species.

GENUS IV. PAGRUS, Cuv. Rounded molars in two rows; front teeth conical, with a villiform card-like band behind them. Cheek scaly. Fifteen species.

GENUS V. PAGELLUS, Cuv. Two or more rows of rounded molars; front teeth villiform. Cheek scaly. Twelve species.

(b.) Teeth conical, with larger ones, or canines.

GENUS VI. LETHRINUS, Cuv. Teeth villiform, mixed with long curved ones, and occasionally one or two rounded molars. Cheek naked (without scales). Twenty-eight species.

GENUS VII. DENTEX, Cuv. At least four large canines among villiform or card-like teeth. Cheek scaly. Thirty species.

GENUS VIII. PENTAPUS, Cuv. Cheek scaly. Teeth villiform, with only two canines; mouth small. Caudal more scaly than in *Dentex*. Eight species.

(c.) Teeth all villiform.

GENUS IX. CANTHARUS, Cuv. Villiform teeth, the exterior ones stronger. Twelve species.

(d.) Trenchant teeth without molars, sometimes accompanied by villiform bands, sometimes without them; no rounded molars.

GENUS X. BOX, Cuv. A single row of thin vertical teeth notched or crenated on the edge. Six species.

GENUS XI. OBLATA, Cuv. Crenated cutting teeth as in *Box*, with a villiform band behind them. Two species.

GENUS XII. BOXAODON, Guich. Body elongated, roundish, covered with small scales. Snout short; mouth small, not protractile. No teeth whatever. Opercular bones not denticulated nor serrated. Eyes large. Dorsals two, with many free spines between them; ventral fins minute, situated on the thorax. Branchial openings wide; branchiostegals six. Valparaiso.

GENUS XIII. SCATHARUS, Cuv. Cutting teeth not crenated in a single row. One species.

GENUS XIV. CRENIDENS, Cuv. (*Girella*, Gray; *Melanichthys*, Schleg. *Fauna Jap.*) Oval scaly fishes, with a nearly even dorsal having many spinous rays. Convex profile; terminal small mouth

and head wholly unarmed. Ventrals consisting of a spine and five soft rays under the pectorals. Scales ctenoid, in some covering all the head except the disk of the preoperculum, mandible, and lips, in other species have more or most of the opercular pieces scaleless; narrow vertical bands of scales exist on the fins in some species, but are easily deciduous. Teeth compressed, curved, crenated with three or more disks, rarely entire, forming two rows on the jaws, and separated by a furrow from an interior band of minute teeth appearing to be granular, but when examined with a lens showing the same forms with the exterior older ones which they are destined to succeed. Vomer and palate generally toothless. In *C. simplex*, a species with entire incisorial teeth, the vomer is furnished with a patch of minute teeth invisible to the naked eye, and there is a similar plate on the front of the palatines. Pharyngeal teeth small, short, subulate, and densely crowded. Branchiostegals six. Six species.

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MENOIDS.

This family is distinguished from the Sparoids by the protractility of the mouth, and by a greater thickness of the face and of the body generally. The Mediterranean species were known to the ancients, and their Greek name is Latinized by Pliny to *Mæna*, and adopted by Cuvier as a generic term. They are mostly small fishes, despised by the ancients, and held in no great esteem now.

“Fuisse gerres aut inutiles mænas,
Odor impudicus urcei fatebatur.”

MARTIAL.

The following table of the genera is from the *Histoire des Poissons*, the source from which our observations generally are drawn:—

TABLE OF GENERA.

MENIDES. Form sparoid, but having occasionally teeth on the palate, or denticulations on the preoperculum. Mouth in all cases very protractile.

No scales on the dorsal fin.

MENA, SMARIS.

Scaly dorsal.

CESIO, GERRES.

The other genera are characterized by ichthyologists who have written subsequently to the publication of the volume of the *Histoire des Poissons*, which contains the *Mænida*. The genus *Emmelichthys* is one of those which combines

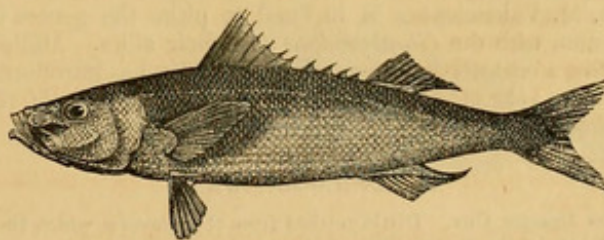


Fig. 105.

Emmelichthys nitidus

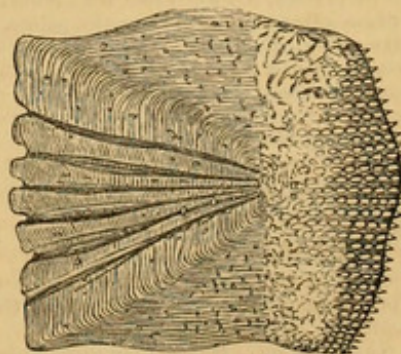


Fig. 106.

Scale of *Emmelichthys nitidus*.

the characters of several groups. It has much affinity to

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Cæsi, but differs in having seven branchiostegals, a deeply and widely notched dorsal, approaching more nearly to two dorsals than *Gerres*, scaly sheaths to the vertical fins of a different character from the scales that invest the fins in these two genera; and the snout, gill-covers, and maxillaries more strongly and more completely scaly. It is not without a resemblance to several of the genera assembled under the head of *Theraponidae*. To *Glaucosoma* it approaches in the extent of scaliness of the head and fins, but differs greatly in aspect, dentition, branchiostegals, and especially in its protractile mouth. From the typical *Percaïdæ*, with which it agrees in having seven gill rays, it is kept distinct by its unarmed head; the want of mandibular pores will not allow it to associate with *Hæmulon*, *Pris-tipoma*, or *Diagramma*; and it bears little resemblance in its sparoid scales to the oblique-scaled typical *Sciænidae*, from which also its elongated face distinguishes it. The want of teeth is a character which it has in common with *Boxaodon* and *Macquaria*, but the latter has only five branchiostegals. It is a genus recently discovered in the Japanese and Australian seas. Fig. 18 shows the protractile mouth of *Emmelichthys nitidus*, with the scales on the maxilla; Fig. 105 gives a figure of the entire fish, and Fig. 106 represents one of the scales.

Concerning the PSEUDOCHROMIDÆ we have almost nothing to say. The genera are not described in the *Histoire des Poissons*, and but little is contained in the *Regne Animal* concerning them. Indeed, a brief notice of the names of the genera composing the family given in the *Archiven für Naturgeschichte*, is our only authority for introducing it here. In the *Regne Animal*, *Plesiops* and *Cichlops* were placed among the Labroids, but M. Valenciennes states, in 1839, that having studied at Leyden the fish sent from Java, by Kuhl and Van Hasselt, he was convinced that the *Plesiops* and *Cirrhopteri* of these naturalists could not remain in the Labroid family. Willughby had already noticed the existence of two small pancreatic cæca in *Chromis* (*Sparus chromis*, Linn.); and M. Valenciennes finds it to agree so nearly with *Plesiops*, as not to be generically distinct. Their teeth, the interrupted lateral line, constitution of their scales, and the filaments of the spinous dorsal rays are alike in both. Cuvier, in stating that the Chromides had no pancreatic cæca, had in view the *Bolti* or *Labrus niloticus*, which, in fact, wants these organs. In conclusion, M. Valenciennes is inclined to place the genera in question with the *Glyphysodons* and their allies. Müller, finding a coalesced pharyngeal in *Chromis*, has introduced it as the type of a family among the *Pharyngognathi*, referring the *Pseudochromidæ* to the *Acanthopteri*.

FAMILY X.—MENIDÆ.

Les Menides, Cuv. Distinguished from the *Sparidæ*, which they resemble, by the protractility of the mouth. Villiform teeth on the jaws more or less short. Premaxillary pedicels long, admitting of the body of the bone being thrust out horizontally when the mandible is long in proportion, but when that bone is abbreviated then downwards. Some genera want teeth on the palate, others have small ones on the vomer. Body scaly. Ventrals situated under the pectorals; dorsal furnished with very fine scales. Stomach of moderate size; pancreatic cæca varying from four to seven; air-bladder large, simple, and rounded anteriorly, divided for the most part into two pointed lobes posteriorly.

GENUS I. *MENA*, Cuv. Aspect of a Sparoid, but occasionally having teeth on the palate, and a denticulated preoperculum. Mouth invariably very protractile. Four species.

GENUS II. *SMARIS*, Cuv. No scales on the dorsal. Palate toothless. General form of *Mæna*. Ten species.

GENUS III. *CÆSIO*, Cuv. Mouth but little protractile. Dorsal far back, and in a great part covered with scales. General shape inclining to fusiform. Twelve species.

GENUS IV. *GERRES*, Cuv. Mouth very protractile, descending when thrust out. Dorsal capable of being concealed in a basal scaly sheath. Small villiform teeth on the jaws, none on the palate. Preoperculum finely denticulated. Body compressed, elevated. Scales

large, deciduous. Ventrals under the anterior third of the pectorals. Twenty species.

GENUS V. *EMMELICHTHYS*, Rich. (*Erythrichthys*, Schleg.) Form of the body that of *Smaris* or *Cæsi*. Dorsal more deeply notched than that of *Gerres*, the last two or three spinous rays being almost detached. Very slender setaceous pharyngeal teeth; none on the mouth. Jaws moderately protractile directly forwards. Head and body, and bases of the vertical fins, scaly. Scales ctenoid. No spines on the head. Preoperculum and suboperculum very minutely crenulated. Suprascapula irregularly dentate. Branchiostegals seven. Two species.

GENUS VI. *DITREMA*, Schleg. Jaw teeth minute, pluriserial, with a few conical ones in front; no vomerine or palatine teeth. Snout a horizontal protractile tube. Opercular pieces and suborbital scale bones not denticulated. Dorsal single, low; anal and genital apertures apart; anal fin having three spines and numerous simple rays. Branchiostegals six.

GENUS VII. *DIPTERYGONOTUS*, Bleek. No teeth on the maxillaries, vomer, or palatines. Opercular bones not denticulated, there being a single flat spine on the operculum only. A horizontally protractile tubular mouth. Dorsal fins two, remote, not scaly. Cheeks scaly. Branchiostegals seven. Macassar.

GENUS VIII. *APOGENOIDES*, Bleek. Setaceous maxillary teeth; no teeth on the vomer or palatines. Opercular bones not toothed; no opercular spine. Mouth little protractile. Dorsal two, remote, not scaly. Branchiostegals six. Macassar.

GENUS IX. *MENDOSOMA*, Guich. Body oblong, compressed, scaly, with the aspect of *Mæna*. Head small; mouth protractile, with a very small opening; many conical teeth near the premaxillary symphysis only, none on the mandible or vomer. Dorsals two, contiguous, or one fin notched to its base. Ventrals thoracic, destitute of the long acute scales. Branchiostegals six. Valparaiso.

GENUS X. *PENTAPRION*, Bleek. Dorsal solitary. Mouth protractile downwards; teeth on the jaws only. Spinous anal rays five. Branchiostegals six. Batavia.

GENUS XI. *VELIFER*, Schleg. Near *Cæsi* and *Gerres*. Body very high and compressed. Dorsal and anal fins excessively large, and supported by soft, thick, unjointed rays. Japan.

GENUS XII. *ACHARNES*, Müll. and Trosch. Distinguished among the *Menidæ* by the interrupted lateral line. Teeth on the jaws card-like; no palatine teeth. Protrusive mouth. Five branchiostegals. Dorsal deeply notched; dis severed pharyngeals. No armature on the gill-cover or preoperculum; no accessory gills.

GENUS XIII. *APHAREUS*, Cuv. A genus of uncertain affinities, and placed by the authors of the *Histoire des Poissons*, after the *Menidæ*, merely because no more fitting position occurred to them. They were acquainted only with a dried specimen which seemed to have some resemblance to *Cæsi*, but differed from it in having an obtuse gill-cover and large mouth with an elevated ray at the ends of the dorsal and anal fins. A very narrow band of villiform teeth on the jaws. Palate smooth, but the vomer projecting and producing two rounded eminences. No scales on the forehead, the lips, or jaws; but the cheeks, gill-cover, and top of the head scaly. Seven branchiostegals. Suprascapula denticulated. Ventrals attached a little behind the base of the pectorals. One species.

GENUS XIV. *CHÆTOPTERUS*, Schleg. Comes nigh to *Aphareus* in habit, but is furnished with vomerine teeth, and possesses four branchiostegals.

FAMILY XI.—PSEUDOCHROMIDÆ, Müll. and Trosch.

Scaly fishes. Dorsal fin long. Jaw and palatine teeth; no armature of the opercular bones; interrupted lateral line; double under pharyngeals and hackle-formed pharyngeal teeth. Six branchiostegals; pectinated accessory gills.

GENUS I. *CICHLUPS*, Müll. and Trosch. Generic characters of *Pseudochromis*, only the card-like (or hackle-formed) teeth of the palatines are wanting; there is a row of vomerine teeth. The stomach is cæcal, the cæcal part short; pancreatic cæca absent; swim-bladder simple.

GENUS II. *PLESIOFS*, Cuv. Aspect of *Chromis*. Eyes approximated. Ventrals very long.

GENUS III. *PSEUDOCHROMIS*. Rüpp.

LABYRINTHIBRANCHS.

The peculiar structure of the pharyngeals in this family, by which a quantity of water can be retained in their complicated folds, is compared by Cuvier to the leaflets of a camel's paunch. The apparatus is covered by convex gill-covers that fit closely to the shoulders; so that even when the fish is out of the water the inclosed liquid cannot eva-

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porate quickly, but remains falling drop by drop on the *branchiæ*, and keeping them sufficiently moist to carry on the oxygenation of the blood. In conformity with this specialty in the form of these organs, is the known habit of all the members of the family whose mode of life has been ascertained of issuing at times from the rivers and ponds, and travelling overland to considerable distances. We have mentioned in a preceding page the habit of the Siluroid *Doras* of travelling in bands from one pond to another as they dry up in succession by the heat of the sun, but they do not possess any peculiar branchial reservoir like the *Labyrinthibranchs*, or *Anabasidæ*, as this family is often called.

The roundness of the sides of the head caused by the convexity of the gill-covers, and the breadth necessary for lodging the branchial apparatus, gives a good deal of the aspect of a Mullet to this family. This likeness, and the general character of these curious fishes, was known to the ancients. Theophrastus, in his treatise *De Piscibus in sicco viventibus*, says that in India there are certain little fishes which leave the rivers for a time and return to them again, and that they resemble the fishes named by the Greeks

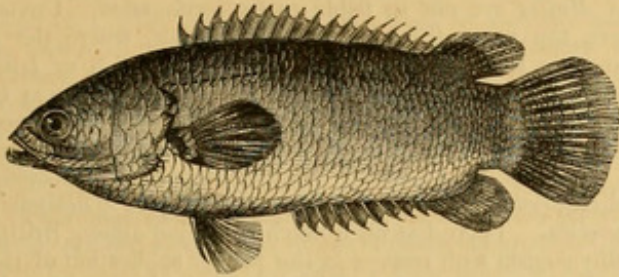


Fig. 107.
Anabas scandens.

Myxinos, or the Mulletts. In 1797, M. de Daldorf, in a memoir communicated to the Linnean Society of London, mentions that in 1791 he had himself taken an *Anabas* in the act of ascending a palm tree (*Borassus flabelliformis*) which grew near a pond. The fish had reached the height of 5 feet above the water, and was going still higher. In the effort to do this it held on to the bark of the tree by the preopercular spines, bent its tail, and stuck in the spines of the anal; then released its head, and, raising it, took a new hold with the preoperculum higher up. The fish is named in the Malay language the "Tree-Climber." The fishermen keep these fishes five or six days in dry vessels, and carry them more than 150 miles to the Calcutta market. As the *Anabas* is often met at a great distance from any water, it is frequently reported by the natives of India to have fallen from the sky. The jugglers carry them about to amuse the people, and another of the family is reared for sport in the kingdom of Siam. It is the *Macropodus pugnax* of Cantor. "When the fish is in a state of quiet its dull colours present nothing remarkable; but if two be brought together, or if one sees its own image in a looking-glass, the little creature becomes suddenly excited, the raised fins and the whole body shine with metallic colours of dazzling beauty, while the projected gill-membrane, waving like a black frill round the throat, adds something of grotesqueness to the general appearance. In this state it makes repeated darts at its real or reflected antagonist. But both, when taken out of each other's sight, instantly become quiet. This description was drawn up in 1840 at Singapore, by a gentleman who had been presented with several by the King of Siam. They were kept in glasses of water, fed with larvæ of mosquitoes, and had thus lived for many months. The Siamese are as infatuated with the combats of these fishes as the Malays are with their cockfights; and stake on the issue considerable sums, and sometimes their own persons and families.

The license to exhibit fish-fights is farmed, and brings a considerable annual revenue to the King of Siam. The species abounds in the rivulets at the foot of the hills of Penang. The inhabitants name it *Pla kat*, or the "Fighting-fish;" but the kind kept specially for fighting is an artificial variety cultivated for the purpose" (Cantor). The *Trichopodus trichopterus* is also very pugnacious; and the exquisite beauty of its varying iridescent metallic tints make it a great acquisition to garden tanks. The *Tr. nobilis* inhabits the rivers of Sikkim, in northern Bengal.

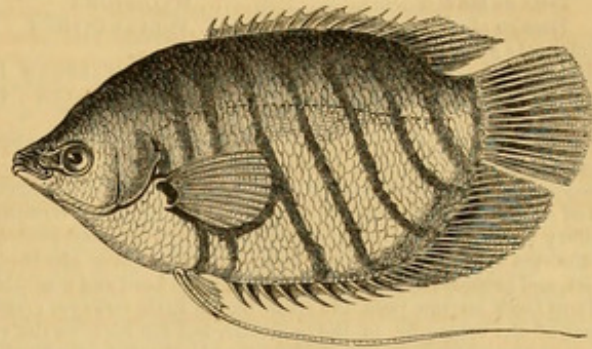


Fig. 108.
Oosphromenus olfax.

The *Oosphromenus olfax* is well known in Batavia under the name of *Gourami*, for its excellent flavour when brought to table. It attains the size of a large Turbot, and Commerson relates that he had never eaten anything more savoury and delicious, neither among fresh-water fish nor among marine ones. He adds, that the Dutch residents in Java rear this fish in large jars, renewing the water daily, and feeding it wholly on river plants, especially the *Pistia natans*. But M. Dupetit-Thouars declares that he saw those kept in a stew crowding to the mouth of a drain to feed on human excrement. The *Ophicephali* are very tenacious of life, and the Chinese bring them to market yet alive, though their entrails have been removed, and sell them in slices. When the irritability of the flesh is so much exhausted that it no longer quivers under the knife, its value is greatly depreciated. This Chinese practice, however much it may shock the feelings when described, is not worse than

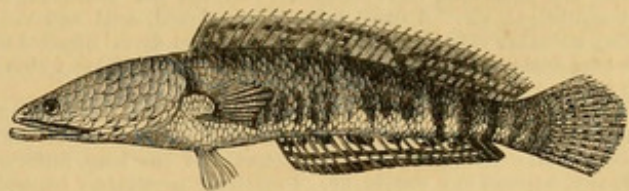


Fig. 109.
Ophicephalus striatus.

the crimping of Cod on the London fish-stalls. The *Ophicephalus marginatus*, Cuv. (*gachua* of Buchanan) is often seen travelling among wet grass in the beginning of the rainy season.

FAMILY XII.—LABYRINTHIBRANCHIDÆ.

Poissons a pharyngiens labyrinthiformes, Cuvier; *Labyrinthibranchii*, Owen; *Anabantidæ*, Cantor. Upper pharyngeal bones furnished with leaf-like folds, inclosing cavities capable of retaining water. Gill-covers convex, and fitting tightly to the shoulder. Scales large, those on the head scarcely inferior in size to those on the body. Body in most rather elongated, in some an oblong oval. Mouth, cleft past the eye in one genus only, in most little more than half way to the eye, in all terminal. Gill-membrane generally shut up under the scales. Ventrals sometimes without a spine, of from one to five or six soft rays, generally under the pectorals, sometimes farther forward. Lateral line interrupted or continuous, curved, deflexed, or straight.

Classification—
Acanthopterygians
Fishes.

ANALYTICAL TABLE OF THE ANABASIDÆ (Dum.)	
Fin-rays much prolonged.	
<i>In the ventrals only.</i>	
A solitary one.	
Dorsal short	TRICHOPUS 9.
Dorsal long	COLISA 6.
Several, one of them very long	OSPHROMENUS 8.
<i>In all the fins, except the pectorals</i>	MACROPODUS 7.
Fin-rays not elongated.	
<i>Palate toothless.</i>	
Opercula and subopercula acutely toothed	ANABAS 1.
Opercula and subopercula not toothed.	
Teeth on the lips	HELOSTOMA 2.
Teeth on the jaws	POLYACANTHUS 3.
<i>Teeth on the palate.</i>	
Dorsal with spinous rays	SPIROBRANCHUS 10.
Dorsal without spinous rays	OPHICEPHALUS 11.

GENUS I. ANABAS, Cuv. Preorbital, operculum, suboperculum, and interoperculum serrated, or strongly denticulated; preoperculum smooth-edged and not visible, being covered with the suborbitals and scales. Form anteriorly elliptical. Mouth small, terminal. Maxillary slender, and retiring under the narrow serrated preorbital; the rest of the suborbitals, large and flat, cover the cheek, temples, and preoperculum. Many pores on the head and mandible. Villiform teeth on the jaws, the outer ones a little stronger; none in front of the vomer or on the palatines, but far back on the vomer among the three superior pharyngeals there is a group of teeth; pharyngeal teeth crowded, conical, and pretty large. Branchiostegals six. Dorsal and anal nearly of equal height throughout. Lateral line broken under the last two dorsal spines, recommencing two scales lower. Scales large, hard, and strong. Stomach small; pancreatic caeca few; air-bladder forked behind, its points filling recesses on the sides of the tail. Two supplementary upper pharyngeals, complicated for holding water. One species.

GENUS II. HELOSTOMA, Kuhl and Van Hass. Mouth small, compressed, and protractile, seeming to issue from, and recede under the preorbital. Teeth seated in the lips. Branchiostegals five. Pharyngeal complications very curious.

GENUS III. POLYACANTHUS, Kuhl and Van Hass. Named because of the numerous dorsal and anal spines. Distinguished from *Helostoma* by the jaws being armed with teeth; from *Anabas* by the absence of denticulations on the operculum; and from *Colisa* by the existence of five soft rays in the ventrals. Stomach small, caecal, placed vertically across the long axis of the fish; pyloric caeca two; air-bladder of moderate size. Three species.

GENUS IV. CTENOPOMA, Pet. Gill-cover with two crescentic notches, and three pectinated toothed lobes. Teeth on the vomer and palatines. Many spines in the dorsal and anal fins.

GENUS V. BETTA, Bleek. Teeth on the premaxillaries, maxillaries, and mandible. Palate smooth; mouth small. Opercular pieces and suborbital scale-bones not serrated nor denticulated. Branchiostegals six. A small spine in the dorsal, anal, and ventrals; the other rays jointed, and flexible; short dorsal opposed to the long anal; ventrals under the pectorals. Java, 1500 feet above the sea.

GENUS VI. COLISA, Cuv. Body oblong, elliptical, compressed. Back and belly equally curved. Dorsal and anal long, the soft portions conical; ventrals before the pectorals, of one long, filiform, soft ray, without any membrane. Preorbital pectinately toothed. Anus situated before the middle of the fish. Branchiostegals five. Scales ciliated. Stomach small; intestinal canal rolled up in a spiral; two pancreatic caeca. Ten species.

GENUS VII. MACROPODUS, (Ctenops, McClell.) Pharyngeal apparatus much as in *Colisa* and *Polyacanthus*. Anal long; its soft part and the dorsal also ending in a long tapering point; ventrals consisting of a spine and five articulated rays, the first a long simple filament, the others branched. Branchiostegals four. Two species.

GENUS VIII. OSPHROMENUS, Comm. Distinguished from *Polyacanthus* and *Colisa*, chiefly by the shortness of the dorsal and the more complicated upper pharyngeal leaflets. Ventrals situated a little behind the pectorals, of a moderate spine, and five articulated rays, the first of which is simple and very long. Branchiostegals six. Stomach caecal, shaped like a retort; pancreatic caeca two, pretty long; air-bladder simple. Three species.

GENUS IX. TRICHOPUS, Lacép. (*Trichogaster*, Schneid.) Differs from *Ospromenus* in having a more convex profile, and an abbreviated dorsal of five spines only. Lateral line having a slightly sigmoid curvature. Anal long, with many small scales along its base; five ventral rays, one elongated. One species.

GENUS X. SPIROBRANCHUS, Cuv. The labyrinthiform pharyngeals less complicated than in other genera; approaching *Anabas* in form, and in the comparative fewness of the anal spines, but

leading to *Ophicephalus* by its possessing palatine teeth. Stomach caecal; two pancreatic caeca; no air-bladder. One species.

GENUS XI. OPHICEPHALUS, Bloch. Resembling a snake somewhat in their elongation, and in their depressed but rounded head being covered with large scales. Acanthopterygians merely in having an anal spine, the other fins being destitute of spinous rays. They are distinguished from other Acanthopterygian fish with thoracic ventrals in the cranium and face being covered, as in the *Mullidæ* and *Anabas*, with polygonal scales or plates. Body elongated, nearly cylindrical anteriorly, somewhat compressed posteriorly. Head more or less depressed, a little wider than the body. Dorsal extending far along the back; caudal rounded. Lateral line continuous. Jaws, vomer, and palatines furnished with villiform or card-like teeth, some of them longer than others. Branchiostegals five. Ventrals with a spine and five soft rays. Stomach caecal, long, and obtuse; intestines rather short; pancreatic caeca two. Twenty species.

Classification—
Acanthopterygians
Fishes.

MUGIL FAMILY.

The English name of Mullet, applied both to the *Mullidæ* and *Mugiles*, is apt to occasion some misapprehension; and we have therefore, in our notice of the *Mullidæ*, spoken of them always as *Surmulletts*, an appellation hitherto proper to one species only. The two French names of *Muges* and *Mulles* are not so liable to be confounded. Cuvier traces the name from the Spanish *Mugel*, where the *g* sounds in the Castilian dialect like the Scottish or Irish aspirated *h*. This is softened on the shores of Biscay to *Meville*, whence the English Mullet. They are mentioned by Aristotle and others of the ancient authors by the names of *Chalones* or *Chelones*, *Myxon*, *Kephalos*, *Spheneus*, and *Kestreus*. *Cefalo* remains in use at Naples to designate a species. There has been much confusion among British ichthyologists with respect to the proper application of the specific names to the species that frequent the British seas, but Mr Yarrell has thrown a flood of light on the obscurity by his excellent figures. Mr Yarrell, say the authors of the *Histoire des Poissons*, has given a charming figure of our *Capiton* (*Mugil capito*, Cuv.) on page 200 of his first volume, under the name of the Grey Mullet; and at page 207 a figure not less good of *Mugil chelo*; and a third distinct species of a different aspect, named by him *Mugil curtus*.

The *Mugil cephalus*, or Mediterranean Grey Mullet, is distinguished from the English species by its eyes half covered by two adipose veils adherent one to the anterior and the other to the posterior margin of the orbit, and by the peculiar concealment of the maxillary bone, which, when the mouth is closed, is completely hidden beneath the preorbital. The base of the pectoral fin is surmounted by a long carinated scale. This is the best and largest of the Mediterranean kinds. It weighs about 10 or 12 lb., and does not appear to have been yet detected in the seas or estuaries of Britain, nor along the oceanic shores of France. It is very common on the coast of Spain, especially around the island of Iviça, where the fishermen are said to recognise two varieties under the names of *Mugil* and *Lissa*. When surrounded by a net, it endeavours, and often successfully, to effect its escape, by leaping over the edges into the open sea.

"Its hearing is very fine, as has been noticed by Aristotle, and it feeds on worms and small marine animals; but it is doubtful, though it has been advanced, that it can live on vegetable substances. It appears to be of a stupid character, a fact which was known in the time of Pliny, for that author tells us that there is something ludicrous in the disposition of the Mulletts; for if they are afraid they conceal their heads, and thus imagine they are entirely withdrawn from the observation of their enemies.

"When, towards the end of spring and the commencement of summer, the fishes of this species, excited by the necessity of living in the fresh water, approach the shores

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Acanthop-
terous
Fishes.

Classification—
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terous
Fishes.

and advance towards the mouths of the rivers, they form such numerous troops that the water, through which they are seen without being clearly distinguished, appears to be bluish. This particularly happens in the Garonne and the Loire at these periods. The fishermen there adopt the plan of surrounding these legions of Mulletts with nets, the inclosure of which they gradually contract, taking care to make a noise to frighten the fish and oblige them to press together, and heap themselves, as it were, one upon the other.

“Of the Mulletts thus taken, some are eaten fresh, others are salted and smoke-dried. It is with their eggs salted, washed, pressed, and dried, that the preparation called *botarcha* is made, which is a condiment greatly in request in Italy and the southern provinces of France. The flesh of this Mullet is tender, delicate, and of an agreeable flavour; it is fatter and more in estimation when it is taken in the fresh water. The ancients, who from the time of Aristotle were acquainted with this fish, had it in great request; and the consumption of it is still very considerable in most of the southern countries of Europe. According to the report of Athenæus, those Mulletts were formerly in very high esteem which were taken in the neighbourhood of Sinope and Abdera; while, as Paulus Jovius informs us, they were very little prized which had lived in the salt marsh of Orbitello in Tuscany, in the lagoons of Ferrara and Venice, in those of Padua and Chiozza, and such as came from the neighbourhood of Commachio and Ravenna. All these places, in fact, are marshy, and the streams by which they are watered are brackish, and communicate to the fish which they support the odour and the flavour of the mud.”

A common mode of fishing in the sea for Mullet, practised at the present time on the shores of the Mediterranean, is to select a point of rock overhanging a considerable depth of clear still water. The fish are attracted to this place by being fed for some time with granulated macaroni, and then the fisherman in the gentlest manner lets down a small hook concealed in a pellet of paste and attached to a very fine line. Skill is exerted in withdrawing the fish, which is speedily hooked, without disturbing the others, but a practised fisher will soon obtain a good load. He must neither show himself nor permit his shadow to appear on the water.

In the *Histoire des Poissons*, *Tetragonurus* is placed at the end of the *Mugilidæ*, with an intimation that the true place of the genus in the ichthyic scale has not yet been ascertained. We shall mention it again when we come to speak of the *Notacanthidæ*.

FAMILY XIII.—MUGILIDÆ.

MUGILOIDES, Cuv. (*Mugil*, Linn.) Body cylindrical; back broad. Scales large, and extending to the head like those of the *Ophicephali*. Two dorsals widely separated, the first one having only four stiff, acute spines; ventrals in general abdominal. Teeth, when present, so fine as to be almost invisible; maxillaries small, and mostly concealed by the thick premaxillary lip that presses against the preorbital when the mouth is shut. Mandible shelving with a small symphyseal cutaneous tubercle that fits a notch between the premaxillaries. Pharyngeals greatly developed, and closing the gullet so that only soft and thin matters can enter the narrow angular opening of the œsophagus. Branchiostegals four, five, or six, as in the *Pharyngobranchs*. Stomach cæcal like a gizzard, with a thick muscular ascending branch.

GENUS I. MUGIL, Cuv. Abdominal *Acanthopteri*, with two widely separated dorsals. External aspect somewhat like that of a Dace or Chub. Mouth small, with a transverse opening and a mesial fold or crest on the under lip which fits a corresponding notch in the upper one. Teeth excessively slender, often scarcely to be seen. Preorbital on the side of the snout finely pectinated, and receiving a slender maxillary more or less completely beneath it. Gill-covers large and convex, covering a complicated pharyngeal apparatus, which prevents any coarse matters from reaching the œsophagus, through the tortuous channel. Stomach gizzard-like; gut long and folded; pancreatic cæca few. Sixty species.

GENUS II. CESTRÆUS, Cuv. Snout pointed. Mouth cleft longitudinally. Mandible short, without a mesial tubercle, and toothless;

rudimentary teeth concealed in the thick lip of the upper jaw; no teeth on the roof of the mouth. General form of *Mugil*, with four spinous rays in the first dorsal, but with the last ray of the second dorsal elongated. Teeth in a narrow band on the upper jaw only. Stomach cæcal, large, not muscular like that of *Mugil*; two pancreatic cæca; air-bladder simple, with very thin coats. Two species. Celebes.

GENUS III. DAJAUS, Cuv. Snout projecting. Mouth a little more longitudinal than that of *Mugil*. No symphyseal tubercle on the mandible. Villiform teeth on both jaws, the vomer, and palatines. Stomach less muscular than that of *Mugil*, the ascending branch being reduced to a tube, but little more fleshy than the cæcal portion; intestinal canal doubled five times; two pancreatic cæca. One species, Jamaica and St Domingo.

Tasmania possesses a species intermediate between *Dajaus* and *Mugil*, having the longitudinal mouth of the former, but the rough plates on the palate and tongue, which most of the *Mugils* have, very little coarser than in that genus, and scarcely deserving the name of teeth. It is the *Dajaus Diemensis* (Rich.)

GENUS IV. NESTIS, Cuv. Form of a Cyprinoid Barbel. Head more compressed than that of *Mugil*; gill-covers flatter. Preorbital not covering the whole maxillary, which is not decurved so as to show itself below the mandible. Teeth on the two jaws, front of the vomer, and pharyngeals; none on the palatine bones. Lower lip very thick, doubled back, callous and trenchant. Stomach differing from that of *Mugil* in being wholly membranous and no-wise fleshy; intestine long, six times folded; pancreatic cæca two; air-bladder simple with thin coats. Two species.

ATHERINE FAMILY.

We are obliged, say the authors of the *Histoire des Poissons*, to leave isolated among the fishes a group composed of a single genus, which it is impossible to divide otherwise than into small tribes, and which does not associate closely with any other genus or family. Some species have teeth clearly visible on the jaws, vomer, and palatines, such as *Atherina Boieri*, and its allies, which have a large flat head; others, like *A. sauclet* have the teeth on the palatines so minute that they are barely perceptible; thirdly, there is a large number of extra-European species which have the roof of the mouth perfectly smooth and toothless; these are mostly American, and have a peculiar physiognomy resulting from the singular position of the pedicels of the premaxillaries and the curvature of the maxillaries. The latter bones are slender, and have a structure very uncommon among fishes, but which exists usually in the Mugil family, that is, to have the posterior end of the maxillary more slender than its anterior or articular end. Another affinity to *Mugil* may be found in the small number of rays in the spinous first dorsal, and in the abdominal position of the ventrals. We cannot, however, unite them to the Mugil family as Pallas advises, since none of the anatomical details which distinguish the Mulletts from other fishes are found in the Atherines. They have neither the notch between the upper lips, nor the symphyseal prominence of the lower jaw; nor the pectinated denticulations of the preorbital; nor the unusual pharyngeal apparatus; nor the gizzard stomach. The premaxillary is much more protractile than with the Mulletts, almost as much as in the Menoid *Smaris*. The teeth require to be examined through a lens to be properly seen, and the pharyngeals, which have the usual form of those of other fishes, are crowded with minute teeth.

The Atherines live in large shoals in all the localities that they frequent; and notwithstanding their small size, rarely more than six inches, they are esteemed as a delicate food. The young, for some time after they are hatched, cling together in dense masses, and in numbers almost incredible. These are taken and prepared in the lump by frying or by boiling in milk. The inhabitants of the Mediterranean coasts of France call these newly hatched Atherines *nonnat* (unborn). In some places the adult fish is so abundant that they are employed to feed animals; at Venice for instance, where they swarm by myriads in the canals that traverse that city, and are sold in the streets

Classification—
Acanthoptero-
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under the name of *Anguella*, for cat's meat. The *Atherina presbyter* is very common on the south coast of England, and is taken in quantities in Portsmouth harbour, and even in the salt-water ditches of the fortifications. In the markets of that place and of Southampton, the Atherines are sold under the name of Smelts, but they are full of sharp angular bones, and are very inferior in flavour to the true Salmonoid Smelt. They seem to frequent, from choice, the mouths of drains that convey the putrid washings of a large city into the sea.

FAMILY XIV.—ATHERINIDÆ, Bonap.

Atherinoidæ, Cant., sub-family. Dorsals two; ventrals abdominal. Upper jaw very protractile; teeth very slender and spare, sometimes existing also on the palate, in other species the palate is smooth. Body generally ornamented by a broad silvery band on the flanks. Stomach siphonal, membranous, a little wider than the rest of the intestinal canal, which latter is shorter and not so frequently doubled back as in *Mugil*; pancreatic cæca none; peritonæum generally lined with a black pigment; ova large; air-bladder large, often prolonged into a canal formed by the caudal vertebræ. Vertebræ more than double the number of those of the *Mugils*. Thirty species.

NOTACANTHS.

The family of *Notacanthidæ*, says M. Müller, includes those *Acanthopteri*, with or without abdominal ventrals, which have many isolated dorsal spines, and the coracoid bones suspended to the vertebral column and not to the head. The same structure exists in *Notacanthus* as well as in *Mastacembelus*, but it still remains to be ascertained whether *Tetragonurus* belongs to this group or not. There is little to add regarding the family to the facts collected in the table. The Notacanth or Campylodon of Otho Fabricius and Reinhardt is a Greenland species, and Bloch has been much blamed for describing it as an Indian fish; but the fact is, that a very similar species inhabits the Australian seas, and one of these may have come into Bloch's hands. *Tetragonurus Cuvieri* of Risso, the only known species of the genus, inhabits great depths in the Mediterranean, and is consequently more rarely seen. It is named *Courpata*, has a black colour, and hard scales, deeply chiseled and ciliated. Its flesh is said to be poisonous. We have seen no specimen, but think from the structure assigned to the scales, that it should be compared with the *Elopidæ* or *Amidæ*.

FAMILY XV.—NOTACANTHIDÆ, Müll.

Scales cycloid, covering the head, body, and partially the fins. Snout prominent; mouth beneath, horizontal; nostrils near the eye. Branchiostegals seven or eight; gill-openings beneath, closed directly behind. Head slightly armed; opercular pieces nearly concealed by the integument. Body elongated, sword-shaped posteriorly. Spinous dorsal not continued by membrane; soft dorsal in some of one or two rays, or altogether absent, in others of many rays. Coracoids suspended to the vertebral column as in the Eels, and not to the head as in most osseous fishes. Ventrals abdominal, or wanting; when present composed of a spine and eight soft rays. Stomach cæcal; pancreatic cæca few.

GENUS I. NOTACANTHUS, Bloch. Dorsal spines free, with a divided soft ray in the axilla of the last one; anterior anal spines detached, each with a low membrane; anal joined to a distinctly-formed caudal. Body much elongated, sword-shaped, and tapering posteriorly. Snout prominent, obtuse. Small cycloid scales covering all parts of the body, head, and face, except the lips. Abdominal ventrals of two spines and seven articulated rays, united on the median line by membrane into one continuous fin. Branchiostegals eight; the membrane continuous across the throat with a free edge. No armature on the head except an acute spine issuing from the maxillary above its posterior extremity. Teeth slender, with lanceolate tips uniserial on the upper jaw, whose border is formed wholly by the premaxillaries; an interior concentric curve without a break is formed on the vomer and palatines by more subulate teeth, which in one species are pluriserial in front; the man-

dibular teeth are uniserial or pluriserial; all the teeth curve backwards. Two species, Greenland and Australia.

GENUS II. RHYNCHOBDELLA, Bloch, Schneider. (*Macrognathus*, Lacép.) Body elongated, compressed. Snout pointed, projecting, fleshy or membranous, flexible and striated underneath, forming a proboscis used as an organ of touch. Branchiostegals seven. Teeth mere scabrosities on the premaxillaries, mandible, and fore end of the vomer. No armature on the head. Scales cycloid, covering the body, bases of the fins, gill-covers, cheeks, cranium, and borders of the eyes. Spinous dorsal not continued by membrane; soft one long and far back; anal corresponding to the soft dorsal, with two free spines in front. Stomach cæcal, obtuse; two pancreatic cæca; a long narrow air-bladder. One species.

GENUS III. MASTACEMBELUS, Kuhl and Van Hass. *Rhynchobdelli*, but with a less elongated snout, which is merely conical and not striated beneath. Teeth rather stronger than in *Rhynchobdella*. A few small spines on the rounded corner of the preoperculum. Vertical fins in some species united, in others the caudal is merely contiguous to the other two. Ten species.

GENUS IV. TETRAGONURUS, Risso. Ventrals a little behind the pectorals. Body elongated, fusiform. Snout obtuse. Mandible a little shorter than the premaxillaries. Upper lips thick, giving the face the aspect of *Mugil*. Teeth uniserial, conical, and a little recurved on the premaxillaries; mandibular teeth also uniserial, more curved, compressed and pointed posteriorly; vomerine teeth on the chevron and along the median line; tongue smooth; pharyngeal teeth in cardlike plates. No armature on the head. Body clothed in hard scales, lying in oblique rows, and exposing disks which are grooved as in *Lutodeira*, of the family of *Gonorrhynchidæ*, to which genus this one has some other external similarity, especially in the remarkable character of two elevated scaly keels on the base of the caudal on each side. First dorsal composed of a series of very short spines, each with its membrane, which folds into a dorsal groove; soft dorsal more elevated, not long, opposite to an anal of similar height and shape. Stomach very long, cæcal, conical; pyloric cæca numerous, ranged along the sides of the ascending branch of the stomach, and along the duodenum; no air-bladder. One species. The proper place of this genus is undecided. M. Müller thinks it may be here.

SCOMBEROIDS.

In the periodicals of the day we read, that in 1855 the Herring-fishery of Scotland alone employed very nearly 70,000 people, made up as follows:—40,350 fishermen, 1913 coopers, 21,832 women employed as cleaners and packers, 3730 labourers, and 1127 fish-curers. What the Herring-fishery is to the northern nations, the capture of the Scomberoids is to the maritime population of the Mediterranean, and to the Mackerel boats of the British Channel, and both sides of the Atlantic, down to the 30th parallel of latitude. The Tunny, Bonito, and Mackerel fisheries are known, by report at least, to all. These well known fishes, remark the authors of the *Histoire des Poissons*, are easily characterized, if we regard the typical forms only. In regard to them, the detachment of the posterior rays of the second dorsal would suffice, but these are merely the chiefs of numerous genera and sub-genera, in which the characteristic forms pass by insensible gradations into others which retain little of the primary types. Scales in general very small, and so thin, that they cause the greater part of the skin to appear quite smooth. Vertical fins without scales; gill-covers destitute of spines and denticulations. Numerous pancreatic cæca;—and behold all is said that can be announced; yet a family aspect is recognisable in all, adhering to them in every modification, and we cannot subdivide them into separate families, but merely into groups of less value.

The following analytical table is not to be considered as separating the numerous genera into natural groups, but merely as a means of facilitating the labours of the student in discovering the generic name of any Scomberoid that he is investigating. The apodal *Rhynchobdellus* and *Mastacembelus*, and the abdominal *Notacanthus*, have been removed from the table as presented in the *Histoire des Poissons*, to form the family of *Notacanthidæ*.

Classification—
Acanthoptero-
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TABLE OF GENERA.

TRIBE I.

A continuous first dorsal; rays of the second dorsal and of the anal detached in form of finlets. Tail tapering to a narrow end. Caudal large.

An interval between the first and second dorsals.

Scales equally small throughout.

Two little crests on each side of the tail.....SCOMBER.

*Scales of the thorax larger, forming a corselet....*AUXIS.

First dorsal reaching to the second one.

A corselet.

A keel on each side of the tail.

Teeth small, or moderate-sized, crowded..... } THYNNUS.

Teeth strong, pointed, separated..... } PELAMIS.

No corselet.

A keel on each side of the tail.

Teeth compressed, pointed, trenchant..CYBIUM.

No keel on the tail.

Pointed cutting teeth, the fore ones longest..... } THYRSITES, } GEMPYLUS.

APPENDIX TO TRIBE I.

A single continuous dorsal; no scaly armour on the lateral line. No corselet. No keels. All or many of the rays of the anal reduced to mere small spines. Teeth of Thyrsites and Gempylus.....

LEPIDOPUS, TRICHIURUS.

Group of Sword-fish.

Snout elongated, ensiform, or dagger-pointed. Keels on the sides of the tail. Teeth close and short, villiform.....

XIPHIAS, TETRAPTURUS, MAKAIRA, HISTIOPHORUS.

TRIBE II.

First dorsal represented by isolated spines.

Thoracic ventrals.

A keel on each side of the tail..... NAUCRATES.

No keel on the tail.

Body elongated..... ELECATE.

Body compressed.

Second dorsal and anal continuous.. } LICHIA, } TRACHINOTUS.

Jugular ventrals..... } APOLECTUS.

TRIBE III.

Lateral line armed with keeled scales.

Armature of the lateral line, strong and conspicuous..... } CARANX.

Armature of the lateral line visible merely because the other scales are small. Body elevated. Profile trenchant..... } OLISTES, SCYRIS, } BLEPHARIS, } GALLICHTHYS, } ARGYREYOSUS, } VOMER, HYNNIS.

TRIBE IV.

No detached finlets; no isolated dorsal spines; no armature on the tail.

Body moderately long, more or less compressed.

Two dorsals.

Villiform or card-like teeth on the vomer and palatines..... } SERIOLA, TEM- } NODON, LACTA- } RIUS, NOMEUS, } NAUCLERUS, } PORTHMEUS.

No vomerine or palatine teeth..... } PSENES.

One dorsal, running far along the back; rays flexible; ventrals thoracic.....

CORYPHENA, LAMPUGUS, CENTROLOPHUS, ASTRODERMUS, PTERACLIS.

Body subrhomboid, high. Aspect Scomberoid. Scales small, or none.

No ventrals..... } STROMATEUS, } PEPILUS, } LUVARUS.

Two very small thoracic ventrals..... } SESERINUS.

Two jugular ventrals..... } KURTUS.

The fishery of the common Mackerel (*Scomber scombrus*) is described in detail, and with much accuracy, by Mr Yarrell, to whose pages we refer the reader, for we shall not now make lengthened quotations from a work which is in the hands of every one who is interested in British Ichthyology. We shall merely repeat from him, that on the 30th of June 1821, these fish were so abundant off Lowestoffe, that the catch on that day, by sixteen boats, amounted in value to L.5252, and it is supposed that the owners and men concerned in the Mackerel fishery on the Sussex coast, realised altogether L.14,000. The common Mackerel, though destitute of an air-bladder, takes a bait readily a few inches below the surface, and is a general inhabitant of all the northern seas, from Greenland and the Baltic, through the North Atlantic, to the Mediterranean, the Black Sea, and Sea of Azof. Very similar species exist in the Australian and Australasian Seas, the Cape of Good Hope, and Seas of China and Japan. Most of these have air-bladders.

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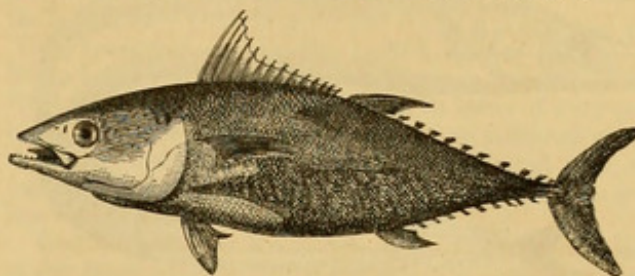


Fig. 110.

Thynnus vulgaris.

The Tunny (*Th. vulgaris*, Cuv.; *Scomber thynnus*, Linn.), fig. 110, is one of the largest fishes of the ocean. When it weighs only a hundred pounds, the Sardinians give it the name of *Scampirro*, a diminutive derived from *Scomber*. When above that weight, and onwards to three hundred pounds, it is called *Mezzo-tonno*, or Half Tunny. The larger individuals frequently weigh a thousand pounds; and Cetti asserts that old males are taken occasionally weighing eighteen hundred pounds. The fishery of the Tunny dates from the most remote antiquity; and the city of Byzantium was more especially enriched by it. The shoals which entered the Bosphorus were said to meet near Chalcedon with a white rock, which so terrified them that they turned into the Gulf of Byzantium, now the port of Constantinople. It was, according to Cuvier, in consequence of this abundance of Tunnies, that the gulf in question received the name of the *Golden Horn*; and the oracle of Apollo designated Chalcedon as the *City of the Blind*, because its founders did not perceive the inferiority of its site in relation to these valued fish. Gibbon, however, tells us that "the curve which the gulf describes might be compared to the horn of a stag, or, as it should seem, with more propriety, to that of an ox. The epithet *golden* was expressive of the riches which every wind wafted from the most distant countries into the secure and capacious port of Constantinople." The same prodigious quantities of the Tunny are still seen there as in ancient times. According to Syllius, twenty vessels might be filled by a single cast of the net; and they might frequently be taken by the hand without the aid of nets. When ascending towards the port, they might be killed with stones; and even women took them in quantities, merely by suspending a large basket by a cord from the windows. The Tunny fishery was of still more ancient practice in the West. The Phœnicians established it at a very early period on the coasts of Spain, both within and beyond the columns of Hercules. It is thus that we find the Tunny on the Phœnician medals of Cadiz and Carteia. Its salted preparation was known to the Romans as an esteemed article, under the name of *Saltamentum Sardinicum*. The Tunny fishery does not seem to be now car-

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ried on at Constantinople on a great or systematic scale, but is chiefly concentrated in the interior of the Mediterranean. The species sometimes wanders along the British shores; and a fine specimen, measuring 9 feet in length, was killed in the beautiful Gairloch, opposite Greenock, in July 1831. It is preserved in the Andersonian Museum, Glasgow.

The fish known to navigators under the name of *Bonito* belongs to our present genus. It is the *Th. pelamys* of Cuv., and sometimes occurs along the British shores. Resembling the Tunny in form, it is a great deal smaller, seldom exceeding the length of 30 inches, and is celebrated in the tropical seas for its eager pursuit of the Flying-fish. The Bonito of the Mediterranean, however, is the *Auxis vulgaris*.

It is a singular thing, as Cuvier has observed, that a fish so generally met with as the great *Lepidopus argyreus* of the European seas, so handsome, and so large,

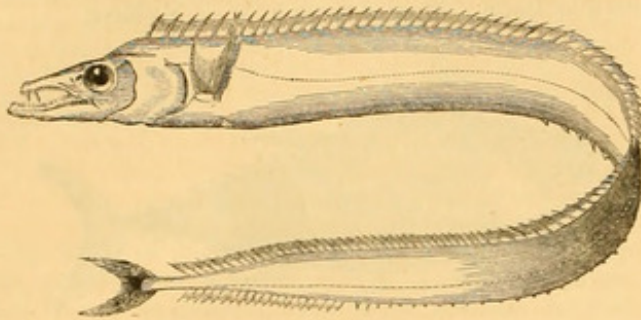


Fig. 111.
Lepidopus argyreus.

should have remained unknown to naturalists so recently as the end of the eighteenth century, and that it should have been afterwards successively described by various writers, under a new name, and by each in ignorance of the labours of his predecessor. If we figure to ourselves a large and broad riband of silver, swimming with a wavy motion through the water, and casting from it in its progress the most beautiful reflections of light, we may form some notion of the general aspect of this creature in its living state. Its length, as described by Montagu (under the name of *Zipotheca tetradens*), was 5 feet 6 inches, with a depth at the gills of $4\frac{1}{2}$ inches; it gradually decreased from the vent to the commencement of the anal fin, where it measured only 2 inches in depth; at the end of that fin the form was nearly round, and the diameter only half an inch. The weight, without the intestines, was about six pounds. Montagu's specimen was taken in Salcomb Harbour, on the coast of South Devon, on the 4th June 1808. It was swimming with astonishing velocity, *with its head above water*, going, as the fishermen said, "as swift as a bird," and was killed by the blow of an oar. It occurs occasionally on most of the European coasts; is more frequent in some parts of the Mediterranean; and has been captured as far south as the Cape of Good Hope.

The very singular form, *Nemichthys scolopacea* (Rich.), captured in the Southern Atlantic by Mr Adams, surgeon, H.M. ship Samarang, seems to be more nearly allied to *Trichiurus* than to any other genus, but as its internal structure has not been investigated, its proper position in the system must remain for the present doubtful. It is remarkable, above all other fishes, for the extreme length of its thread-like tail and long jaws, compared to its abbreviated body, many times shorter than the gape of the mouth. It is apodal, with the anus on the thorax, a range of spinous rays, each with a triangular membrane, not connected to the following one, running along the whole back, and a ~~ventral~~ ^{anal} equally long, but with taller simple flexible rays, and a more connected membrane. There is no caudal, though, as the tip of the tail was slightly damaged, this fact was not fully

established. When newly caught the fish had a dull white colour, with brown spots. The editor of the *Archiven für Naturgeschichte* is inclined to place this fish among the Tæniidæ, but it seems to us to associate better with *Trichiurus*, and we place it here without inquiring whether *Trichiurus* be a real Scomberoid or not.

Naucrates ductor, the famous *Pilot-fish* of navigators (*Gasterosteus ductor*, Linn.), so named from its habit of keeping company with ships at sea, and frequently swimming beneath their bows. It would seem, from early indications of a similar instinct, to be the *Pompilius* of the ancients, described as pointing out the way to dubious or embarrassed sailors, and as announcing the vicinity of land by its sudden disappearance. It was thus regarded as a sacred fish. The other story of its serving as a guide to the Shark does not appear to have been transmitted to us from so remote a source. It is not mentioned even by the ichthyologists of the sixteenth century; and Cuvier regards as the first allusion to it, that of Dutertre in his *Description of the Antilles*, printed in 1667. Since that period it has been carefully repeated by all voyagers and compilers; and Osbeck even makes it a subject of pious reflection on the wonderful ways of Providence. We are told by a greater than Osbeck that "they that go down to the sea in ships, that do business in great waters; these see the works of the Lord, and his wonders in the deep:" but the fact in the present instance seems reducible to this, that the Pilot accompanies both ships and Sharks, sometimes swimming before, sometimes behind, for the sake of preying upon whatever may be thrown overboard in the one case, or left uneaten in the other. It is true that the Shark never attacks it; but it is also true that the hawk does not attack the swallow; and in both instances the reason is the same; the Pilot being too nimble for the unwieldy Shark in the water, just as the feebler but more agile bird is too swift in its movements for *falco* in the air. It is thus that the apparent alliance of these dissimilar fishes may be explained even upon general principles, to say nothing of Bosc's observation, who assures us that he has seen hundreds of Pilot-fish, that they always keep at a respectful distance from the Shark, and swim about swiftly in different directions, that they may more certainly avoid it. If any food be thrown overboard, the Pilot stops to seize it, and abandons both the Shark and vessel. Geoffroy no doubt tells a story of two Pilot-fish having been seen to take a great deal of trouble, swimming to and fro, in order to conduct a Shark towards a baited hook; but admitting the truth of the details, it is clear, that whatever advantage might eventually accrue to the conductors, the probable result to the Shark was a cruel death, and one is consequently the more inclined to admire how the narrative itself should find place in a *Memoir sur l'affection mutuelle des quelques animaux!* The Pilot-fish in question is chiefly a Mediterranean species, although it also spreads into distant oceans, having been found by Daldorf under the equator. A greta extent of geographical distribution may indeed be expected in reference to a species which is said to suffer itself to be led away immense distances in its eager pursuit of ships. Dutertre records that he saw one which followed his vessel for more than 500 leagues. Whether he kept his eye upon it night and day during all that time, or in what other way he ascertained it to be the same individual throughout so long a traverse, is what he does not state, and we therefore cannot explain.

In further illustration of the subject, we shall subjoin a short extract from a recent publication, Dr Meyen's *Reise um die Erde*: "The Pilot swims constantly in front of the Shark; we ourselves have seen three instances in which the Shark was led by the Pilot. When the Sea-Angel neared the ship, the Pilot swam close to the snout, or near one of the breast fins of the animal; sometimes he darted

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rapidly forwards or sideways, as if looking for something, and constantly went back again to the Shark. When we threw overboard a piece of bacon fastened on a great hook, the Shark was about twenty paces from the ship. With the quickness of lightning the Pilot came up, smelt at the dainty, and instantly swam back again to the Shark, swimming many times round his snout, and splashing, as if to give him exact information as to the bacon. The Shark now began to put himself in motion, the Pilot showing him the way, and in a moment he was fast upon the hook. Once we watched a Pilot for many days, who kept constantly swimming close before the keel of the ship. The sailors say, as of a thing well known and familiar, that such a fish so situated has lost his Shark, and is seeking another. Upon a later occasion, we observed two Pilots in sedulous attendance on a Blue Shark, which we caught in the Chinese Sea. It seems probable that the Pilot feeds on the Shark's excrements, keeps his company for that purpose, and directs his operations solely for this selfish view." The reviser of this article has seen many Sharks caught in the Bight of Benin. They were frequently accompanied by one or two Pilot-fish, pretty objects with their light-blue bands, more often by troops of the disgusting-looking *Echeneis*, and not seldom without either of these fishes. The Pilot-fish swam gracefully round the head of the fish, but quickly struck off on one side when the monster, urged by his voracious appetite, turned up to take the bait. This bait was approached both by the Pilot-fish and Remora—by the one with an easy and elegant motion, by the other with a wriggling of the taper tail that conveyed the notion of swimming with difficulty. It seemed to us that both these attendants had no other object than that of procuring food for themselves. The Remora very commonly deserted the Shark, even when it was not caught, and attached themselves to the ship's bottom, darting off when any greasy water was thrown overboard by the cook, to pick up the morsels of fat from the clear blue water, returning again to their resting-place to be borne through the water without trouble.

The generic term *Coryphæna* is derived from *κορυφή*, *vertex*, or top of the head, in reference to the height of the crest of the cranium. This division contains the famous *Dolphin* of the Mediterranean (*Cor. hippurus*, Linn.), so celebrated for the beauty of its versatile tints.

..... "Parting day
Dies like the Dolphin, whom each pang imbues
With a new colour as it gasps away,
The last still loveliest, till—'tis gone—and all is gray."

The species are still in some measure indistinctly characterized. They occur in the Pacific and Atlantic Oceans, and the Mediterranean Sea, and are remarkable, among other things, for their keen pursuit of Flying-fish, which, in the first place, they force to leave their native element, and then following swiftly in a corresponding track, receive with open mouth the moment they descend exhausted to the surface. The *Coryphæna* may be regarded as among the most brilliant inhabitants of the sea. It is necessary, according to Bosc, to have seen them following a vessel in troops, before we can form a proper estimate of their beauty. When they swim embodied near the surface, and beneath the light of a cloudless sky, they seem effulgent with the richest gold, combined with the sparkling lustre of the topaz, the emerald, and the sapphire,—and every brilliant hue in perpetual change, accordant with the vivacity and varied grace of their movements. It is indeed a spectacle sufficient anywhere to excite our unfeigned admiration; and when seen suddenly amid the waves of the lonely and monotonous ocean, it comes upon us like a glad surprise. The beauty of these fishes has in every age attracted the wonder

"Of all who on the wide deep wandering are;"
and it is so far to be regretted, that their fugitive colours

have been the chief object of attention,—their more precise description and specific discrimination having been greatly disregarded.

The *Coryphæna* are strong, active, and voracious fishes. While swimming rapidly, they seem rather as if impelled or projected forwards by some exterior force, than by any exertion of their own. But, on attentive examination, a strong and rapid muscular movement may be detected by the constant undulation of the long dorsal fin, a movement which greatly contributes to the throwing off of those lustrous metallic reflections for which they have so long been noted. The Mediterranean species, *Cor. hippurus*, if not the most beautiful, is the largest known. It sometimes attains to the length of five feet. Its colours, so far as they are capable of description, are silvery blue above, with markings of a deeper azure, and reflections of pure gold—the lower parts citron yellow, marked with pale blue. The pectoral fins are partly lead colour, partly yellow; the ventrals are yellow on their under surface, and black above; the anal fin is yellow. The iris of the eye is made of apparent gold. This description is from the recorded observation of the living fish by M. Biberon. Another eye-witness, Colonel Bory St Vincent, describes the back as being of a sea-green colour, sprinkled with orange spots; the abdomen silvery; the lateral line yellow; the dorsal fin celestial blue, with golden-coloured rays; the caudal fin surrounded by a green hue; the other fins yellow.

One or two other kinds, not so distinctly known, occur in the Mediterranean, and many others in more distant seas. The Portuguese name more than one species *Dorade*, a term which, from its similarity to *Daurade* (a frequent appellation of our Gilt-head, *Chrysophris aurata*), has produced some confusion. Not less ambiguous is the name of *Dolphin*, which appears to have been first misapplied to the *Coryphæna* by the Dutch. It is scarcely necessary to observe, that the English word *Dolphin*, as synonymous with the Greek *Δελφίς*, the Latin *Delphinus*, and the French *Dauphin*, was originally, and is still correctly, applied only to designate a group of cetaceous animals (allied in structure to the Whales), to which the classical *Dolphin* of antiquity assuredly belonged. But by some conversion, into the history of which it is not worth while to inquire, the term has been applied by most modern writers, particularly poets, to a creature of another class, a genuine fish, of the genus *Coryphæna*. No fault, therefore, can be imputed to the naturalist, if the general misapplication of the term is now found to occasion any misconception. There is no doubt, however, that the animal beloved by gods and men, the *Hieros Ichthys* of the heroic Greeks, and the revered symbol of the Delphic Apollo, was nothing more than a Pellock or Porpoise.

Xiphias (Sword-fish), though by no means uncommon, are seldom captured, owing to their extreme vigilance. Cap-

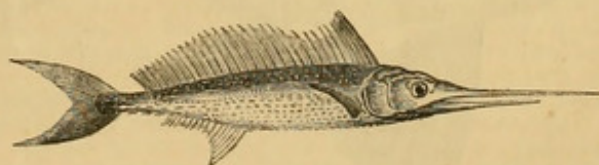


Fig. 112.

Xiphias Gladius, young.

tain Beechy informs us, that while in the Pacific Ocean, near Easter Island, "as the line was hauling in, a large Sword-fish bit at the tin case which contained our thermometer, but fortunately failed in carrying it off." Their mode of capture in the Mediterranean may be likened to Whale-fishing in miniature, and is said to be a very amusing and exciting sport. A watchman placed upon a mast, or

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standing on the summit of a neighbouring rock, gives warning by signal when he sees a fish approach. The fishermen then row towards it; and, being so skilful as frequently to strike the fish from a great distance, they throw a harpoon into it attached to a long line. An arduous struggle then commences, during which the aggressors are sometimes pulled about by the fish for many hours before they can get it into the boat. The sword-like prolongation of the snout in *Xiphias* is formed of the confluent premaxillaries, firmly and immovably articulated with the prenasal and maxillary bones as in the *Scomberesox*.

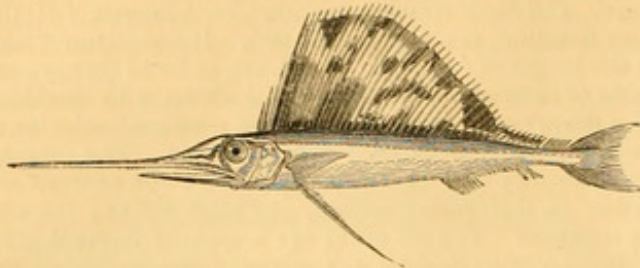


Fig. 113.
Histiophorus pulchellus.

We cannot give more space to the more remarkable forms of this large and important family of fishes. The peculiarities of their structure, such as the loose texture of their bones, the glandular-like assemblages of pancreatic cæca which they possess, and the papery-like scales, scarcely to be distinguished from the smooth skin, with the neat tapering tail and large crescentic caudal, together with the delicacy of the cutaneous fold or membrane, in which the other two vertical fins are developed, and which, from its early disappearance, leaves many of the rays detached in form of finlets, are all prominent characters of the more typical species, and give such an unity of aspect to the whole group, that it might rank as an order, and not as a mere family division. The family is generally distributed in all districts of the ocean, and the *Temnodon saltator* is especially a cosmopolitan fish, being found in all the temperate and warmer districts of the Atlantic and Pacific Oceans. In concluding, we must express our regret that M. Valenciennes should have adopted the word *Rhombus*, first used by Lacépède to distinguish a Scomberoid genus, but which has been generally employed by ichthyologists to designate the Turbots among the *Pleuronectida*. Cuvier had given the Scomberoid genus the name of *Peprilus* in the second edition of the *Regne Animal*, and this being also a Lacépédian name of this genus, the continuance of it would have

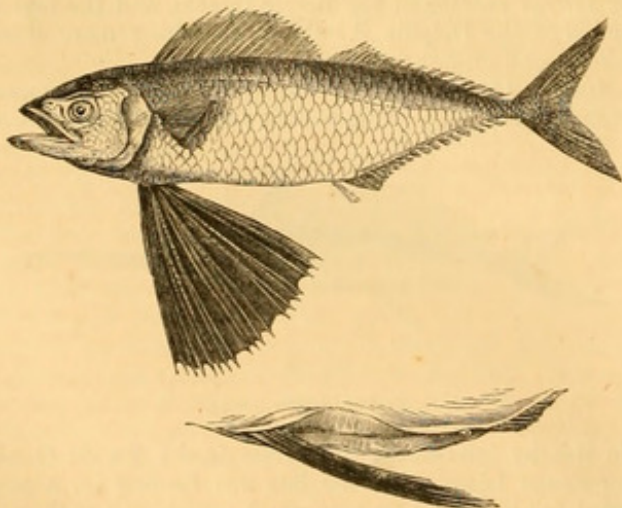


Fig. 114.
Gasterochisma melampus.

avoided the mistakes that are likely to arise from two very different genera retaining the same appellation.

FAMILY XVI.—SCOMBERIDÆ.

Classification—
Acanthopteros
Fishes.

Scales generally small, tender, smooth, seldom extending to the vertical fins; bones less solid than in most other osseous fishes. The tail and caudal fin, generally, very vigorous. Pancreatic cæca numerous, and frequently united in bunches. No armature on the opercular pieces. In many, the sides of the tail are keeled and armed with keeled, often acute scales. The posterior rays of the second dorsal and anal are often detached from the rest of the fin. Sometimes the spines of the first dorsal are not connected by membrane. The front anal spines are detached in most; the caudal is very frequently large. These characters are variously combined, none being common to all, but they serve to divide this numerous family into tribes.

TRIBE I.—*Finlets, and no Armature on the Lateral Line.*

First dorsal continuous, the rays of the second detached, forming finlets. Body fusiform. Caudal large and vigorous. Tail becoming very slender, and more or less keeled. In some there is an interval between the first and second dorsal, in others these fins are contiguous; in some the scales of the thorax are large, forming a corselet. Most, or all, have seven branchiostegals.

GENUS I. SCOMBER, Linn. Detached finlets behind the dorsal and anal; a large interval between the dorsals. Tail with a slight ridge on each side, but no acute keel. Generally an air-bladder, though in some species that organ is absent. Fourteen species.

GENUS II. THYNNUS, Cuv. Mackerels, but with contiguous dorsals; the scales of the thorax larger and stronger, forming a corselet which ends posteriorly in points. Detached finlets more numerous; no free spine in front of the dorsal. An acute cartilaginous projection on the lateral caudal ridge. Thirteen species.

GENUS III. AUXIS, Cuv. Dorsals separated by an interval. Tail keeled on the sides; intermediate between, and connecting the Mackerels, having widely separated dorsals, to the Tunnies and Bonitos, with small teeth, numerous finlets, keeled tail, and contiguous dorsals. Three species.

GENUS IV. PELAMYS, Cuv. Differs from *Auxis* in having contiguous dorsals and strong pointed teeth, standing rather widely. Two species.

GENUS V. CYBIUM, Cuv. No corselet. Compressed lancet-pointed trenchant teeth. Detached finlets and long first dorsal of *Thynnus*. Elongated body, keeled tail, and no pectoral cuirass; this last character distinguishing them from *Pelamys*. Very short villiform teeth on the chevron of the vomer, palatines, tongue, and branchial arches. Sixteen species.

GENUS VI. THYRSITES, Cuv. No lateral caudal keel; no pectoral corselet. First dorsal contiguous to the second. Body elongated, much compressed. Small but perfect ventrals. Teeth pointed, compressed, trenchant; longer and stronger anterior premaxillary teeth; palatine teeth small, pointed. Four species.

GENUS VII. GEMPYLUS, Cuv. *Thyrsites* with rudimentary ventrals. No palatine teeth. Two species.

GENUS VIII. ROVETTUS, Bonap. (*Ruvetus*, Cocco; *Tetragonurus*, Lowe; *Aphurus*, Idem.) Body elongated, compressed. Head covered with a scabrous leathery skin. Belly keeled on the ventral edge. Tail compressed, without a lateral keel. Head unarmed; snout much abbreviated. Gill-openings very wide. Mandible shorter than the premaxillaries. A row of equidistant, compressed, slightly recurved, serrated teeth on the jaws; some of them long, especially the premaxillary ones near the symphysis, which are the longest; a uniserial range of smaller ones on the vomer and palatines. Two dorsals, with finlets above and below the tail. Caudal forked. Branchiostegals seven. Many pancreatic cæca; small air-bladder. One species.

APPENDIX TO TRIBE I.

GENUS IX. LEPIDOPUS, Cuv. (*Aphanopus*, Lowe.) Form of *Gempylus* and *Thyrsites*, even more elongated; but they have no soft dorsal or finlets, the spinous rays running all along the back. Vestiges of ventrals in form of a little squamoid appendage, with the styloid pubic bone felt through the skin. Teeth like those of *Thyrsites* on the jaws; none on the vomer, and very fine ones on the palatines. Branchiostegals six. A long cæcal stomach; twenty-three pancreatic cæca; air-bladder long and narrow. One species.

GENUS X. TRICHIURUS, Linn. Head, body, and dentition of *Lepidopus*, but without a vestige of ventrals. The dorsal, also, is spinous throughout like that of *Lepidopus*; while the anal consists of a series of spines that scarcely protrude through the skin, and the tail ends in a filiform point without a caudal fin. Four species.

GENUS XI. NEMICHTHYS, Rich. (*Voy. of the Sappho*, pl. x., 1848.) Form greatly elongated, and tapering posteriorly into an exceedingly long filamentous-looking tail. Head longer than the

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body, excluding the tail. No ventrals. Elongated jaws formed as in *Scomberesox*; the edge of the maxillary touching the angle of the long gape of the mouth, which is bounded by the very slender premaxillaries and mandible. Branchiostegals nine or ten, as fine as a hair. Anus between the small pectorals. Eye large. Dorsal spines isolated, each with a membrane in its axilla, extending from the occiput to very near the point of the tail, where they can no longer be traced for their minuteness; anal fin with more numerous and taller spines, and apparently a continuous membrane, disappearing also near the hair-like point of the tail; no caudal. None of the spines strong enough to be pungent, but none of them jointed. Teeth arranged in very close, fine, file-like bands, on the premaxillaries and mandibles; individually, when viewed through a lens, they appear to be semi-lanceolate with the points turned backwards. One species.

Group of Sword-fish. Muzzle in form of a sword or dagger.
No detached finlets.

GENUS XII. XIPHIAS, Linn. Allied to *Thynnus* by their very small scales, the keels on the side of the tail, and interior organization. Their distinctive character is the elongation of the beak, composed chiefly of the premaxillaries and vomer, supported at the base by the frontals, nasal, and maxillaries, and which is a great offensive weapon. Their branchial laminae are peculiarly formed. The caudal, having the distinctive form of the family, is a powerful instrument of natation. No ventrals. Branchiostegals seven. Stomach caecal, conical; pancreatic caeca numerous: air-bladder large. Though the difference between these great Scomberoids and *Nemichthys* is so vast, as respects size, they seem with regard to the structure of the jaws to bear much the same relation to that small fish that *Hemiramphus* does to *Scomberesox*. One species.

GENUS XIII. TETRAPTURUS, Rafin. Scomberoids with elongated and pointed bill as in *Xiphias*, but which have ventrals, and instead of a keel on each side of the tail, have little crests as in *Scomber*. Two species.

GENUS XIV. MAKAIRA, Lacép. With the pointed bill and the small lateral caudal crests of *Tetrapturus*, but without ventrals. One species.

GENUS XV. HISTIOPHORUS, Lacép. (*Notistium*, Herm.) Approaches nearly to *Xiphias*. The bill, and lateral caudal crests of *Tetrapturus*, but the dorsal is very high; and their long slender ventrals are composed of two rays. Branchiostegals seven. Stomach caecal, a great bag as long as the abdomen; caeca in a mass like a pancreas. Five species.

TRIBE II.—CENTRONOTI, Lacép. Scomberoids, with the first dorsal composed of isolated spines.

i.e., No continuous membrane to the spinous dorsal; with or without finlets behind the articulated dorsal or anal; and the lateral caudal keel present in some genera, wanting in others. Ventrals present in almost all.

GENUS XVI. NAUCRATES, Cuv. A fusiform body, small uniform scales, and a keel on the side of the tail as in *Thynnus*. Two free spines before the anal, and the above characters of the tribe. Four species.

GENUS XVII. ELECATE, Cuv. *Naucrates*, except that the two spines before the anal are wanting, also the lateral caudal keel. The head, moreover, is depressed. Five species.

GENUS XVIII. LICHIA, Cuv. Body oblong, compressed, without keel or lateral ridges on the tail. Dorsal spines isolated, with each a membrane in its axilla, and a decumbent spine in front of all. Four species.

GENUS XIX. PAROPSIS, Jen. Differs from *Lichia* in the total want of ventrals.

GENUS XX. CHORINEMUS, Cuv. (*Scomberoides*, Lacép.) *Lichia* with the rays of the second dorsal or of the anal either wholly isolated or connected by a low membrane so tender that it disappears easily. Branchiostegals seven or eight, in some only four or five. Sixteen species.

GENUS XXI. TRACHINOTUS, Cuv. Differ from *Lichia* in having a more elevated body, and steeper profile before the eye, and in the anal and dorsal being more acutely falciform anteriorly. Some American species have the lower bodies of *Lichia*, and differ from that genus chiefly in the short, almost truncated snout. Twenty-four species.

GENUS XXII. APOLECTUS, Cuv. *Trachinoti* with ventrals attached to the throat. One species.

GENUS XXIII. PALINURUS, De Kay. Rays of the dorsal not free, but connected by a low membrane; a spine before the anal.

Preoperculum and operculum serrated. The last-mentioned character seems to remove this fish from the *Scomberidae*, with which, however, its entire habit accords. One species (*Trachinotus argenteus*, Storer).

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TRIBE III.—Scomberoids, with a cuirassed lateral line;

The scaly shields being themselves keeled and acute. This kind of armour becomes feebler in certain genera, so that it would not be noticed but for the smallness of the other scales.

GENUS XXIV. CARANX, Cuv. Keeled scales on the lateral line strong and acute. Two separate dorsals. A couchant anterior spine; two free spines before the anal. No appearance of the corset of *Thynnus*. Posterior dorsal and anal rays sometimes very slightly connected, or even forming detached finlets. Seventy-one species described in the *Histoire des Poissons*, and there divided into—

Trachurus, which have the whole lateral line strongly cuirassed. *Caranx*, with only the posterior part of the line cuirassed. Body lanceolate. Finlets.

Carangus, low bucklers, low bodies, profiles nearly straight, and no finlets.

Citula, *Carangi*, with the tips of the dorsal and anal much prolonged.

Bleeker subdivides the genus into—*Megalaspis*, equivalent nearly to *Caranx*; *Decapterus*, of which *C. kurra* is a type; and *Caranx*, the type of which is *C. jarra*.

GENUS XXV. CARANGICHTHYS, Bleek. Premaxillary and mandibular teeth pluriserial; those forming the external row longer, with some canines in front of the mandible; teeth on the vomer, palatines, and tongue. Preoperculum denticulated. Lateral line armed with spinous shields. Branchiostegals seven. Kema.

The genus *Caranx* is succeeded naturally by small groups of Scomberoids, having a compressed body and an elevated trenchant profile leading to *Vomer*, in which this compression and elevation are at a maximum. In these the keeled scales of the lateral line are comparatively feeble.

GENUS XXVI. OLISTES, Cuv. Resemble the *Citulae* in their falciform acute dorsals and anals, and have in addition the middle rays of the dorsal and anal prolonged into long, simple, articulated filaments. Two species.

GENUS XXVII. SCYRIS, Cuv. *Citulae* with high trenchant profiles. The first or spinous dorsal concealed beneath the integuments; its spines lying against the interneurals. Anterior soft rays both of dorsal and anal prolonged. Two species.

GENUS XXVIII. BLEPHARIS, Cuv. Rhomboidal form. Spines of first dorsal very short; anterior rays of soft dorsal, and corresponding ones of the anal, prolonged into unbranched articulated filaments; long ventrals. A convex trenchant profile of moderate height. Three species.

GENUS XXIX. GALLICHTHYS, Cuv. Differs from *Blepharis* in having a higher profile, convex forehead, and vertical face. Body compressed, high. Ventrals long; caudal forked; first dorsal very low, in some reduced to a series of very short spines; anterior rays of the second dorsal and of the anal prolonged. Three species.

GENUS XXX. ARGYREIOSUS, Lacép. Profile descending in an oblique straight line from the occiput; not gibbous on the forehead. The dorsal line between the nape and the second dorsal, instead of ascending like that of *Gallichthys*, is almost horizontal, and on its posterior half it supports the first dorsal; the general form is therefore less rhomboidal. Ventrals, second ray of the first dorsal, and anterior part of the second dorsal and anal, long and pointed. Two species.

GENUS XXXI. VOMER, Cuv. Oval form, but the gibbous profile of the forehead over the eye projects out of the oval, and the face is rather concave. From the forehead to the second dorsal the back is but slightly convex, being almost horizontal. The ventral curve is part of a regular ellipse. First dorsal very low and weak, and its posterior spines not connected by membrane; second dorsal and anal low and long, not pointed or falciform. One species.

GENUS XXXII. HYNIS, Cuv. Like *Vomer*, but without a vestige of the first dorsal. Branchiostegals eight. Differs much from *Vomer* in its skeleton.—Stomach siphonal, the pylorus being at the point of a dilated, compressed, triangular sac; pancreatic caeca numerous; very large air-bladder prolonged into two conical processes, one on each side of the tail. One species.

TRIBE IV.—Scomberoids, having no detached finlets, no isolated dorsal spines, and no lateral armature of the tail; divided into genera having two dorsals, and those which have only one. (a.) Two dorsals.

GENUS XXXIII. SERIOLA, Cuv. Differs from *Caranx* in wanting the armature of the lateral line, and from *Lichia* in the dorsal spines

Classification— being connected by membrane. Villiform teeth on the jaws, vomer, and palatines. Ten species.

Acanthop- GENUS XXXIV. *SERIOLELLA*, Guichen. Body elongated, compressed; covered with very delicate scales. Head small, compressed. Jaw-teeth acute, compressed, moderately curved, distant, uniserial; vomerine teeth villiform; palatines smooth, edentate. Preoperculum ciliated. Two free spines before the anal. Two dorsals, the anterior one short, lower, spinous, but without a reclining spine in front; the second one extending far on the back; no spurious fins; ventrals thoracic. Lateral line not keeled. Branchiostegals six. Valparaiso, Juan Fernandez.

GENUS XXXV. *TEMNODON*, Cuv. *Seriola*, with thin lanceolate trenchant teeth, like those of *Cybium*, in the outer row; those on the vomer and palatines villiform. Body oblong. Small first dorsal; the two spines before the anal almost hidden. One species.

GENUS XXXVI. *LACTARIUS*, Cuv. Differs in its dentition from *Seriola* in having two or four long canines among the villiform bands in front of the jaws. Vomer, palatines, and tongue rough. No free spines before the anal; two dorsals and an unarmed lateral line.

GENUS XXXVII. *NOMEUS*, Cuv. Differs from *Seriola* in having a smaller mouth. Teeth on the jaws curved, uniserial, widely set. No villiform bands behind. Ventrals large, exceeding considerably those of *Seriola*; no detached finlets. One species.

GENUS XXXVIII. *GASTEROCHISMA*, Rich. So closely allied to *Nomeus* that it is placed after it, though the detachment of the posterior rays of the second dorsal and anal would seem to send it to a different group, but the membrane of these fins is so delicate that it disappears in handling, and the normal condition may be that of continuous fins. Form of the body exactly that of a common Mackerel, but the scales are larger. Snout more pointed, and mouth larger than in *Nomeus*. No vestige of a crest or keel on the tail. Branchiostegals five. Ventrals one spine and five jointed rays; two dorsals contiguous, the first one higher than the second and rounded in outline; pectorals small; ventrals extremely large, folding into a deep slit on the edge of the belly, which is lined with scaleless integument. The anus, opening at the end of a short very slender tube, is included in this sheath. Teeth on the jaws, subulate, slightly curved, widely set in a single row; vomerine and palatine teeth more delicate and more irregularly placed. No detached spines before the anal; ventrals black, as in *Nomeus*. One species. New Zealand.

GENUS XXXIX. *NAUCLERUS*, Cuv. Resembling *Naucratus*, but wanting the lateral keels on the tail, and with a preopercular spine.

GENUS XL. *PORTHMEUS*, Cuv. Differs from *Nauclerus* in having a single dorsal, or rather in the spinous dorsal being absent, and in the whole edge of the preoperculum being denticulated; in the roughness of the mastoid bone, and in the presence of super-orbital crests. Teeth on the vomer and palatines as in the preceding allies of *Seriola*. One species.

GENUS XLI. *PSENES*, Cuv. Differs from *Seriola* and the groups which follow it, in having no teeth on the vomer or palate. Teeth on the jaws uniserial, short, thickish, standing widely apart, curved. Vertical fins partially scaly. Branchiostegals six. Two dorsals. Snout formed like that of *Trachinotus*. Five species.

(b.) *One dorsal occupying most of the back, its rays flexible. Vertical fins partially scaly. Ventrals thoracic. Palatine teeth.*

GENUS XLII. *CORYPHÆNA*, Linn. Thoracic Scomberoids, having elongated compressed bodies covered with small scales. Head trenchant above. Dorsal long, single, supported by flexible rays, most of which are not jointed. Head greatly elevated; facial profile convexly curved in the arc of a circle, descending rapidly. Eyes low. Mouth large. Teeth on the jaws and palatines card-like. Fifteen species.

GENUS XLIII. *LAMPUGUS*, Cuv. General form and dentition that of *Coryphæna*, but the head is oblong; forehead lower; the eyes of middle height. The dorsal low and equal. Six species.

GENUS XLIV. *CENTROLOPHUS*, Lacép. *Coryphæna* less elongated than *Lampugus*; a space between the nape and the dorsal; and no teeth on the palate. Five species.

GENUS XLV. *ASTRODERMUS*, Bonell. Allied to *Coryphæna*, *Scomber*, and *Zeus*. Head elevated and trenchant. Mouth small. Four Branchiostegals. Very small ventrals; scales radiating like stars. One species.

GENUS XLVI. *PTERACLIS*, Cuv. Differs from the general character of the family in having large scales, a low forehead, high dorsal, ventrals of few rays, and separated pancreatic cæca. The true position of the genus is still undecided. Body greatly compressed, with a long dorsal like that of *Coryphæna*, but so high that, in conjunction with the anal, it renders the fish higher than it is long. Ventrals slender, jugular. Scales much like those of *Brama*,

but they do not extend to the branchiostegal membrane. Branchiostegals seven. Four species.

Classification— Acanthop- GENUS XLVII. *STROMATEUS*, Linn., Bloch. No ventrals; a single dorsal with its spinous rays concealed in its anterior edge; vertical fins scaly. Scales small, lost in the skin. Pancreatic cæca scomberoid. Eleven species.

Fishes. GENUS XLVIII. *PEPRILUS*, Cuv., *Reg. An.* (*Rhombus*, Lacép.) American *Stromatei*, distinguished by the projection of the pointed and trenchant-edged pubic bones, thus forming a link with *Psettus*. Five species.

GENUS XLIX. *LUVARUS*, Rafin. Badly characterized. One species, said to have a small, flat, moveable appendix before the anus, serving as a kind of operculum. This distinguishes it from *Stromateus*.

GENUS L. *SESERINUS*, Cuv. Differs from *Stromateus* and *Peprilus* in having two very small ventrals, but has the internal structure of *Stromateus*. The ventrals composed of a spine and five soft rays. Branchiostegals six.

GENUS LI. *KURTUS*, Bloch. Comes near *Peprilus*, from which the genus differs in having a shorter dorsal and well developed jugular ventrals. A long anal; and scales so fine as to become perceptible only by drying the skin. No scales on the fins. Branchiostegals seven. Pubic bones emitting a spine between the ventrals. Small trenchant plates before the dorsal, with a couchant spine at their base. Ribs dilated, convex, and forming rings which inclose the air-bladder in a tube that is prolonged under the vertebræ of the tail. Body high anteriorly, tapering posteriorly. One species.

DORY FAMILY.

M. Valenciennes described this group as the fifth great tribe of Scomberoids, distinguished from the other four by its members having all protractile mouths. He assigns as reasons for so placing them, that they are connected to the rest of the Scomberoids by many anatomical characters which they possess in common, by the similarity of their dermal constitution, and general family likeness. The *Zeides*, he says, have two dorsals, and some other osteological characters analogous to those of the Percoids; but the nature of their integuments, and the shields which arm their sides, ally them incontestably to the Scomberoids having a cuirassed lateral line. *Lampris*, which has also a protractile mouth, has viscera similar to those of *Thynnus*, and thus links the group closely to the rest of the Scomberoids. But he adds that the group is a natural one, which has relations to several others not less natural, and he divides it into two sections,—one in which the dorsal is so deeply divided as to appear like two; and a second in which the dorsal is continuous or single.

The best known example of the family, and one common enough on our western coasts, is the *Zeus faber*, or John Dory of Billingsgate. This was for long neglected in the London market, until Quin, whose gastronomic acquirements were well known, brought it into a repute which it still retains with city men; chiefly, we suspect, on account of the character which he gave it, for it is by no means a fish that adorns a table by its handsome aspect. The names of this fish, in the Bay of Biscay and the Mediterranean, have relation to the resemblance which its dorsals bear to a cock's-comb. In some places it is called "Sea-chicken," and in Gascony *Jau*, which signifies cock. In Spain, Languedoc, and Sardinia, it has the analogous names of *Gal*, *Gallo*, and *Gadda*. *Dory*, or *Dorée*, by which it is known on both sides of the British Channel, refers evidently to its yellow colour; and we suspect that the John which is prefixed in England is not *Jaune*, which would be merely a repetition of *Dorée*, but a corruption of the Gascon *Jau*, and, in fact, that it means the Gilt-Cock of the sea. The round black spot on the side has obtained for it, in common with the Haddock, the reputation of being the fish from which St Peter took the piece of money. In some of the Mediterranean ports it is called St Christopher's fish; and the modern Greeks call it *Christop-saro*, or Christ's fish, and hang it up in their churches. At the Canaries it is called *Gallo san Pedro* (St Peter's Cock).

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Its excellence as an article of diet was known to Paul Jovius, who compares it to Turbot. Dories, very similar to the European fish, are found at the Cape of Good Hope, and

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distribution, appearing in almost precisely the same forms in the two hemispheres, and in both the Atlantic and Pacific sections of the ocean. The *Lampris guttatus* is a rare and beautiful fish of great size, whose headquarters seem to be in the northern seas. It is seldom taken on the British coasts, and still seldomer in the Mediterranean.

The *Equule* are small fishes, very interesting from their forms, but of no great utility to man.

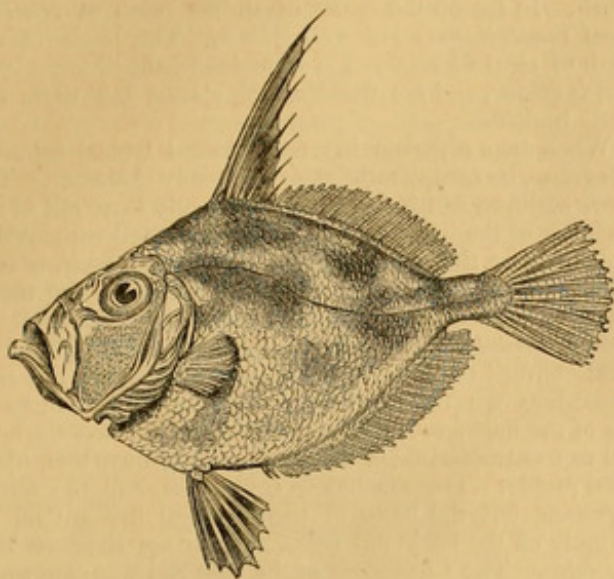


Fig. 115.
Capros australis.

in the seas of Japan. A distinct species exists in the Australian seas, which has the same black mark on the sides. The *Capros aper*, occasionally taken on the British coast,

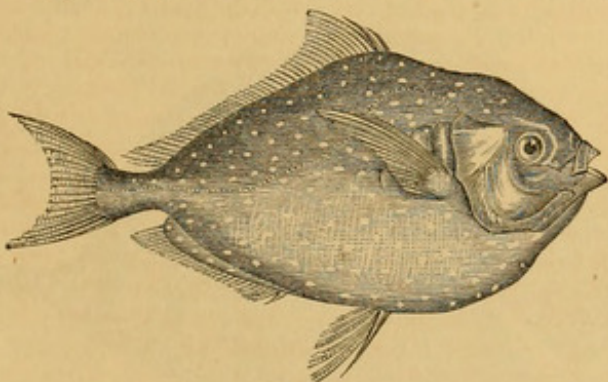


Fig. 116.
Lampris guttatus.

and more common in the Mediterranean, is also represented in the Australian seas. Indeed, the Scomberoids and the

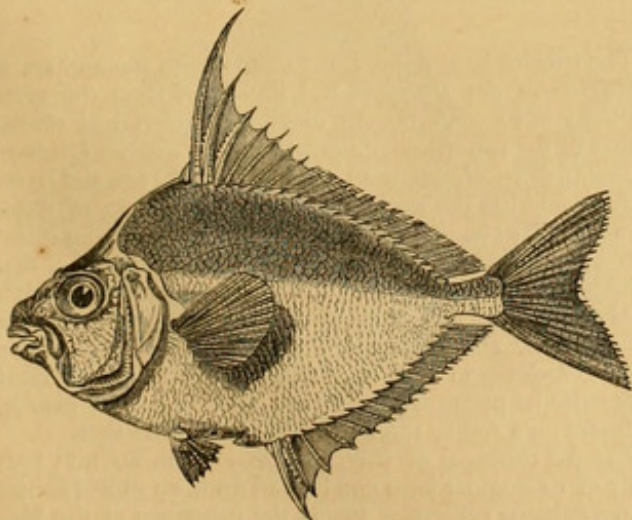


Fig. 117.
Equula serrulifera.

fishes most nearly allied to them, are very general in their

FAMILY XVII.—ZEIDÆ.

Scomberoid fish, with protractile mouths, forming, in the *Histoire des Poissons*, the fifth tribe of *Scomberidæ*. Mouth very protractile. Feeble teeth, not numerous. Bodies oval, much compressed.

GENUS I. ZEUS, Linn. (*Zeini*, Bonap.) One dorsal deeply notched, or two contiguous dorsals, anterior one spinous, with filiform tips taller than the spines; ventrals rather before the pectorals; anal spines four. Caudal rounded. Dermal shields bony, along the bases of the dorsal and anal. A very protractile mouth. Branchiostegals seven. Teeth small and feeble. Stomach large, caecal; pyloric caeca extremely numerous; air-bladder simple, oval, large. Six species.

GENUS II. CAPROS, Lacép. Deeply notched dorsal, and a still more protractile mouth than *Zeus*; destitute of the spinous bucklers, but covered with very rough scales. Eye large. Caudal rounded. Branchiostegals five to eight. Spines of the anal two or three. Teeth very small. Two species.

GENUS III. CAPROPHONUS, Müll. and Trosch. Distinguished from *Capros* by a single row of upper and under teeth, by the roughness of the maxillary, and by the three spines of the anal forming a separate fin before the soft one.

GENUS IV. LAMPRIS, Risso. A single dorsal greatly elevated in front into a long falciform point, the low part running back to near the caudal; anal long and low; ventrals long, corresponding in form to the front of the dorsal under which they are attached; the dorsal has two small short spinous rays in front, and the anal only one. Scales small, very thin. Stomach caecal, conical; pancreatic caeca above sixty, each dividing dichotomously several times; air-bladder very large, terminated behind by two short, horn-like processes. One species.

GENUS V. EQUULA, Cuv. Small Scomberoids. Mouth small, protrusive as in *Gerres*, furnished with fine teeth like those of a *Chatodon*. One or two small spines on the anterior frontal; near to which are the two contiguous orifices of the nostril. A small osseous crest behind the nape in front of the dorsal, and a similar one between the anus and anal fin, sometimes spinous at the tip. Anal and dorsal fins long, higher in front, the second and third spines being strong and tall; ventrals under the pectoral consisting of a strong spine, and five soft rays. Body oval, much compressed; serrated along the bases of the dorsal and anal. Very small smooth scales. Branchiostegals generally eight, sometimes nine. Stomach caecal, conical; two pancreatic caeca; air-bladder having two projections posteriorly. Twenty-four species.

GENUS VI. MENE, Lacép. Body high; the dorsal profile being a flat curve, the ventral one very convex, with the ventrals at its apex under the pectorals, but at a great distance from the head; the intervening thoracic space presenting a trenchant edge, supported by the pubic bones and coracoids. Mouth protractile. Ventrals with a very short spine and five articulated rays, the first one being long. Dorsal, with four spinous rays, more elevated in front but low posteriorly, and extending to near the caudal; anal long and very low, its very short rays much branched; caudal forked. Skin smooth and satiny. Stomach siphonal; pancreatic caeca numerous, extremely slender, and having very delicate coats; air-bladder very large. One species.

CHÆTODONTS

Have received the name of *Squamipennes*, because the softer, and frequently also the spinous, portions of the dorsal and anal fins are covered with scales, which, as it were, encrust them, and render their discrimination from the rest of the body by no means easy. This is the most obvious character of these fishes, of which the form is in general much compressed. The intestines are rather long, and the caeca numerous. This family was comprised by Linnæus in his genus *Chatodon*, so called from the long, slender, and hair-like character of the teeth; and the species in general

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are alike remarkable for their singular forms and splendid colours.

The seas of the torrid zone have indeed no cause to envy the productions of those famous lands, the shores of which they have so long bathed with their translucent waters. If the equatorial regions of Africa and America possess, among their feathered tribes, the brilliant Souimangas, the lustrous Humming-birds, and the gorgeous Chatterers, the intermediate ocean and the Indian seas contain countless thousands of the finny race which surpass even these in splendour. The Chætodons, in particular, form a family on which nature has bestowed her ornaments with a lavish hand. The deep purple of the iris, the paler richness of the rose, the azure blue of the crystalline sky, the darkest velvet black, and deepest violet tint of the pansy, are seen combined with metallic radiance on the pearly bodies of this resplendent group. The eye of man receives the greater pleasure from their contemplation, in that, being of moderate or small size, and haunting habitually the coral basins of the transparent tropical seas, they disport themselves in the beams of a vertical sun, as if desirous of exhibiting their splendid liveries to the greatest advantage in the blaze of day.

TABLE OF GENERA.

No palatine teeth.

Brush-like teeth on both jaws. TRIBE I.

Preoperculum not spinous.

Dorsal single, wholly scaly.

None of the dorsal spines ending in filaments.

CHÆTODON, CHELMON.

Some of the dorsal spines with filamentous tips.

HENIOCHUS, ZANCLUS.

Dorsals two, the soft one alone scaly.

Three anal spines; scales large.

EPHIPPIUS, DREPANE.

Four anal spines; scales small, imbedded.

SCATOPHAGUS.

Dorsal merely notched.

TAURICHTHYS.

Preoperculum bearing a strong spine.

HOLOCANTHUS, POMACANTHUS.

Exterior teeth tricuspid; interior ones villiform.

PLATAX.

Fine and short villiform teeth on the jaws.

PSETTUS.

Palatine teeth present.

Trenchant teeth on both jaws. TRIBE II.

PIMELEPTERUS, DIPTERODON.

Card-like teeth on both jaws. TRIBE III.

BRAMA.

Villiform teeth.

PEMPHERIS, TOXODON.

These genera are placed in tribes in the *Histoire des Poissons*. The first tribe being the Squamipennes with

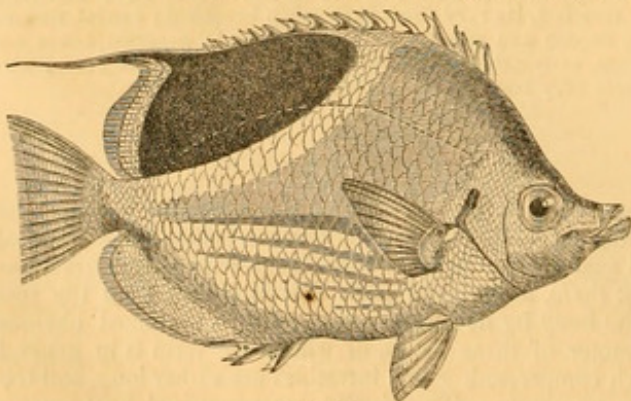


Fig. 118.

Chatodon ephippium.

brush-like teeth, forming the Linnæan genus *Chætodon*,

whose name is framed to describe this kind of dentition, in which the individual teeth are longer and stouter than villiform teeth, and resemble the strong bristles of a clothes-brush. In fig. 53 the coarse brush-like teeth of *Histiop-terus recurvirostris* are well shown. The tissue of the teeth of most Chætodons is albuminous, they have a yellowish colour, and are flexible and elastic, but when dry easily broken.

When once a person has seen several typical fishes of this group, he readily recognises the family character. The dense scaliness of the fins, which gradually taper out of the thickness of the body, so that one cannot tell without dissection where the one ends and the other begins, is very different from the small scales which creep on the membrane or rays of the vertical fins of some Sciænoids, as *Nebris*, *Lepipteris*, &c., and these never have the flexible, bristle-formed teeth of horny texture with which the true Chætodons are furnished; and, moreover, show more or less of the muciferous development of the bones of the head and face characteristic of Sciænoids, giving them their blunt facial profile. The Hæmulons come nearer to the *Squamipennes*, but the bases of their vertical fins are set on abruptly on the back and belly, and do not slope off into the sides. The Chætodons of the Red Sea were known to the ancients. *Ælian* speaks of them under the name of *Citharædus*. None of the species come into the seas of Europe, except the *Brama Rati*, which wanders occasionally to the coasts of England. The Chelmons are Chætodons with a tubular prolongation of the premaxillary and mandible, in form of a long, slender snout.

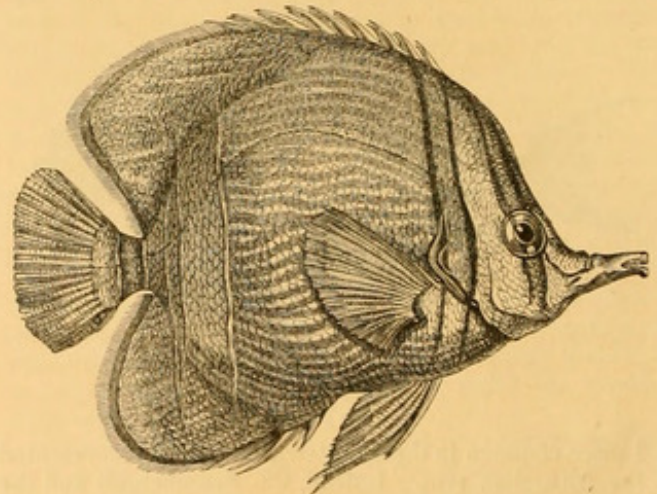


Fig. 119.

Chelmon marginalis.

The species here figured was unknown to the authors of the *Histoire des Poissons*, but its habits, from the great similarity of its conformation, may be considered as similar to that of the two species described in that work. *Chelmon rostratus*, or *enceladus*, is an inhabitant of the sea and rivers of Java, and has the instinct of throwing a drop of water from its bill, so as to light upon any insect resting on a leaf or blade of grass near the stream, and thus make it fall that it may instantly dart upon it. This was observed recently by M. Reinwardt, and an account to the same import is contained in the *Philosophical Transactions* for 1764. The Chinese residing in Java keep this fish in jars, and tempt it to practise its peculiar art for their amusement, by placing an insect on a rod or thread within range of its shot.

Zanclus cornutus of Cuv. has become, on account probably of its singular form and horned front, an object almost of superstitious reverence among the fishermen of the Moluccas. It is alleged, that when they happen to capture one of this species, they immediately salute it by certain genuflexions, and then cast it into the sea. It is, however, an excellent table fish, which attains a weight of 15 lbs.,

Classification—
Acanthop-
terous
Fishes.

Classification—
Acanthop-
terous
Fishes.

Classification—
Acanthop-
terous
Fishes.

and resembles the Turbot in flavour. It is rather widely diffused, occurring both in the Indian seas and Pacific Ocean.

Baron Cuvier has remarked, that among all the strange and fantastic fishes preserved in the representations of Ruysch, Renard, and Valentyn, and which have so long excited the mistrust of naturalists, none seems more likely to provoke that feeling than the species which these writers designate by the Malay name of *Shankarbauw*, or Buffalo-fish; and yet it now turns out that none is more accordant with the truth of nature. Its sharp recurved horns, the protuberance above the head, the compressed and unequal spines, and the singular distribution of colour,—all exist in a species recently received from the Indian Archipelago. It has accordingly been named *Taurichthys* by Cuvier—the Greek translation of the Malay name. The species here

celebrated for the splendour and singularity of its aspect is that named the *Emperor of Japan* by the Dutch, and the *Chatodon imperator* of Bloch, figured in many works. Its body is deep blue, traversed all over by about two and thirty narrow bands of orange yellow. The pectoral fins are black, and the entire tail bright yellow. It is a large fish of its kind, sometimes attaining the length of 15 inches, and, as an article of food, is one of the most esteemed of all the Indian species, resembling our own much-prized Salmon in flavour. Another and more recently discovered species is *H. semicirculatus*, Cuv. It occurs both at Timor and New Ireland. Its colours are white and blue; its length from 4 to 5 inches. The inhabitants of Waigiou call it *Mami*.

Many fish of this family are remarkable for bony enlargements of some part of their skeleton, very often of the interneural bones. In the *Ephippus gigas* the top of the skull is swelled out into a solid mass, which hangs forwards like the crest of a helmet, or like the skull of a Rhamphastos, and the interhæmal which supports the first two anal spines is also curiously swollen. *Platax arthriticus* is another member of the family which derives its name from these gout-like

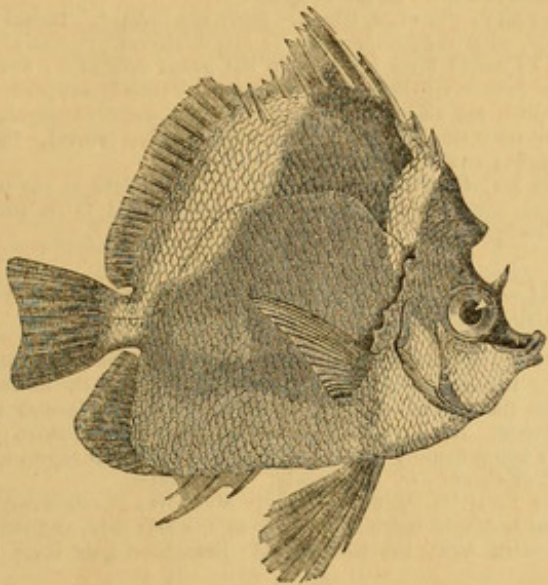


Fig. 120.
Taurichthys varius.

figured is *T. varius*, which is from four to six inches long, with a height almost equal to its length.

The species of *Holocanthus* are remarkable for the great beauty and symmetrical distribution of their colours, and for their excellence as articles of food. They are numerous

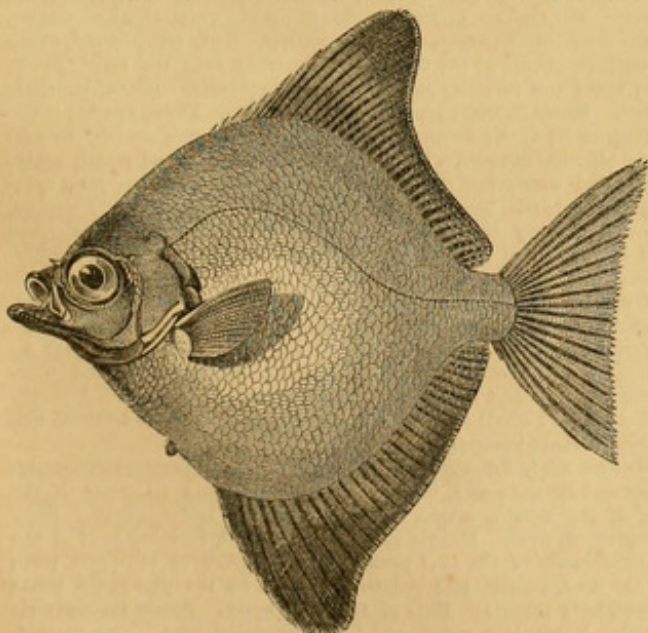


Fig. 121.
Psettus argenteus.

both in the Indian and American seas. One of the most

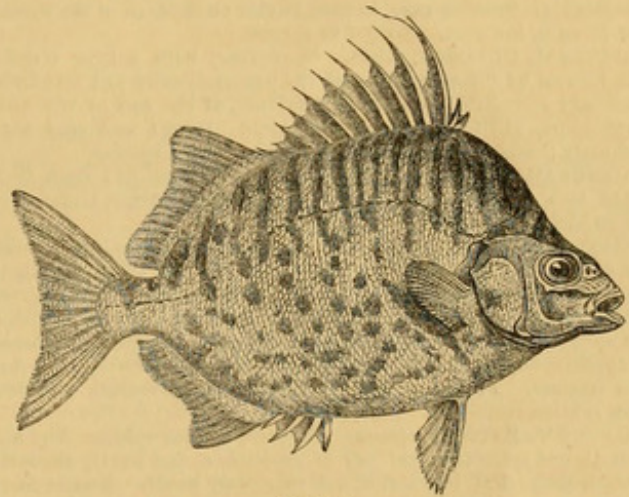


Fig. 122.
Scatophagus multifasciatus.

swellings of some of its bones. *Psettus argenteus* is a Chinese and Australian species, represented by fig. 116; and *Scatophagus multifasciatus* is another handsome fish of the southern seas.

The *Toxotes jaculator* (fig. 118) is a small Javanese species, measuring 6 or 7 inches in length, remarkable for

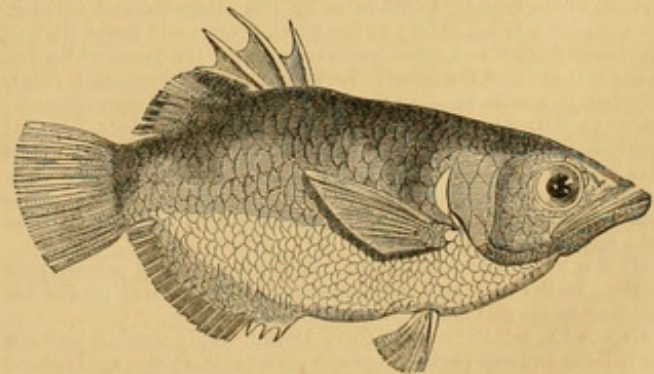


Fig. 123.
Toxotes jaculator.

possessing the same faculty as that mentioned in our notice of *Chelmon rostratus*. When it perceives a fly or other insect upon an aquatic plant, it dexterously drives it into the water by a shower of drops. Cuvier received a specimen from Batavia, the stomach of which was entirely filled with ants. This species has been erroneously multiplied in systematic works. It is twice described by Shaw under two

different names (*Scarus Schlosseri* and *Labrus jaculator*), neither of which is the right one; and there is no doubt of its being identical with Hamilton Buchanan's *Coius chaterius*, a supposed new species from the Ganges. It seems pretty widely distributed throughout the Indian Archipelago, and is known to the Malays by the name of *Ikan-sumpit*.

FAMILY XVIII.—CHÆTODONTIDÆ, Bonap.

Squamipennes, Cuv. The most apparent character of this family is the incrustation of the soft portions of the dorsal and anal fins, and often of the spinous parts also, with scales. Scales strongly ctenoid. Body generally greatly compressed. Intestines long, and pyloric cæca numerous. Dentition various, giving rise to generic subdivisions.

(a.) CHÆTODONTINI, Bonap. Brush-like teeth on the jaws, none on the palate.

GENUS I. CHÆTODON, Linn. Preoperculum not spinous. Dorsal single, entirely scaly; no prolongations of its spinous rays, but the soft dorsal sometimes ending in a long filament. Muzzle comparatively short, but more or less projecting. Teeth like long bristles densely crowded. Pyloric cæca long, slender, and numerous; air-bladder strong. Body compressed, elliptical, or nearly orbicular. Tail short. Caudal truncated. Head small. Branchiostegals six. Spinous rays, in most twelve or thirteen in the dorsal, and three in the anal. Sixty-five species.

GENUS II. CHELMON, Linn. *Chætodonts*, with a long slender bill, formed by the elongation of the premaxillaries and mandible. Maxillary roundish. Mouth very narrow, at the end of the bill; teeth short, villiform. Body very high. Dorsal and anal high and scaly; caudal square. Scales large. Three species.

GENUS III. MEGAPROTODON, Guich. Distinguished from *Chætodon* by a cluster of longer teeth, with hooked points, situated on the end of the mandible. Algiers.

GENUS IV. HENIOCHUS, Cuv. No preopercular spines. Spinous rays of the single dorsal much graduated, the third or fourth one having a long filamentous tip, like a whip-thong. Body covered with large scales. Branchiostegals five. Body obliquely rhomboidal, the apex of the soft anal and the filamentous dorsal spine being at opposite angles, and the mouth and soft dorsal forming the other two corners. Profile nearly vertical. Preoperculum serrated. Five species.

GENUS V. ZANCLUS, Comm. No preopercular spines. The filiform-tipped spinous dorsal ray of *Heniochus*, and nearly the same form of body, but the scales are extremely small. Muzzle more tubular and projecting, but not so much as in *Chelmon*. Posterior parts of the soft dorsal and anal low, with a straight inclined outline, so that the mouth and tail are the opposing angles of the rhomb; the other two being the long dorsal spine and apex of the soft anal, as in *Heniochus*. Stomach cæcal, of moderate capacity; fourteen pancreatic cæca. Two species.

GENUS VI. HISTIOPTERUS, Schleg. Resembling *Heniochus* and *Taurichthys* in the form of the body. Dorsal fin very tall, with four strong spines, without scales. Cheeks scaly. Preoperculum, operculum, and top of the head and snout presenting the granulated surfaces of the bones. Snout more or less elongated and tubular, the elongation being chiefly in the nasal, vomer, and lower limb of the preoperculum and other bones supporting the jaws, which are at the extremity of the snout. Teeth coarsely bristle-formed, blunt, crowded, in a wide band on the jaws. Eye large. Three species.

GENUS VII. EPHIPPUS, Cuv. No preopercular spines. Dorsal deeply notched between the spinous and soft portions; the spinous part being destitute of scales, and capable of folding into a scaly furrow on the back as in the *Sciænoïds*. Three anal spines. Body oval or nearly orbicular. Ventral profile almost horizontal. Pectoral fins short. Branchiostegals six. Four species.

GENUS VIII. DREPANE, Cuv. *Ephippi*, with long pointed pectorals. Bodies high and more rhomboidal, the ventral profile descending to the soft anal. Branchiostegals six.

GENUS IX. SCATOPHAGUS, Cuv. Dorsal deeply notched between the spinous and soft part. No preopercular spines; four anal spines. Scales small, lost in the epidermis, but ctenoid in structure. Body a broad oval. Tail between the vertical fins very short. Stomach siphonal; many pancreatic cæca; air-bladder simple, pretty large. Six species.

GENUS X. TAURICHTHYS, Cuv. Dorsal less deeply notched. A protuberance on the occiput, and a horn opposite the middle of each orbit. Ventrals rather large. Form unevenly subrhomboidal, higher than long. The dorsal apex formed by the fourth or fifth spinous ray; second anal spine the largest. Preoperculum not spinous. Face concave. Two species.

GENUS XI. HOLOCANTHUS, Lacép. Dorsal single, scarcely

notched, or wholly even. A large spine at the angle of the preoperculum. Body a regular oval. Vertical fins all scaly. Border of the preoperculum generally serrated. Branchiostegals six. Twenty-six species.

GENUS XII. POMACANTHUS, Cuv. More elevated than *Holocanthus*, but still having a nearly oval form. Preorbital and preoperculum always with entire edges, but with the strong spine at the angle of the latter. Dorsal spines generally fewer than in *Holocanthus* (nine, or rarely ten); anal spines three or more, deeply imbedded in front of the anal. Teeth furnished with two short lateral points, as in a few *Holocanthi*. Six species.

GENUS XIII. PLATAX, Cuv. Setiform brush-like teeth, but in front of them a row of trenchant teeth trilobate at the points, as in a few *Holocanthi*, but more evident in this genus. Body very much compressed and elevated, so that it appears to graduate insensibly into the dorsal and anal, which taper to long points; the entire height of the fish much exceeding its length; these fins are scaly, and the spinous rays (which are few in the dorsal) are buried in their front edges. Ventrals long and pointed; caudal rounded. Branchiostegals six. Fourteen species.

GENUS XIV. PSETTUS, Comm. Body compressed. Dorsal and anal scaly, with the points more or less falciform. Spines almost concealed; might form a group in the genus *Chætodon*; but the teeth are rather villiform than setiform. Ventrals reduced to a single spine, the short rays being obsolete. Branchiostegals six. Some are more elevated, and others more rounded or oval. Dorsal spines eight; anal spines three. Three species.

GENUS XV. HYP SINOTUS, Schleg. Ventrals close to the anus; soft dorsal low. Height of the body nearly equal to its length. Branchiostegals six.

TRIBE II.—PIMELEPTERINI (Bonap.) *Chætodontidæ*, with palatine teeth and with trenchant teeth on the jaws.

GENUS XVI. PIMELEPTERUS, Lacép. (*Dipterodon* and *Xysteres*, Lacép.) Distinctive character, uniserial teeth, each having a trenchant limb rising at a right angle from a horizontal heel. Body oblong. Head obtuse. Dorsal single. Fins thickish; the soft rays being densely covered with scales. General aspect much like that of *Crenidens*. Head scaly. Ten species.

GENUS XVII. DIPTERODON, Cuv. Much like *Pimelepterus*, but the dorsal is deeply notched anterior to the soft rays, and the incisorial teeth want the bony heel. Branchiostegals six. One species.

TRIBE III.—*Chætodontidæ*, with villiform or card-like teeth on the jaws and palate. Included in *Pimelepterini* of Bonap.

GENUS XVIII. BRAMA, Bloch, Schneid. Vertical fins covered with scales, the articulated dorsal occupying much of the back, and, as is usual in the family, higher in front, on the border of which three spinous rays are buried; becoming low posteriorly. Anal shorter, but similar in form. Mouth nearly vertical when closed. Teeth card-like on the jaws and palatines. Body compressed, ovate in outline, obtuse at the facial end, tapering into the tail. Snout very short and forming part of the obtuse profile. Branchiostegals seven. Stomach short; pancreatic cæca five. Three species.

GENUS XIX. NEMOBAMA, Valenc. (*Polymixia nobilis*, Lowe.) Body oblong, covered with very rough scales. Head small, scaly. Snout and upper jaw naked. Mandible scaly, with two long symphyseal barbels. Teeth on the jaws, palatines, vomer, and tongue, minute, densely crowded, villiform. Opercular bones unarmed and scaly, except the interoperculum, which is naked and skinny. Dorsal fins united; ventrals seven-rayed. Branchiostegals four.

GENUS XX. CRIUS, Valenc. (*Leirus*, Lowe.) Body compressed, keeled anteriorly, clothed wholly with smooth scales. Head small, truncated, scaly. Preoperculum furrowed on the limb, with an entire margin without spines; operculum, suboperculum, and interoperculum without spines or serratures, but sub-ciliated. A single series of very small setaceous teeth. Dorsal, anal, and caudal fins scaly. Branchiostegals six.

GENUS XXI. SCORPIS, Valenc. Unites the characters of *Trachinotus* and *Platax*; and, but for the teeth covering all parts of the roof of the mouth, might have entered the latter genus. Body compressed, oval. Muzzle short and rounded, forming part of the circumference of the oval profile. Broad band of villiform teeth on the jaws, vomer, and palatines; those on the pterygoid bones exceedingly minute. Most of the head scaly. Scales strongly ciliated. Ventrals, a spine, and five articulated rays. Two species.

GENUS XXII. PEMPHERIS, Cuv. Similar to *Brama* in outline, except that the occiput and shoulder are less convex, and the posterior parts taper more. The teeth are villiform. The short and

Classification—
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terous
Fishes.

high dorsal is over the posterior half of the pectorals, occupying but little of the back, while the long anal resembles that of *Brama*. Eye large. Air-bladder double as in *Myripristes*. Resembles *Kurtus*, but differs in the magnitude of the scales on the fins. Its short dorsal and scaly anal, with the existence of vomerine and palatine teeth, separate the genus from the *Sparidæ*. Eight species.

GENUS XXIII. TOXOTES, Cuv. A short compressed body, with the dorsal placed on the posterior half of the back. Very strong spinous rays; the soft parts and the anal scaly, and opposite to each other. Scales large. Snout depressed, short; mandible advancing beyond the premaxillary. Very short, close, villiform teeth on the jaws, end of the vomer, and palatines; also on the pterygoids and tongue. Minute denticulations on the border of the preopercular and preoperculum. Stomach short and large; twelve pancreatic cæca; air-bladder large and thin-coated. One species.

GENUS XXIV. HOPLGNATHUS, Rich. (March 1841.) (*Scarodon*, Schleg. 1844.) Compressed oval Chaetodontoids, with the soft dorsal and anal opposite, and scaly; spinous portion of the dorsal longer, but lower than the soft part; ventrals a little behind the pectorals. Jaws and teeth of *Scarus*. Scales feebly ctenoid, imbedded deeply in the skin, few on the head, and confined to the temporal region. Branchiostegals seven. Three or four species.

RIBBON-FISH.

A natural family nearly allied to the Scomberoids, and having bones of a still looser texture than the Mackerels, in most little more solid than a fibrous net-work. Cuvier included *Lepidopus* and *Trichiurus* in this family, but we have followed M. Valenciennes in placing these two genera at the end of the first tribe of Scomberoids, and along with them *Nemichthys*, whose greatest affinity seems to be with *Trichiurus*. M. Valenciennes, however, considers the two genera in question to be a link between the families, and to be connected with the elongated Scomberoids by their strong compressed curved teeth; while they have an equal relationship to the Tænioids by the presence of ventrals merely in a rudimentary condition, or their entire absence.

The first tribe, being the Ribbon-fish, which have small mouths, includes those to which this family name applies best, because species exist which are nine or ten feet long, yet are not six inches high, and scarcely an inch thick. The *Trachypteri* have several rays in the ventrals; the *Gymnetri* only one or two filamentous rays; and *Stylephorus*, still imperfectly known, appears to be truly apodal. Few fish of so much interest, from the singularity of their appearance, and the peculiarities of their structure, are so imperfectly known. This arises in a great measure from the delicacy of their texture. They are constructed for inhabiting the still waters of great depths, and are seldom seen except when thrown ashore in tempests. Their tender fins are easily mutilated, their thin soft flesh rapidly decays, their bones have too little firmness to keep the skeleton together when rudely handled, and they almost never come before a naturalist in a perfect condition. M. Valenciennes had twenty individuals under examination when he drew up his history of the family, and he has done much to remove the confusion which the imperfect and contradictory descriptions of authors, framed on mutilated specimens, had created. The *Trachypteri*, he says, are extremely tender, and their fins brittle, and their entire form can be seen in very young individuals only. The woodcut fig. 4 represents one species, *Trachypterus falx*, which has 168 rays in its dorsal fin, and plumes of rays on the head and tail. This fish shines with the most brilliant silvery tints, and when moving freely in the water, its varying hues relieved by three large round black spots on the sides, must render it one of the prettiest of the many elegant fish that the seas produce. The anatomy of *Trachypterus leiopterus* is given in the *Histoire des Poissons*, and the stomach is there described as cæcal, long, and narrow, with a very short ascending pyloric branch arising from its lower third part. The pancreatic cæca are almost innumerable, and open

Classification—
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terous
Fishes.

into the intestine by two parallel rows of holes. It had no air-bladder. The *Vaagmaer*, or *Deal-fish*, has also been recorded by Dr Fleming as a British species. It is the *Trachypterus bogmarus* of the *Histoire des Poissons*, the *Gymnetrus* or *Gymnogaster arcticus* of previous authors, and is described in the *Natural History of Iceland*, written in 1658 by Jon Gundmunsen, a native of that island. Nilsson includes it among the Norwegian fish, but as one very rarely seen. The Supplement to Yarrell's *British Fishes* contains a figure and description of one taken in Iceland, translated from a memoir by Reinhardt, curator of the Museum at Copenhagen. The *Gymnetrus Hawkinsii* is another rare British Ribbon-fish. The *Stylephorus chordatus* of Shaw was taken in the Gulf of Mexico, and is known only by a single specimen in possession of the College of Surgeons of London, but which is not, unfortunately, in the best condition. The long filament from which it derives its name is considered by Blainville to be a prolonged ray of the caudal fin, and not a lengthened spine as in *Trichiurus*. The *Cepola rubescens*, Red-band Fish or Red-snake Fish, belonging to the second tribe of Ribbon-fish, though not common on the English coast, is sometimes taken in numbers, as was the case about twelve years ago in Torbay.

FAMILY XIX.—TÆNIIDÆ.

TÆNIOIDES OU POISSONS EN RUBAN, Cuv. Compressed, elongated, ribbon-shaped fish. Skin naked and silvery. Long dorsal often joined to the caudal; the anal when it exists similarly connected; the articulated fin-rays for the most part simple; soft rays of the ventral never exceeding five, sometimes reduced to one or two, attached to the throat. This character brings them near the Blennies, while the small mouth and protractile snout of *Trachypterus* indicate some analogy with the *Zeiides*.

ANALYTICAL TABLE OF THE TÆNIIDÆ (Dum.)

Dorsal conspicuous, and		
Long, without spines.....	CEPOLA	4.
Short, and far back.....	LOPHOTES	5.
Dorsal none.		
Lateral line armed with spinous scales.....	TRACHYPTERUS	1.
Lateral line not scaly.		
Ventrals uniradiate.....	GYMNETRUS	2.
Ventrals none.....	STYLEPHORUS	3.

TRIBE I.—Mouth not wide; jaw protractile.

GENUS I. TRACHYPTERUS, Cuv. (*Bogmarus* and *Gymnogaster*, auct.) Pectorals of moderate size or small; ventrals often greatly developed, attached under the axilla of the pectorals, and having several soft rays (four to seven). Body elongated and compressed like a ribbon or blade of a sword; skirted along the whole dorsal edge by the dorsal fin, the anterior part of which, separated by a notch, rises like a tall slender fan. Mouth extremely protractile. Caudal having an upper lobe similar to the first dorsal in form and height, and a few very short rays on the lower lobe; between these there is a small filament. Lateral line armed with scales, each carrying a hook. Jaws with visible teeth. Skeleton fibrous, but extremely tender. Fins brittle and wearing down by age. Branchiostegals six or seven. Six species.

GENUS II. GYMNETRUS, Cuv. Ventrals reduced to a single elongated ray, which is often dilated at the extremity. Branchiostegals four, five, or six. Eight species.

GENUS III. STYLEPHORUS, Shaw. *Trachypteri* with the point of the tail prolonged in form of a slender cord twice the length of the body. Dorsal commencing over the operculum, and extending to very near the posterior extremity of the fish, on which is the caudal, placed so as to resemble a second dorsal; the long cord which terminates the tail is the lower ray of this caudal. No visible scales. No visible trace of ventrals. One species.

TRIBE II.—Tæniidæ, with a moderately large mouth.

GENUS IV. CEPOLA, Linn. Head much like that of *Amblyopus* and *Ophidium*, but with a large eye. Body greatly elongated and very much compressed, with a dorsal reaching from the head to the caudal, and an anal but little shorter. Caudal pointed; ventrals

Classification—attached under the pectorals. Muzzle obtuse. Cleft of the mouth nearly vertical. Teeth acute. Only two or three of the very numerous dorsal rays are simple, and only two on the anal, and they are as flexible as the jointed ones. The only bony and pungent spine is that of the ventrals. Twelve species.

GENUS V. LOPHOTES, Giorna. Head short, surmounted by a very elevated osseous crest, which inclines forwards beyond the mouth, and has a long and strong spinous ray articulated to it, bordered behind by membrane. The space between the spine and the caudal is occupied by a long, low, even dorsal, sustained mostly by simple rays. Caudal distinct, small; a very short anal close to the caudal, and just before it the anus, the abdominal cavity occupying nearly the whole length of the body; pectorals of moderate size; ventrals close behind them, excessively small, composed of a spine and five soft rays. One species.

GENUS VI. KROHNUS, Cocco. Snout short. Mouth deeply cleft. Body elongated. Head blunt; teeth on the jaws; a barbel on the chin. Anus near the head. First dorsal short and high, the second extending along the whole of the back to the end of the tail; anal similar to the second dorsal, also reaching to the point of the tail; ventrals tapering into long filaments.

GENUS VII. BIBRONIA, Cocco. Lancet-shaped, compressed. Head declivous. Jaws toothless. Single dorsal extending forwards and connected through the caudal with the long anal; rays of the ventrals elongated.

GENUS VIII. PELORI, Cocco. Distinguished from *Bibronia* by the dorsal and anal, being separated from the caudal. Teeth on the jaws.

Bibronia and *Pelori* belong to a sub-family of *Tæniidæ*, designated *Bibroninæ* by Cocco, but whose characters we have not been able to procure.

TEUTHYIDS.

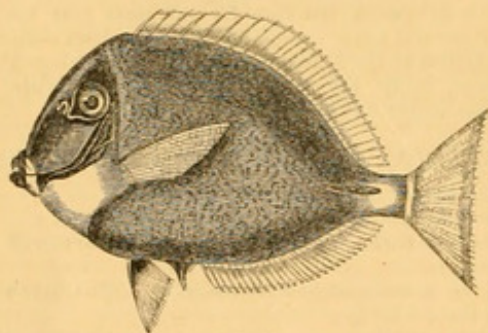


Fig. 124.

Acanthurus Delisianus.

This family is entirely strange to the European seas. Gronovius described the first known genus under the name of *Hepatus*, which Linnæus afterwards changed to *Teuthyes*, a name unfortunately used also to designate a genus of Cephalopods, and which on that account has been replaced in later times by Forskål's term of *Siganus*. The name of the family has, however, been preserved in the *Histoire des Poissons*, as derived from the Linnæan appellation. The group is a natural one, having the characters assigned to it in the table, and a family physiognomy easily recognisable. They are common enough fish in the Indian and Pacific oceans. One species is known as the "coral shoemaker" at the Seychelle Islands. They feed on marine algæ, and must be pretty objects in the coral basins that they frequent, where the clearness of the water allows them to be distinctly seen. They are not the objects of any special fishery, and their history can be best studied in the detailed account of species contained in the *Histoire des Poissons*.

No. 16 represents *Naseus longicornis*.

FAMILY XX.—TEUTHYDIDÆ, Bonap.

Teuthyes, Cuv. Oval forms, compressed. Small mouth, not protractile. Uniserial teeth on both jaws. Palate and tongue toothless. A single dorsal. Branchiostegals four or five. Scales cycloid. Pectorals moderate in size. Ventrals under the axillæ of the pectorals. Many of the genera have the sides of the tail armed, or a recumbent spine in front of the dorsal. Phytophagous fishes.

ANALYTICAL TABLE OF THE TEUTHYDIDÆ (Dum.)

		Classification—
Sides of the tail armed with—		Acanthop- terous Fishes.
Several bucklers in one row.....	PRIONURUS	4.
Two immoveable plates with trenchant edges.....	NASEUS	3.
A moveable blade in a furrow.....	ACANTHURUS	2.
A fixed blade, trenchant on both edges.....	AXINURUS	5.
Sides of the tail unarmed.		
Dorsal deeply notched or double.....	AMPHACANTHUS	1.
Dorsal single, spinous in front.		
One dorsal spine elongated.....	KERIS	7.
Several (five) dorsal spines, of equal height.....	PRIDON	6.

GENUS I. AMPHACANTHUS, Bloch. (*Buro*, Commer.; *Siganus*, Forsk.; *Centrogaster*, Houtt.) The peculiar character of this group is to have a spine in the ventrals on each side of the articulated rays which vary from three to five; in other respects they have the body oval. Mouth small and but little protractile. Teeth small, denticulated and uniserial. Five branchiostegals, the last one dilated and concealed in the isthmus. A recumbent spine in front of the dorsal; numerous spinous rays in the anal. The epicoracoid is cylindrical or prismatic, and is reflexed so as to be attached to the anterior interhamals of the anal. The spines of the dorsal are thirteen, and only accidentally fourteen; the anal spines seven. Thirty species.

GENUS II. ACANTHURUS, Forsk. A strong moveable trenchant spine on each side of the tail. Head elevated, compressed. Eye high up. Five branchiostegals. Teeth uniserial, incisorial, denticulated. A single dorsal. Skin thick, generally clothed with small scales. They want the additional spine in the ventrals which distinguishes *Amphacanthus*; and the epicoracoid is not developed as in that genus. Fifty species.

GENUS III. NASEUS, Commer. Tail armed with two osseous bucklers carrying trenchant spines, not moveable. Teeth conical, pointed, without denticulations; a horn-like projection above the muzzle. Four branchiostegals, more rarely five. Three articulated rays on the ventrals and a spine; spines of the dorsal five or six, and two in the anal; soft rays in both fins numerous. Intestinal canal extremely long; four pancreatic cæca; a pretty large air-bladder. Fourteen species.

GENUS IV. PRIONURUS, Lacép. Teeth crenulated as in *Acanthurus*, in which the genus differs from *Naseus*. Tail armed by a series of horizontal, fixed, trenchant spines; a couchant spine before the dorsal. Branchiostegals five. Five pancreatic cæca. Two species.

GENUS V. AXINURUS, Cuv. et Valenc. Distinguished from *Naseus* by a more elongated form similar to that of *Thynnus*. A very small mouth, and excessively slender teeth. Armature of the tail consisting of a single blade cut squarely like the edge of a hatchet, and not springing from a buckler. It resembles *Naseus* in its general roughness, and in having three soft ventral rays. Branchiostegals five. Spinous rays of the dorsal four; of the anal two. One species.

GENUS VI. PRIDON, Cuv. Allied at once to *Naseus*, *Acanthurus*, and *Amphacanthus*, forming an intermediate link of union between them. Branchiostegals three. Spines of dorsal five, and of anal two. Teeth serrated as in *Acanthurus*. Ventrals having only three jointed rays as in *Naseus*. Forehead a little enlarged before the orbits, and the tail without armour as in *Amphacanthus*.

GENUS VII. KERIS, Cuv. The advanced position of the ventrals before the pectorals and immediately under the eye distinguishes this genus from the rest of the family; but it has affinities with them. The teeth fine, smooth, and pressed one against the other as in *Axinurus*. Tail without armature as in *Pridon*. Spines of the dorsal seven; of the anal three; ventrals of five soft rays and a spine. No scales, but the skin is granulated so as to resemble mosaic.

FLUTE-MOUTHS.

This family, established by Cuvier under the name of *Fistulares* or *Bouches-en-flute*, is not described in the *Histoire des Poissons*, the rich accumulations of species in the Paris Museum remaining still unpublished; and we are unable to add anything of moment to the account of the family contained in the *Regne Animal*, ii., p. 267. Specimens of several members of the family are imported in the insect boxes which the Chinese keep for sale to Europeans, and which contain many small fishes dried and pinned down like insects, often of curious forms, that reach our museums in no other way.

Fig. 12 represents one of the abbreviated forms of the family in the Australian *Centriscus humerosus*.

Classification—
Acanthop-
terous
Fishes.

Classification—
Acanthop-
terous
Fishes.

FAMILY XXI.—AULOSTOMIDÆ, Müll.

Bouches-en-Flute, Cuv.; *Aulostomi* (*Röhrenmauler*), Müll.; *Aulostomatidæ*, Cant. Characterized by the prolongation of the nasal vomer, preopercula, interopercula, pterygoids, and tympanics, into a long tube, with the mouth at the extremity, formed as usual of the premaxillaries, maxillaries, palatines, and mandible. The intestines have no great dilatations nor many folds, and the ribs are either short or wholly absent.

ANALYTICAL TABLE OF THE AULOSTOMIDÆ (Dum.)

Dorsal single, and
 Preceded by spines.....AULOSTOMA 2.
 Not preceded by spines.....FISTULARIDÆ 1.
Dorsals two.
 Conspicuous, the first ray stiff, denticulated.....CENTRISCUS 4.
 Sheathed beneath a kind of shield.....AMPHISILE 5.

GENUS I. FISTULARIA, Linn. Mouth of small extent, placed at the extremity of the tubular face, having a nearly horizontal gape. The elongated head constitutes a third or fourth part of the entire length of the fish, which is itself long and slender. Branchiostegals six or seven. Bony processes stretching from the head give support to the anterior part of the body. Stomach a straight fleshy tube; pancreatic cæca two. Dorsal single, opposite the anal, and composed mostly of simple rays. Small teeth on the premaxillaries and mandible. A filament sometimes as long as the body issues from between the lobes of the caudal. Rostral tube very long and depressed. An excessively small air-bladder. Invisible scales. Four species.

GENUS II. AULOSTOMA, Lacép. Dorsal preceded by some free spines. Jaws toothless. Body distinctly scaly and less slender than that of *Fistularia*; compressed and higher between the dorsal and anal. Tail short and finer, terminated by an ordinary caudal without the filament; the facial tube is also shorter, thicker, and more compressed than in *Fistularia*. Air-bladder very large. One species.

GENUS III. POLYPTERICHTHYS, Bleek. Separated from *Aulostoma* by possessing mandibular, vomerine, and palatine teeth. Ternate.

GENUS IV. CENTRISCUS, Linn. Body oval or oblong, compressed and trenchant on the belly. Two or three slender branchiostegals. A spinous dorsal pretty far back, with a strong first spine. Small ventrals behind the pectorals. Mouth very small, opening obliquely. No pancreatic cæca. Intestine folded three or four times; a considerable sized air-bladder. Large denticulated plates support the strong anterior spine of the first dorsal; the rest of the body is covered with small scales.

GENUS V. AMPHISILE, Klein. Back cuirassed by large scaly patches whose summit is crowned by the strong dorsal spine; in some, scaly pieces arm also the flanks and the spine, and the second dorsal and anal are crowded towards the base of the tail; in others, the cuirass covers only half the back, and the spine is farther forward.

GOBIOIDS.

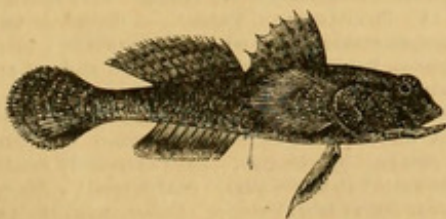


Fig. 125.
Gobius lentiginosus.

This family includes many very curious forms, differing greatly from one another in external aspect, and assembled together chiefly by the flexible nature of their spinous rays; but even that character is not positive, since in some the spines are pretty pungent. It has been made in some degree a receptacle for genera that could not be placed in other groups, though they exhibited no very marked affinity for the typical Gobioids. As first conceived by Cuvier, it included the Blennies also, but these have been since separated, and Müller has added the *Discoboli* of Cuvier, which cannot, he thinks, be kept apart from the Gobioids. The Gobioids have thoracic ventrals, and most of them have these ventrals united by their interior borders to form an oblique circular, infundibuliform disk, the front border of the disk being membranous

and lower. This character does not, however, extend to all the genera. The *Kobioi* of Aristotle were not the Gobies of the moderns, since he describes his fish as having numerous pancreatic cæca, whereas our Gobies are destitute of these organs. The Goby of Ausonius is a Gudgeon, and reasons are assigned in the *Histoire des Poissons* for the *Kobioi* of Aristotle and the *Kothos* of Athenæus being the *Cottus gobio*, and not a Gobioid at all; while the *Phukis* of Aristotle is considered to be the name given by him to the real Gobies. He classes these fish with those which frequent rocky places, and live upon marine algæ and crustaceæ, which change colours with the season, and which are, according to his observations, the only fishes of the sea which make a nest of leaves, and deposit their eggs therein. In a preceding page, we have mentioned the Sticklebacks as having also this habit. M. Mertens relates, in fact, that the *Gobius capito* (erroneously considered by him as identical with *G. niger*) of the Mediterranean, makes a nest of algæ and *zosteræ*; that the male remains at it to impregnate the eggs of the females which come to lay there; and that he watches over the eggs and protects the young after they are hatched. The Black Goby, Double Spotted Goby, Spotted Goby, and Slender Goby, are enumerated by Mr Yarrell as British species. The Chinese waters nourish not only many Gobies similar to the European species in general aspect, but also some very peculiar forms. Among these is *Trypauchen vagina*, the *Hung-læ* of the Chinese, of which the generic character consists in a deep pit on each side of the nape, not however communicating with the branchial cavity; and *Amblyopus*, a genus of several species, and of a very curious aspect. The Chinese generic name is *Shay-king* or "Warp-snake;" *king* meaning the warp of a web of cloth, evidently referring to its long anguilliform body. The face is very strangely wrinkled, and the eyes exceedingly small.

The *Periophthalmi* and *Boleophthalmi* are lively fish of elongated forms, with the united ventrals of the Gobies, and large, gay dorsal fins spotted like the wings of a butterfly. They have narrow gill-openings, and spend much of their time out of water, hopping over the moist sands left by the retreating tide, and spending a kind of amphibious life, pursuing the Crustaceæ which live on the sands, and, when menaced by a bird of prey, diving into the mud. Their eyes are protected from injury, when they resort to this means of escape, by moveable adipose lids. The *Boleophthalmi* are named from the power they possess of thrusting out their eyes when they wish to look around them; when the eyes are retracted, the membranous cellular lid swells over them. The thick double lips of these fish, and their hunting habits, are expressed by the Chinese name *Peih kow-kow*, "Broken-mouth dog."

Eleotris has not united ventrals, and has the aspect of a Sciaenoid, but with a smaller depressed head. Like most of the Gobioid family, organized for living on muddy or sandy bottoms, the mucigenous functions of the skin are called largely into action, and numerous mucoducts open on the surface. This gives them somewhat of the appearance of *Eleginus*, and of the Sciaenoid genera that come nearest to it; also of *Bovichthys*, a Percoid form belonging

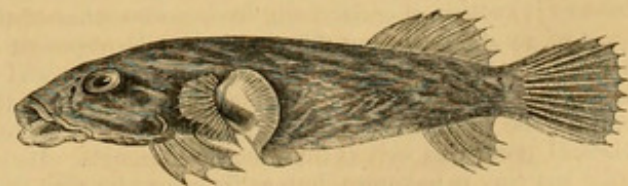


Fig. 126.
Gobiesox tudes.

to the *Uranoscopidæ*, and in fact to the ground-fish of

Classification—
Acanthopterus
Fishes.

several families. Allied to *Eleotris* and *Philypnus*, by family aspect, is *Notothernia*, of which numerous species inhabit the higher latitudes of the southern seas—the Falklands, Cape Horn, South Shetland, &c. *Gadus Magellanicus* of Forster, of which there is a drawing in the British Museum, is a member of this genus.

In Wiegman's *Archiven* (ix., p. 295), Müller has assigned his reasons for uniting Cuvier's *Cyclopteri* to the Gobioids. Two species of *Lepadogaster*, a *Cyclopterus*, and two of *Liparis*, are described by Mr Yarrell as British fish. The *Cyclopterus lumpus*, or "Cock-paiddle" of the fishermen of the Frith of Forth, is mentioned with respect for its good qualities by Sir Walter Scott in his novel of the *Antiquary*, and it appears frequently in the Edinburgh fish-market. It is not very rare on the English shores, but its qualities are less appreciated there. The appearance of the dorsal fin, resembling the crest of a cock, is the evident origin of the first part of its Scottish name, and its mode of swimming or paddling of the second.

Callionymus is a genus of many species, some of them very gaily and handsomely coloured, with large dorsal fins, and bearing a considerable resemblance to the *Sclerogenidae*, from the armature of the preoperculum. They are considered by M. Valenciennes to possess characters sufficient to erect them into a separate family; but he has abstained from doing so until he has studied the peculiarities of their structure by the examination of a greater number of species than he had collected at the date of the publication of the 12th volume of the *Histoire des Poissons* in 1837. One species is common enough on our sandy shores, and the female, which has smaller fins and duller tints of colour, is often described as a distinct species. *Harpagifer* differs from *Callionymus* in having wider gill-openings. *Comephorus* is an apodal fish of Lake Baikal, of very rare occurrence, since it inhabits the greatest depths of the lake. It is destitute of scales, has a small stomach, no pancreatic cæca, and no air-bladder. Its bones are soft and fibrous. It is obtained only when violent north winds cast it ashore in the spring time. So oily is its flesh that it cannot be eaten, and even the carrion crows refuse to touch it. *Chænichthys* is a southern fish, being an inhabitant of the groves of kelp which skirt the shores of Kerguelen's Land. It is a voracious fish that takes the hook readily, and has somewhat of the aspect of a Gurnard, but its cheek is not mailed. In the structure of its bones it comes nearer to the *Lophiidae*.

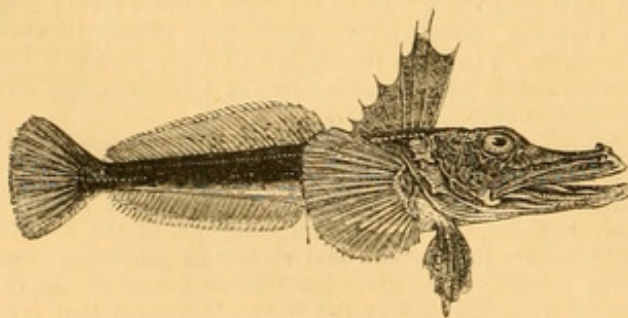


Fig. 127.

Chænichthys rhinoceratus.

Patacus is another singular form, having somewhat of the aspect of an *Agriopus*, but differing in the development of its suborbital bones, which do not cuirass the cheeks, and in the total want of anything like spines or serratures on the bones of the head and shoulder, from all the Percoid and Sciaenoid groups, as well as from the Sclerogenids. Its internal anatomy is unknown, but, as far as can be seen from the dried specimen, the bones have little solidity. Its closest affinities seem to be Gobioids or Blennioids; perhaps it should stand next *Anarrhichas*, with which it agrees in being apodal. Fig. 8 represents this fish.

FAMILY XXII.—GOBIIDÆ, Cuv.

Classification—
Acanthopterus
Fishes.

Spinous rays of the dorsal slender and flexible. An intestinal canal of simple structure, having only slight dilatations, and no cæcal expansion of the stomach; no pancreatic cæca.

The family thus characterized was divided by Cuvier into two subordinate groups, the Gobies and Blennies, which are considered merely as sub-families by M. Valenciennes, but as distinct by Müller and others. The males of both have a small papilla at the opening of the seminal efferent tube, and many members of the family are viviparous, which implies internal impregnation in some way or other, though no intromittent organ has as yet been described.

The first subdivision or family of *Gobiidae* have only five branchiostegals, and the more typical genera have the ventrals united into a hollow disk or funnel-shaped fin, more or less oblique, situated under, or a little behind, the base of the pectorals.

TABLE OF THE GOBIIDÆ.

Ventrals united, infundibuliform.

Body sword-shaped.

A cavity on each side of the nape.....TRYPAUCHEN 4.

No nuchal cavities.....AMBLYOPUS 5.

Body more or less cylindrical.

Dorsal solitary, and

Notched in the middle.....APOCRYPTES 3.

Not notched.....GOBIOIDES 2.

Dorsals two.

Eyes near one another.

Teeth equal.....BOLEOPHTHALMUS 8.

Teeth unequal.....PERIOPHTHALMUS 7.

Eyes farther apart.....GOBIUS 1.

Ventrals united in a shallow basin.....SICYDIUM 6.

Ventrals separated by

A ventral disk, behind the pectorals.....PLATYPTERUS 23.

The ordinary scaly thoracic integument.

Vomerine teeth.....PHILYPNUS 10.

No vomerine teeth.

Lateral line continuous.....ELEOTRIS 9.

Lateral line broken.....NOTOTHERNIA 11.

GENUS I. GOBIUS, Linn. Ventrals united a little posterior to the pectorals, forming a hollow disk; two dorsals, spines of the first one flexible, the second one pretty long. Body elongated. Head of moderate size, rounded. Cheeks convex. Eyes approximated. No air-bladder. Villiform or card-like teeth, often with a stronger exterior row, approaching to canines. Scaly fishes with or without filaments on the head. One hundred species.

GENUS II. GOBIOIDES, Lacép. Differ from *Gobius* in the spinous rays and articulated ones on the back being united into one long low fin, which reaches nearly to the caudal. One species.

GENUS III. APOCRYPTES, Valenc. (*Scartelaos*, Swains.) Teeth on the jaws uniserial, the mandibular ones almost horizontal, with two canines standing more interiorly and close together; in other respects *Gobii* with two dorsals. Elongated bodies. A long pointed caudal. Generally small scales. Five species.

GENUS IV. TRYPAUCHEN, Valenc. A deep hole on each side of the nape not communicating with the branchiæ; in general form like *Amblyopus*, having a single long dorsal and an anal united to a caudal with longer rays. One species.

GENUS V. AMBLYOPUS, Valenc. Elongated fishes, with the ventrals of *Gobius*. Mouth vertical, armed with strong curved teeth, not covered by the lips. Eyes extremely small. The long low dorsals united to the caudal. Scales small. Six species.

GENUS VI. SICYDIUM, Valenc. *Gobies*, with the ventrals forming a shallow round basin adhering almost equally throughout its circumference. Teeth on the jaws flexible in a close row, with some strong interior ones on the mandible. Four species.

GENUS VII. PERIOPHTHALMUS, Schneid. Head wholly scaly. Eyes close together, having an inferior eye-lid which can cover them. Pectorals scaly for more than half their length, giving them the appearance of having an arm like *Lophius*. Ventrals united as in *Gobius*. Teeth uniserial, more or less vertical. Narrow gill-openings. Profile descending rapidly, forming with the nape an angle, on which the pretty large prominent eyes are placed. Scaly fishes, with the four vertical fins distinct; in some the ventrals are deeply divided. Eight species.

GENUS VIII. BOLEOPHTHALMUS, Valenc. *Periophthalmi*, with teeth analogous to those of *Apocryptes*; those of the upper jaw being straight and pretty strong, especially towards the symphysis, while the mandibular ones are very fine, and disposed horizontally, with two more interior taller pointed ones. Head more oblong, and the profile less vertical than in *Periophthalmus*. Scales small, in some almost imperceptible. Five rays in the first dorsal. Pec-

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Fishes.

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torals not always scaly in the lower part; resembling *Periophthalmus* in their double lips and lower eyelids. Ten species.

GENUS IX. ELEOTRIS, Cuv. Separate ventrals, but in general structure *Gobii*, resembling them in the other fins, intestines, and genital papilla. Branchiostegals six. Colours for the most part dull. Twenty-three species.

GENUS X. PHILYPNUS, Valenc. *Eleotrides*, with card-like teeth on the chevron of the vomer, in addition to the larger ones on the jaws. One species.

GENUS XI. NOTOTHENIA, Rich. General form of *Eleotris*, with timid reflexed lips. Premaxillaries but little protractile. Scales pretty large. Lateral line interrupted under the end of the second dorsal. Head unarmed, porous. Branchiostegals six. Teeth on the jaws acute, crowded, unequal. Tongue and palate toothless. Ventrals jugular, of a spine and five articulated rays; dorsals two; the first sustained by a few flexible rays; second long, near the first, even; anal like the second dorsal; the rays of both these fins divided at the tips as in *Trachinus*, with a notch in the membrane behind each. Pancreatic caeca five; no air-bladder; stomach caecal. Eleven species.

GENUS XII. ASTERROPTERYX, Rüpp. Scaly fishes with a compressed head and body, having considerable resemblance to *Eleotris*. Scales ciliated. Medium-sized mouth; teeth curved, conical, uniserial; vomer and tongue smooth. Gill-openings not approaching near each other. Branchiostegals three. Two dorsals, the rays of the first simple, but articulated. Ventrals not united, of six rays, all articulated. No visible lateral line. No genital papilla. No stomachal or caecal dilatation of the intestine; no pancreatic caeca; no air-bladder observed. One species.

In this family Müller places the *Discoboli* of Cuvier, or *Gobiesocidæ* of later ichthyologists.

TABLE OF THE DISCOBOLI.

Form elongated, depressed, or subcylindrical.		
<i>Ventral disk single.</i>		
Vertical fins united.....	LIPARIS	20.
Caudal separated.		
<i>Gills four.....</i>	GOBIESOX	15.
<i>Gills three.....</i>	COTYLIS 16, SICYASES 17, SICYOGASTER	18.
<i>Ventral disks, two.....</i>	LEPADOGASTER	13.
Form lumpish, thinner on the back; disk single.	CYCLOPTERUS	19.

GENUS XIII. LEPADOGASTER, Gouan. Ample pectorals, which descend to the throat where their rays are stronger, and where the two fins are united by a transverse membrane extending forwards, and proceeding from the union of the two ventrals. Body smooth, scaleless. Head large and depressed. Mouth projecting, protractile. Gill-openings not wide. Branchiostegals four or five. One dorsal only, consisting of soft rays opposite to an anal fin of like form. Intestines short, straight; no pancreatic caeca; no air-bladder.

In the typical species (*Porte-Ecuelle*, "Regne Animal") there is a circular concave disk under the pubic bones formed by the otherwise little developed ventrals; and a second disk before it less complete, formed under the coracoid by the pectorals. Eight or ten species.

GENUS XIV. TRACHELOCHISMUS, Barn. In this genus, as in *Lepadogaster*, there are two ventral disks, by which they are distinguished from the allied genera in which there is only one lateral, single-notched disk. The gill-openings join, but in *Lepadogaster* they are separated. *Tr. Gouani, Candolii, bimaclulatus, piger.*

GENUS XV. GOBIESOX, Lacép. Have not the double disks of *Lepadogaster*; but the pectorals and ventrals form a single large disk split on each side, and prolonged there by membranes; dorsal and anal short, and separated from the caudal. Gill-openings larger. *G. dentex.*

GENUS XVI. COTYLIS, Müll. and Trosch. (*Chorisochismus*, Barn.) Teeth of *Gobiesox*; a row of conical teeth on the jaws; behind the fore bigger ones a mass of smaller ones. They differ from *Gobiesox* in having only three gills; and by the branchiostegal membrane of both sides being attached to the isthmus, without covering it by an overhanging cuticular mantle or free border of skin. One species. *C. nudus.*

GENUS XVII. SICYASES, Müll. and Trosch. (*Tomicodon*, Barn.) Resembles *Cotylis* in having only three gills, and in the insertion of the branchiostegal membrane, but it has only a solitary row of teeth in the jaws, the middle and bigger ones being incisorial, the lateral ones conical. One species. *S. sanguineus.*

GENUS XVIII. SICYOGASTER, Barn. Distinguished from *Sicyases* by the cutting mandibular teeth; the other teeth are conical. *S. marmoratus.*

GENUS XIX. CYCLOPTERUS, Linn. Ventrals encircling the pubic bones united into one by membrane and forming an oval con-

cave disk, which is used as a sucker by the fish to attach itself to a rock. Mouth large. Teeth on the jaws and pharyngeals small, pointed. Opercula small. Gill-openings closed below. Branchiostegals six. Pectorals very large, and uniting nearly under the throat to embrace the ventral disk. Skeleton but slightly osseous. Skin viscous, scaleless, but containing small hard grains. A pretty large stomach; many pancreatic caeca; a long intestine; a moderate sized air-bladder. In the typical species the first dorsal is more or less visible, though very low, and is composed of simple rays; the second dorsal, having branching rays, is opposite to the anal. Body short and thick as well as high.

GENUS XX. LIPARIS, Art. Differ from *Cyclopterus* in having an elongated body, compressed posteriorly, and a single pretty long dorsal with a corresponding anal. Skin smooth.

The eight preceding genera form the *Discoboli* of the *Regne Animal*. The following genera are said, in the *Histoire des Poissons*, to be manifestly related to the *Gobii*, but to have characters which point to their being types of peculiar families.

GENUS XXI. CALLIONYMUS, Linn. Gill-openings reduced to a small hole on each side of the nape. Ventrals widely separated, larger than the pectorals, and attached to the ventral surface of the throat. Head oblong and depressed. Mouth very protractile. A process more or less elongated issuing from the inferior angle of the preoperculum, and terminated by diverging points. Villiform teeth on the jaws, none on the palate. First dorsal elevated, its rays flexible and setaceous; second dorsal and anal long. Skin generally smooth. Stomach not caecal; no air-bladder. A genital papilla. Twenty-five species.

GENUS XXII. HARPAGIFER, Rich. A Gobioid, with the ventrals of *Eleotris*, differing from *Callionymus* in having a pretty large gill-opening, which does not however descend to beneath the throat. Operculum and suboperculum bearing strong spines, none on the preoperculum or interoperculum. Two dorsals, the first sustained by four flexible rays. Teeth on the jaws slender, minute; none on the palate or tongue. Branchiostegals six. Stomach caecal; pancreatic caeca three; no air-bladder. Lateral line crossing the nape to join its fellow, ending under the middle of the second dorsal.

GENUS XXIII. TRICHONOTUS, Bloch, Schneid. Agrees with *Callionymus* in the form of the ventrals, and in the simple intestinal canal, without pancreatic caeca. Body elongated, almost cylindrical, terminated by a large pointed caudal. Eyes almost touching on the dorsal aspect of the slightly depressed head. Villiform teeth on the jaws, palatines, and front of the vomer. Gill-openings very large, coming forward to beneath the eyes. Branchiostegals seven. Dorsal single, extending to near the caudal, its front rays simple, some of them elevated; anal also long, with simple rays in front. Scales. Lateral line straight, continuous. Stomach a long narrow sac, with the pylorus near its bottom; no pancreatic caeca; no air-bladder. One species.

GENUS XXIV. PLATYPTERUS, Kuhl and Van Has. Two dorsals separated to some distance. A triangular horizontal head. Mouth under the end of the snout. Narrow bands of villiform teeth on the jaws, none on the palate. Large ventrals attached to the under surface of a flat breast, further back than the pectorals. Branchiostegals six. Some denticulations at the angle of the preoperculum. A genital papilla. Scales. Intestinal canal a simple tube, without dilatations; no pyloric caeca; no air-bladder. One species.

GENUS XXV. COMEPHORUS, Lacép. Elongated, scaleless, tapering fish, with a short depressed head, and large terminal horizontal mouth. Very wide gill-openings. Seven branchiostegals. Very long pectorals, and no ventrals. Teeth extremely short, in bands on the jaws, chevron of the vomer, and palatines. Mandible slightly longer than the premaxillaries. Branchiostegals six. Eight flexible rays on the low first dorsal; second dorsal higher, long, like the anal, and terminating with it not far from the forked caudal, leaving a very slender naked part of the tail between the three vertical fins. Stomach small, pointed, caecal; no pancreatic caeca; no air-bladder. One species.

GENUS XXVI. CHLENICHTHYS, Rich. Head large, depressed (but with flat vertical cheeks), wider than the elongated body, which tapers gradually in all directions to the caudal. Snout produced, flat, and wide. A large mouth, bordered above wholly by the premaxillary, the maxillary, which is articulated to the nasal, lying behind; the angles of the mouth are laterally protractile, giving a great extent to the gape. Teeth small, curved in crowded bands on the jaws; few on the pharyngeals; vomer and palatines smooth; preorbital rough, radiated, of moderate size, the other suborbitals small. Cheeks naked. Ventrals situated before the pectorals, composed of a spine and five soft rays, the first three of which are enveloped in soft skin, and are very thick, the other two branched as usual. Eye large, lateral. Gill-opening ample, extending forward between the limbs of the mandible. Branchiostegals six. No scales. Lateral line running straight to near the caudal, where

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it is interrupted, and resumed a little lower down, terminating at the caudal. It is protected throughout by small scabrous shields, and there are a few scattered shields on the sides, the rest of the skin being smooth. Second dorsal long, sustained by simple tapering, jointed rays; anal similar in extent, its rays divided at the tips, which project like those of *Trachinus*; caudal rounded; all the rays of the pectoral branched. Stomach caecal, ovoid; pancreatic caeca two; urinary bladder forked; ovaries in a sac, with an oviduct; a genital papilla, small in the female. No air-bladder. One species.

GENUS XXVII. *PATÆCUS*, Rich. Very much compressed. Profile of the whole fish semi-parabolic; the forehead greatly overhanging, and the facial line descending obliquely backwards. Mouth small, almost horizontal. Mandible porous, with minute barbels. Teeth extremely minute, granular; none on the palate, vomer, or tongue. Eyes lateral, high up. Preorbital a sculptured triangular disk with an ascending process. Suborbital chain tubular, slender, running to the temples, not connected with the preoperculum. Cheek naked. No scales. Rays of all the fins simple; no ventrals; pectorals of eight rays, attached very low to the coracoids. Dorsal, like that of *Agriopus*, commencing before the eyes, and running backwards to the caudal, to which it is connected by membrane. Spines in dorsal and anal numerous, flexible, scarcely to be distinguished from the jointed rays by the naked eye; rays of the caudal ten only, not joined to the anal. Lateral line running high on the back; vertebræ thirty-five; bones of the head and shoulder showing through the skin, striated, fibrous. One species. *Vide* fig. 8.

BLENNIOIDS.

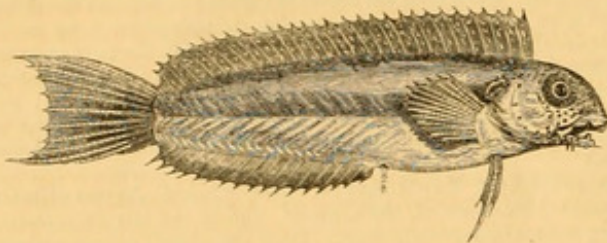


Fig. 128.
Petrosciartes Bankieri.

Mr Yarrell describes four species of the genus *Blennius* as having been detected on the British shores. The English seas also produce a species of *Pholis*. *Salaria* presents a singularity in its dentition, which distinguishes it from other fishes; its jaw teeth are implanted in the lips, and are very fine and slender, and so connected with muscular fibres that each can be raised or lowered independently of the others, or they can be moved in a mass by the motion which the fish imparts to its lips, as in some Sharks. *Clinus* is the modern Greek name for the Gobies, and has been applied by Cuvier to designate a Blennioid group, which is distinguished from most of the other Blennies by the large number of its dorsal spines, and other characters mentioned in the table. It is a viviparous genus, and the male possesses a pointed tubercle, with an aperture at its tip, and a bulbous dilatation within the abdomen behind the rectum, into which a very slender deferent canal from the milts is seen to enter together with the urethra from the urinary bladder. This structure has a similarity to a penis, but it is remarked in the *Histoire des Poissons*, that it ought rather to be considered as a modified cloaca than as an organ homologous with that of the viviparous Vertebrata. The *Tripterygions* are found both in the Mediterranean and in New Zealand, and have the same habit of hopping over the wet sands which is attributed in a preceding page to some of the Gobioids.

Bregmaceros is a very interesting fish, whose affinities seem to be with this family. It was first described by Dr Thompson in the *Annals of Natural History* under that generic name, from a drawing made in the China seas by Dr Cantor, and again, under a new generic name, by Sir John Richardson, from two examples of a different species brought home by Sir Edward Belcher from the same seas. In its ventrals it differs from all other known

fish, but as a description will convey but an imperfect idea of their peculiar structure, the reader is referred to the

Classification—
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Fishes.

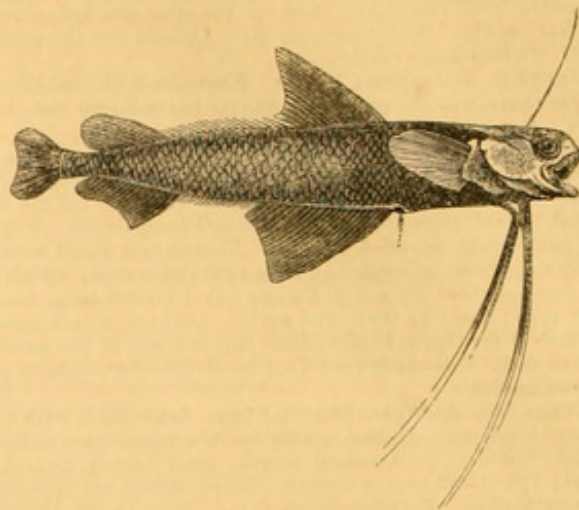


Fig. 129.

Bregmaceros mirut.

ichthyology of the *Voyage of the Sulphur*, where he will find a magnified representation of these fins. *Iluocates* and *Phucocates* are two very nearly allied genera, described by Mr Jenyns in his account of the ichthyology of the *Voyage of the Beagle*. They were discovered at Cape Horn, and specimens have been since procured at the same locality by Sir James Ross. *Gunnellus*, owing to its compressed body, and the parallelism of its dorsal and ventral profiles, resembles a Ribbon-fish, and its name has a similar origin to that of Deal-fish, being from *gun-wale*, contracted into *gunnel*, the narrow board that forms the upper streak of a boat. In some species there is merely a minute, blunt spinous point to represent both ventrals. One species occurs on the British coasts abundantly, and there are others in all parts of the Arctic seas. There is much resemblance in form between some *Gunnelli* and the *Ophidia*, and perhaps a relationship.

The viviparous Blenny (*Zoarces viviparus*) is a well-known species, and has been long celebrated for a peculiarity which is chiefly observable among cartilaginous fishes, that, namely, of producing its young alive. These are so matured at the time of their birth, that on their first exclusion they swim about with the utmost agility. No fewer than 200 or 300 young are sometimes produced by an individual, and the abdomen of the mother is so distended before parturition, that it is impossible to touch it without causing them to be extruded. Full-grown individuals seldom exceed 12 inches in length; the body is slender and smooth; the colour yellowish olive, pale beneath, and marked on the upper parts with dusky spots. It is a littoral fish, and of frequent occurrence under stones. When boiled, the back-bone acquires a green colour. America produces a much larger species, which sometimes exceeds the length of 3 feet. It has been described under the name of *Blennius labrosus*.

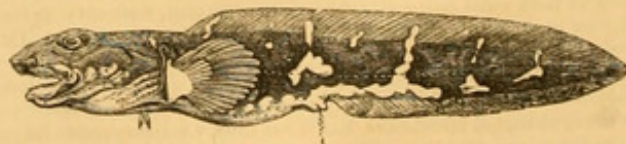


Fig. 130.

Lycodes mucosus.

The arctic genus *Lycodes*, instituted by Professor Reinhardt of Copenhagen, and of which the Greenland seas contain several species, has much general resemblance to *Zo-*

Classification—
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Fishes.

Classification—
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Fishes.

arces. Sir Edward Belcher obtained some good specimens in Northumberland Sound to the north of Wellington Strait.

Notwithstanding the size of *Anarrhichas*, its thickness, the total absence of ventrals, and the extraordinary nature of its dentition, it is impossible, says M. Valenciennes, to overlook the affinity that exists between the genus and *Blennius*. The proportions of the several parts, the forms of the head, the disposition of the fins, the delicacy of the scales, imbedded in the thickness of a slippery mucoid skin, are the same in both genera. The internal anatomy is also alike: a short intestine, no pancreatic cæca, no air-bladder, and a similarity in the skeletons, ally them closely to each other, especially if we take for comparison the large American *Zoarces*. The most common species (*Anarrhichas lupus*) is of frequent occurrence in most of the northern seas, and is well known along the coasts of Britain by the names of *Sea-wolf* and *Sea-cat*. Its ordinary length is from 3 to 4 feet, but examples sometimes occur of nearly double that size. The colour is obscure livid brown, with several transverse stripes or bands of a darker hue. The dorsal fin, as already mentioned, extends along the whole length of the back, and is composed of seventy-three rays. The fore teeth project considerably, and diverge a little from each other, forming a powerful kind of armature, moved by jaws of such strength that the animal has been known to imprint the marks of its teeth on a bar of iron. The uninviting aspect of this fish has probably not been without influence in producing a prejudice against it as an article of food. Its flesh, however, is far from being unsavoury, and bears considerable resemblance to that of the Eel. It is in great request among the Icelanders, who eat it dry and salted; while the other parts of the fish are likewise converted to useful purposes, the skin forming shagreen, and the gall being used as soap. The vascular tubes of the teeth are very large in the Wolf-fish, and were early recognised as such by anatomists.

Opisthognathus is a genus of which one species has been found in the Indian Ocean, and another in the Gulf of Mexico.

FAMILY XXIII.—BLENNIIDÆ, Müll.

Pars Gobioidarum, Cuv. With much of the structure of *Gobies*, the *Blenniidæ* have a character common to most of the genera in the jugular ventrals composed of two flexible rays, sometimes with a spine, but more generally without. Stomach thin, without a cæcal dilatation; no air-bladder. Body elongated, compressed. One dorsal, composed almost entirely of simple but generally flexible rays. Skin very muciparous, scaly or naked. A genital papilla.

ANALYTICAL TABLE OF THE BLENNIIDÆ (Dum.)

<i>Body scaleless.</i>	
Head crested.	
<i>Gill-openings large.</i>	
Teeth numerous, firm.....	BLENNIUS 1.
Teeth labial, moveable.....	SALARIAS 6.
<i>Gill-openings narrow.</i>	
Teeth regular.....	CHASMODES 5.
Teeth irregular.....	PETROSCIRTES 3.
Head destitute of crests or tentacula.	
<i>Dorsal spinous</i>	CLINUS 8.
<i>Dorsal soft, without spines</i>	PHOLIS 2.
<i>Body scaly.</i>	
Dorsal solitary and	
<i>United to the other two vertical fins.</i>	
Continuous without a depression.....	LYCODES
Suddenly depressed near the end of	
the tail.....	ZOARCES
<i>Isolated.</i>	
Ventrals distinct.	
<i>Barbels, four of them mandibular</i>	CIRRHIBARBIS 1.
<i>No barbels; maxilla prolonged</i>	OPISTHOGNATHUS
<i>No barbels; maxilla not prolonged</i>	MYXODES
Ventrals none or rudimentary.	
<i>Replaced by a spine</i>	GUNNELLUS
<i>Apodal; crushing teeth</i>	ANARRHICHAS

GENUS I. BLENNIUS, Linn. Body elongated. Skin soft, muciparous, scaleless.

Gill-openings large. Branchiostegals six. Ventrals attached to the throat consisting of two rays externally, but the last of the two often divided under the skin; the flexible rays, termed spinous, differ little in their structure from the others, being many of them obscurely jointed, though simple and tapering; dorsal single, extending along the whole back. Filaments over the eyes. Nostrils or nares of various forms. Mouth small; cleft of the jaws a semicircle. Teeth uniserial, strong, simple, crowded, the row often terminated on each side by a canine. Intestinal canal simple; no pancreatic cæca; no air-bladder. Aperture of the ovary between the anus and urinary canal; and without a papilla in the female. A tuft of papillæ round the opening of the seminal duct in the male. Thirty-five species.

GENUS II. PHOLIS, Flem. *Blennies* destitute of supraorbital cirrhi, or fleshy crests. Four species.

GENUS III. PETROSCIRTES, Rüpp. (*Blennechis*, Valenc.; *Omobranchus*, Ehren.) *Blennioids*, with the gill-openings closed beneath, and consisting merely of a small chink above the base of the pectoral; their dentition is a modification of that of *Blennius*. The inferior incisorial teeth, attached to the front only of the mandible in a transverse row, are terminated on each side by a canine, sometimes enormously large, strongly curved, and fitting into holes in the roof of the mouth when the jaws are shut. Dorsal undivided; cirrhi generally present. Fifteen species.

GENUS IV. BLENNOPHIS, Valenc. Near *Petroscirtes*. Body compressed, scaleless. Head obtuse. Mouth small. Four recurved, hooked teeth in each jaw near the symphysis. Dorsal single, notched; anal like the dorsal, but shorter; caudal distinct; pectorals ovate, broad; jugular ventrals two-rayed.

GENUS V. CHASMODES, Valen. Gill-openings above the pectorals, as in *Petroscirtes*. A mouth deeply cleft, armed with teeth in front only, uniserial, firm, and regular; an even dorsal, extending from the top of the head to be united to the base of the caudal; anal similar, but only half as long, and not connected with the caudal. Body oval, oblong, destitute of scales. Branchiostegals six. No cirrhi on the head. Three species.

GENUS VI. SALARIAS, Cuv. *Blennies*, with uniserial, almost innumerable, extremely slender, contiguous teeth, moveable together by the impulse of the lips, like the keys of a piano or harpsichord. Head strongly compressed above, wide transversely below. Intestine rolled on itself in a spiral, and longer than that of the *Blennies*; no air-bladder. Thirty-five species.

GENUS VII. PSEUDOBLINIUS, Schleg. vel *Pseudoclinus*. Distinguished from the true *Blennii* by their general aspect and their card-like teeth.

GENUS VIII. CLINUS, Cuv. *Blenniidæ*, with elongated, compressed, scaly bodies. Exterior teeth conical, pointed, with a villiform band behind; teeth on the vomer, and occasionally on the palatines also. Spinous rays of the dorsal numerous. Snout less blunt than in *Blennius*. Stomach larger, and intestine shorter. First rays of the dorsal sometimes separated from the others by a notch, sometimes detached to the head, where they form an elevated plume; in others, the dorsal is continuous and even. Two spines in the anal. Branchiostegals six. Twenty-five species, some of which have Labroid lips.

GENUS IX. ACANTHOCLINUS, Jen. Distinguished from *Clinus* by the larger number of spines in the anal—upwards of twenty; a longitudinal band of small teeth on the tongue; the position of the ventrals under the pectorals; and by the existence of three lateral lines. Branchiostegals six. Three species.

GENUS X. MYXODES, Cuv. Scaly fishes intermediate between *Clinus* and *Gunnellus*. Head elongated. Snout pointed, projecting beyond the mouth. Teeth uniserial, as in *Blennius*, but without the canines; the larger teeth nearer the symphyses. Resemble *Clinus* in the great number of spinous rays in the dorsal; and differ from *Gunnellus* in having some soft rays in that fin. Three species.

GENUS XI. CRISTICEPS, Valenc. *Blennioids*, with the first three dorsal rays standing on the occiput, connected by membrane and forming a separate fin from the long dorsal which begins over the gill-opening and reaches to near the caudal, the eight posterior rays being articulated; anal shorter than the dorsal, and having only two spinous rays. Two species.

GENUS XII. CIRRHIBARBIS, Cuv. *Myxodes*, with still more numerous spines in the dorsal, a few more soft rays; tentacles numerous on the snout, mandible, maxillary, and over the orbit. Teeth villiform as in *Clinus*. One species.

GENUS XIII. TRIPTERYGION, Risso. Distinguished from *Clinus* by the dorsal being divided into three portions. Conical teeth in an exterior row on the jaws, and villiform teeth behind; a small transverse band of short ones on the front of the vomer. Branchiostegals generally six; in one species only five. No anal spines. Six species.

GENUS XIV. BREGMACEROS, Thomp. (*Ann. N. H.*); *Colloptilum*, Rich. (*Voy. of Sulphur*). Body fusiform. Head short, obtuse. Mouth

Classification—*Acanthoptercus* Fishes. small, edged laterally by the maxillaries, above by the very small premaxillaries. Minute teeth round the margin of the mouth, moveable; none on the vomer, palatines, or tongue. Cheeks and gill-cover scaly; gill-opening large. A long ray on the occiput; dorsal and anal commencing opposite each other at the anus, and reaching to near the caudal, both alike, high at first, then reduced to very short simple rays, and then rising again posteriorly. Caudal small, forked, on a narrow tail. Scales small, cycloid. No accessory gills. Ventrals very long, of three jointed ones the third one much and curiously branched. No pyloric caeca; gut straight, without any distinction of stomach; no swim-bladder. China seas and Philippines. The complicated structure of the ventrals in this genus is not in accordance with the form of these members in the rest of the family. Two species.

GENUS XV. PHAROPTERYX, Rüpp. Mouth small, rather oblique, armed above and below with fine brush-like teeth in a narrow band. Palate and tongue smooth. A symphyseal filamentous barbel on the mandible. Gill-openings connected with each other above the isthmus. Four branchiostegals. Head and whole body scaly. Lateral line interrupted; body fusiform. Ventrals having five long simple rays situated before the pectorals, connected with each other by a short membrane; part of the ventral rays flat, lanceolate, and clothed with skin; rays of all the fins undivided and perfectly flexible. Anus not far from the base of the pectorals. Dorsal and anal long, but separated from the rounded caudal; a notch separates the first six dorsal rays from the remainder. Mediterranean.

GENUS XVI. LUOCÆTES, Jen. Body elongated, compressed, dagger-shaped, scaleless. Snout projecting beyond the mandible. Teeth acutely conical, uniserial, on the jaws and palatines; two bigger ones projecting near the premaxillary symphysis; on the front of the vomer few, aggregated. Eyes large, prominent. Branchiostegals five; projecting muciferous tubes fringing the mouth, preorbital and preoperculum. Ventrals minute, three-rayed, jugular; dorsal and anal fins long and low, uniting with the pointed caudal. Five branchiostegals. The jaws, suborbital scale-bones, and preoperculum encircled by muciferous pipes. One species.

GENUS XVII. PHUCOCÆTES, Jen. Similar in form to *Iluocætes*, but with the mandibular teeth biserial or triserial, and two or three strong vomerine teeth in front of smaller ones; uniserial palatine teeth. Eyes small. Branchial opening very narrow. Branchiostegals six. Pores on the jaws not tubular, but very conspicuous. Whole skin porous; vertical fins as in *Iluocætes*. One species. Cape Horn.

GENUS XVIII. GUNNELUS, Cuv. (*Muraenoides*, Lacép.; *Centronotus*, Schneid.) Ventrals jugular, very small, almost imperceptible, often reduced to a single ray. Head very small. Body compressed, elongated, ensiform. A long low dorsal extending along the back to the base of the caudal, and wholly sustained by simple unarticulated rays; anal about half as long, united to the base of the rounded caudal. Teeth as in *Olinus*. Intestinal canal simple, running nearly straight to the anus; no air-bladder, and no genital papilla. Eighteen species.

GENUS XIX. CARELOPHUS, Kroy. Distinguished from *Gunnellus* by the presence of pancreatic caeca and tentacles. No teeth on the vomer. Ventrals having one spine and three soft rays. No lateral line.

GENUS XX. ZOARCES, Cuv. Jugular ventrals of few rays. General form and most of the structure of *Olinus* and *Gunnellus*, without spinous rays in the front of the dorsal or anal, but near the end of the dorsal there are some short spinous rays, followed by articulated ones which unite with the small caudal; the anal also unites with the caudal, but its edge is even, without the depression of the dorsal. Conical teeth on the jaws, in several rows near the symphysis, uniserial towards the corners of the mouth; palate toothless; viviparous. No air-bladder. Five species.

GENUS XXI. LYCODES, Reinh. Body elongated, thick anteriorly. Head conical, obtuse. Body compressed. Tail ensiform. Scales minute, imbedded in the skin. Stout teeth on the premaxillaries, mandibulars, vomer, and palatines. Branchiostegals six. Membrane united to the isthmus, aperture narrow, posterior. Ventrals merely a single very short rudimental ray, jugular. Tail surrounded by the long vertical fins; rays articulated, divided. No air-bladder. Intermediate between *Zoarces* and *Anarrhichas*. Five species.

GENUS XXII. DICTYOSOMA, Schleg. Distinguished from *Gunnellus* and *Zoarces* by the entire want of ventrals. Branchiostegals six.

GENUS XXIII. ANARRHICHAS, Linn. Blennies, without ventrals; dorsal sustained entirely by simple unjointed rays, destitute of stiffness, commencing at the nape and reaching to the base of the caudal, which is distinct and rounded; anal corresponding nearly to the posterior half of the dorsal, and also rounded off at the base of the caudal; pectorals rounded. Skin soft, scaleless, and mucoid. Jaws, vomer, and palatines, armed with osseous plates, that are crowned by small enamelled teeth; the anterior teeth being more

long and conical. Branchiostegals six. A short fleshy stomach, with a very small caecal part; no pancreatic caeca; no air-bladder. Three species.

GENUS XXIV. OPISTHOGNATHUS, Cuv. Blennioids, with the simple flexible spines of the majority of the family, except the ventral spine which is pungent; ventrals of five soft rays situated under the base of the pectorals; dorsal and anal even, terminating at a little distance from the rather small rounded caudal. Scales small. Lateral line distinct. Branchiostegals six. In one species the maxillary is prolonged beyond the corner of the mouth to the coracoid bones, in another it scarcely exceeds the usual size, not passing the border of the preoperculum. Fine card-like teeth on the jaws. Resembling the Blennies in the large blunt head, and cirrhi at the nostrils; but differing in having an air-bladder. Two species.

Classification—*Acanthoptercus* Fishes.

LOPHIOIDS.

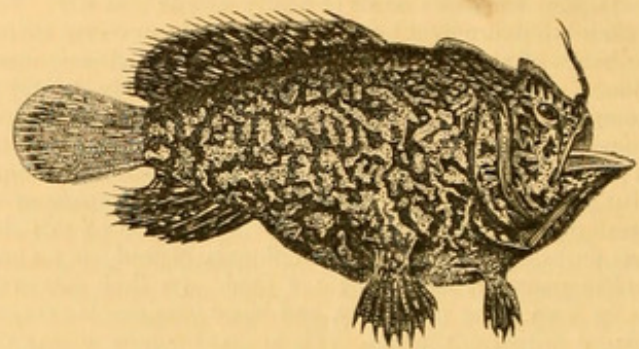


Fig. 131.

Cheironectes caudimaculatus. (Vide fig. 1.)

The *Lophioids* were, from the softness of their bones, placed among the branchiostegous fishes by Artedi; but Cuvier recognising the fibrous structure of their skeletons, brought them back to the *Acanthopterygii*, and since then Müller has shown that the Ostracions with which Artedi had associated them are themselves osseous fishes. In fact, the whole organization of the *Lophioids* is that of an *Acanthoptercus* fish; their two dorsals, the composition of the auditory organs, the freedom of the semicircular canals within the cranium; the construction of the digestive viscera; that of the organs of generation in male and female, the connections of the premaxillaries and maxillaries, and of the teeth which they support, as well as the mandibular, palatine, and vomerine teeth, are all characters of true *Acanthopteri*. The skeleton itself, though not hard, is fibrous; and this is the case in the common *Lophius* with respect to all the cranial bones without exception, those also of the jaws, gill-covers, scapular chain, the spinal column, the fins, os hyoides, and gills, all of which have the fibrous structure.

Distinctive characters of the family are to be found in the almost general absence of scales, which are replaced in *Malthæa* by bony tubercles, and in many species of *Cheironectes* by small grains armed with spines; in the elongation of the ulna and radius into a kind of arm, whose fingers are represented by the rays of the pectoral; in the restriction of the apertures of the gills, and the absence of the suborbital bones, on which M. Valenciennes places much value as a family characteristic. Cuvier, in his memoir on the *Cheironectes*, traces their affinity to the Blennioids and Gobioids as follows:—The advanced position of the first dorsal exists in *Cristiceps*; *Callionymus* has only a small gill-opening; *Gobius macrocephalus* of Pallas has the head depressed and wide; the *Periophthalmi* and *Boleophthalmi* have the pectorals supported on arms, and these fish walk and run over the mud in quest of their prey, like the *Cheironectes*; all these facts prove that the *Lophioids* are nearly allied to the Gobioids; most of them have, moreover, like these last, a simple intestinal canal, without pancreatic

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cæca. In quoting these remarks from Cuvier, M. Valenciennes adds that *Lophius* nevertheless has two pancreatic cæca near the pylorus, and shows some relationship to the Percoids, from which, however, he gathers that in natural families there are analogous repetitions or representations of genera in the several groups. Many wonderful things have been said of *Lophius*, or the Fishing-Frog. It has arts and schemes strange and various; it fishes with a line; it fishes with a bait; and not content with gathering a crowd of fish around it by the temptation of its baited filaments, it engulfs them in its vast branchial bags, which sacs, sustained by branchiostegals of proportional size, have no opercular bones, so that, in short, the *Lophius* is an isolated genus, differing from all others in organs connected with its respiration. But in truth the *Lophius* possesses exactly the same bones which enter into the composition of these parts in other fishes; the proportion alone differs, and the enormously large head has given rise to much of the marvellous in these descriptions. The organ of smell is that in which the *Lophius* differs most from other fishes, whether they are osseous or cartilaginous. It has two orifices to its nostril, as is usual, but they are not easily found, unless sought for at the extremity of the nostril tube in an uninjured specimen. This organ is supported on a membranous stalk, and when one opens its summit, it spreads out like the cup of a flower. The bottom of this cup is divided into projecting leaflets, on which the olfactory nerve is distributed, after traversing the axis of the foot-stalk. The fish erects these stilted nostrils, and turns them towards any object whose odour it wishes to ascertain, much as a Slug elongates its horns. In fishes in general the plaited pituitary membrane is fixed immovably at the bottom of a cavity excavated in the bone. The opercular bone in this fish is long and strong, is suspended vertically from the convex epitympanic condyle (as in *Diodon* and *Anguilla*), and has a long slender fin-ray proceeding from the back part of the joint. The suboperculum is produced backwards, and is divided into slender branches towards its border-like fin-rays, as in the Plagiostomes. The anterior rays of the dorsal situated on the head are articulated at their bases by rings, as represented by Mr Yarrell. The spine is composed of thirty vertebræ, and the myelon terminates in a point at the twelfth, the rest of the neural canal being occupied by a long *cauda equina*, or bundle of nerves. Except in the Lophobranchs, there is scarcely another instance among fishes of a similar structure, the myelon being generally co-extensive with the neural canal. The *Lophius piscatorius* is common on the S. coast of England, and many are taken annually in Portsmouth Harbour. A second species is supposed to exist in the European seas, and a very similar one abounds in the China seas. Specimens of the young are generally pinned in along with other small fishes in the insect-boxes exported from Canton. The *Cheironectes* are small fishes, of frog-like aspect, and many of them have the faculty of distending their large membranous stomach with air, and so swelling out the body as the Tetraodons and Diodons do. The quadrupedal character which these fishes possess from the position of their pectoral and ventral fins is expressed by fig. 1, p. 206. The small hole in the axilla of the pectoral is the only gill-opening, and this structure, by retaining the moisture about their gills, enables these fish to remain long out of water, and to travel over sea-weed and sand in search of prey. Commerson considered them to be a kind of Amphibia. Many are curiously coloured, and have strange cutaneous appendages to the fins and other parts of the body.

Malthæa is a genus of fish of depressed forms, very wide in the pectoral region, and they are remarkable as being the only fishes of this family which possess a suborbital bone. *Halieutea* is still more depressed in the body than *Malthæa*,

and dried specimens are very common in the Chinese insect-boxes. The species named *H. stellata*, is of an aurora-red colour above, and bright lake-red beneath. Its back is curiously muricated.

Batrachus is a genus of small fishes, of a disagreeable aspect, but which departs less from the ordinary piscine types in outward form than the preceding Lophioids. It has much the aspect of some *Cotti*, to which the armature of its head bears also a resemblance. It differs, however, widely from the *Scelerozenidæ*, in the cheek not only being not cuirassed by the suborbital, but in that bone being altogether absent. The suboperculum is as large as the operculum, and is likewise armed with strong spines. The species are divided according to the naked or scaly condition of their skin, and by the presence or absence of barbels round the jaws.

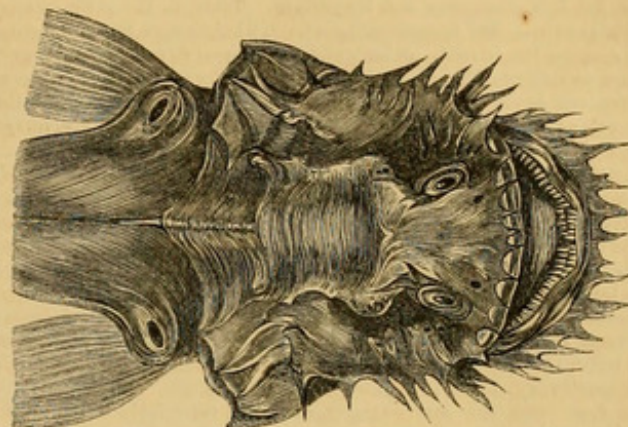


Fig. 132.

Batrachus dubius.

FAMILY XXIV.—LOPHIIDÆ, Cuv.

Pectorales pediculæes, Cuv. *Armflösser* of the Germans. Skeleton fibrous, rarely much indurated. Scales almost always wanting, replaced in *Malthæa* by osseous tubercles, and in many *Cheironectes* by small grains which support spines. Forearm, that is the ulna and radius supporting the pectoral fin, prolonged, making a kind of arm. Gill-openings restricted to a round hole or vertical slit behind the pectoral, and not extending under the border of the suboperculum and operculum. No suborbital bones.

GENUS I. *LOPHIUS*. Head, in comparison with the rest of the body, excessively large, broad, depressed, spiniferous. Infundibuliform pedicellated nostrils. Very wide mouth. Conical slender teeth on the jaws, palatines, and most frequently on the chevron of the vomer, on the superior and inferior pharyngeals, but not on the tongue. Branchiostegals six; branchiostegal membrane very extensive; branchial arches three only. No supplementary gill adhering to the operculum. The operculum, suboperculum, and interoperculum concealed by the muscles, but the preoperculum more visible. There is no suborbital. Teeth moveable. Dorsals two, some of the rays of the first one far forwards on the head, detached from the others, produced into tall filaments which carry a cutaneous tag at their extremity; these rays are articulated by a ring to their interneural bones, a mode of articulation which exists also in the *Chaetodontidæ*, *Siluridæ*, and some *Cyprini*. Nostrils campanulate and pedunculate. Stomach very large and very muscular; intestine short; two pancreatic cæca. Five species.

GENUS II. *CHEIRONECTES*, Cuv. Head and body vertically compressed. Three free rays on the head, sometimes united by membrane, but not followed by a spinous fin separated from the soft dorsal as in *Lophius*. Head neither very large nor the gape so enormous as in that genus. Most have the power of inflating the body by filling a large membranous stomach with air like a Tetraodon or Diodon. The relative position of their ventrals and pectorals gives them the appearance of possessing four feet (see fig. 1, p. 206), but it is the ventrals that here represent the anterior limbs. Gill-opening a small hole concealed in the axilla of the pectoral. Mouth cleft more or less vertically. Fine slender and pointed teeth crowded in card-like plates on the premaxillaries, mandible, vomer, palatines, and pharyngeals. Eyes small and far forward. Opercular bones wholly concealed by the integuments. Branchiostegals six. Branchial arches four. Body not tapering posteriorly in the same way with that of *Lophius*. Dorsal occupying much of the back; pectoral

Classification—
Plectognaths.

pedicellated, as in *Lophius*, by the elongation of the radius and ulna, which are mostly concealed by the skin. Twenty-eight species.

GENUS III. MALTHEA, Cuv. Body anteriorly, and the head much depressed; very wide at the pectorals, chiefly from expansion of the subopercula; posteriorly tapering and more or less compressed. Pectorals pedicellated. Gill-opening a small orifice in the axilla of the pectoral. Body covered with a tubercular skin; many cutaneous filaments. Mouth small, opening beneath the projecting snout, horizontal and protractile; a peculiar pedicel with soft tips attached to the snout, represents the three free rays of *Lophius*. This genus is the only one of the family in which a suborbital scale-bone is present. Seven species.

GENUS IV. HALIEUTEA, Valenc. Body very flatly depressed, orbicular. Snout not prolonged. Palate smooth, toothless. Skin studded with small conical, acute, bony spines, having radiating bases. Branchiostegals six. One species.

GENUS V. BATRACHUS, Schneid. A large flat head and wide mouth, bordered by cutaneous filaments. A very small first dorsal; pectorals pedicellated on short flat arms; ventrals jugular, of three rays, the first elongated and lanceolate. Teeth on the jaws, vomer, and palatines. Six branchiostegals. Gill-openings not extending quite under the throat. A long and low dorsal and anal. Suboperculum as large as the operculum, and emitting strong spines; preoperculum unarmed. No suborbital; no caecal dilatation of the stomach; no pancreatic caeca; air-bladder deeply forked anteriorly; and muscular laterally. Seventeen species.

GENUS VI. CERATIAS, Kroy. Form high and much compressed. Mouth cleft nearly vertically. Gill-opening below the pectorals, prettily large, round. Branchiostegals six. Teeth of moderate size, conical, moveable, slightly curved on the premaxillaries and mandible; none on the vomer or palatines; three branchial arches with two layers; the third pair of arches adherent to the gullet by their interior border. No ventrals; pectorals very small but supported on long arms; anterior dorsal of two free moveable rays, one on the head, the second near the middle of the back; posterior dorsal and anal very short, and close to the caudal fin. Tips of all the rays free from the connecting membrane, especially those of the caudal and ventrals, cartilaginous, not jointed, and with soft extremities. No true scales, but innumerable recurved spines rising from bony bases. No air-bladder. Two small pyloric caeca. Skeleton soft and cartilaginous. Greenland. *C. Holbøli*.

GENUS VII. CHAUNAX, Lowe. Body oblong, tetraedral, subinflatable, naked; skin of the belly lax. Tail abruptly attenuated, subcompressed. Head large, somewhat tetraedral, flat on the dorsal aspect. Mouth very large, transverse. Teeth on the premaxillaries, vomer, and palatines, small granular. Nostrils neither tubular nor pedicellated. Branchial openings behind the pectorals. Dorsal solitary; ventrals pedicellated, fleshy, jugular; anal far back. A single barbel in the internasal pit; no other elsewhere.

PLECTOGNATHS.

Artedi constituted an order named *Branchiostegi*, in which he included the Plectognaths with the addition of *Cyclopterus* and *Lophius*, attributing to the latter as well as to *Balistes* and *Ostracion* the want of a branchiostegous membrane. *Lophius*, however, has as ample branchiostegous membranes as any fish possesses, and six long branchiostegals; while *Balistes* and *Ostracion* have gill-covers and branchiostegals, though the thickness of the integument keeps them concealed. In *Diodon*, the operculum is not connected with the preoperculum, but is suspended to the outer angle of the epitympanic. The real cause of his assembling these genera into one group would appear to have been the tardy ossification of their skeletons, for which reason he placed the order between the osseous and the cartilaginous fishes. But though the bones of the Plectognaths differ in some degree from those of the great mass of osseous fishes, and there are fewer pieces in their skeletons, they belong to that division of the class by the fibrous character of their bones, as Cuvier mentions in his *Regne Animal*; and Müller has shown that they agree with other osseous fishes, in having two valves at the origin of the arterial trunk, differing in that respect from the *Chondropterygii* or Plagiostomes, and from the Ganoids, all of which have many valves. The want of mobility in the upper jaw, through its union by suture with the cranium, is the character that distinguishes the Plectognaths most

distinctly from the ordinary osseous fishes, though even this character is not universal in the group. Their dermal productions, scales, spines, roughness, and osseous plates, differ from ordinary fish scales. By Agassiz, they were on that account considered to be Ganoids, but Cuvier has assigned them a more correct place in our systems.

Classification—
Plectognaths.

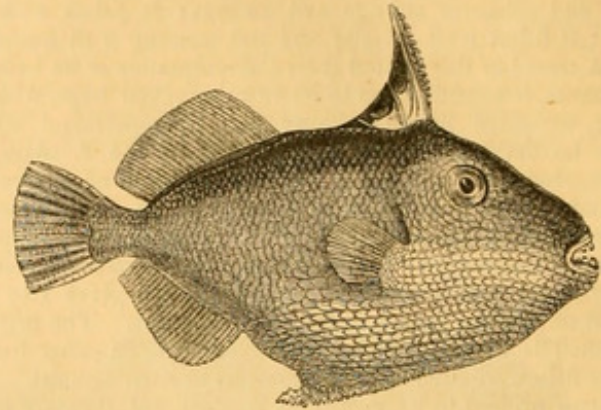


Fig. 133.
Xanthichthys curassavicus.

The Sclerodermids, or *Balistini*, are distinguished by the conical snout, a small terminal mouth, and distinct but not numerous teeth. In *Balistes* the first dorsal spine is articulated by ring and bolt to the broad interneural osseous plate. When the spine is raised, a depression at the back part of its base receives a corresponding projection from the contiguous base of the second ray, which fixes it like the hammer of the gun-lock at full cock, and it cannot be let down until the small spine has been depressed, as by pulling at the trigger; it is then received into a groove on the supporting plate, and offers no impediment to the progress of the fish through the water. (Owen.) This trigger-like fixing of the spine takes place also in the dead fish; and when a *Balistes* is removed from a bottle for examination, it is generally necessary to release the spine by pressing on the small trigger-ray. The spine of the *Balistes* is roughened with ganoid or enamel grains like a file, and the teeth of this fish consist of true dentine, with a thick layer of denser tissue that differs little from enamel.

In the Gymnodonts, or *Diodontidae*, the maxillaries coalesce wholly or in part with the premaxillaries, and the teeth are incorporated with the bone of the jaws, so that the whole looks like one or two great teeth; but the teeth, individually small, are developed from pulps, are arranged in lamellæ, and approach the cutting edge of the compound tooth or jaw as their predecessors are worn away, much as in *Scarus*. The dental plates consist of hard or unvascular dentine. This kind of dentition is adapted to cut and bruise the food on which these fishes live—fuci and crustacea. None of them are used as food for man, and they are generally considered to be poisonous. An instance occurred a few years ago at the Cape of Good Hope of two sailors being poisoned by eating a Tetraodon, and dying from the effects thereof. A detailed account of the symptoms was drawn up by a surgeon in the Dutch navy, who attended them till they died, which was in less than half an hour after eating the deleterious fish. The Tetraodons and Diodons have the power of inflating their bodies by filling their stomachs with air. This viscus is very large, occupying the whole length of the abdominal cavity, and has very thin coats. When thus blown up into a globular form, the fins cease to play, and the fish turns over, and floats belly upwards, driving before the wind and waves, without being able to direct its course, until it has resumed its former shape, by expelling the wind. The inflation of the Diodons, however, causes the strong spines with which the skin is studded, and which resemble those of a hedgehog, to radiate on every

Classification—
Plectognaths.

Classification—
Plectognaths.

side, thus furnishing a good defensive armour. When taken, the Gymnodonts produce a sound, doubtless by expulsion of air from the stomach. Their air-bladder is deeply bilobate, and their kidneys, placed high up, have been mistaken for lungs. Differing from other fishes in the comparatively short tail, feeble as a locomotive organ, the myelon of the Gymnodonts is particularly short, and instead of being, as is usual in fishes, nearly as long as the spine, was found by Professor Owen to be only four lines long in a *Diodon* which measured 7 inches. It is still shorter in *Orthogoriscus*, and the neural canal is chiefly occupied by a long "cauda equina." In this respect they agree with *Lophius*, and they resemble that genus also in having only three branchial arches. In *Orthogoriscus* the processes of the pair of leaflets forming a gill are alternate, and not opposite as usual. Among the Diodons and Tetraodons there are genera which have no external openings to the nostrils, but merely cutaneous tentacles, on which the olfactory nerve is finally expended. *Tetraodon naritus* (Rich.) has only one nostril to each pituitary sac, but it is nearly as wide as the sac itself, and its membranous border can expand either in an infundibuliform way, or contract the orifice. The Tetraodons are remarkably tenacious of life, and have a disagreeable odour, which they retain for several years when preserved in alcohol. The Malays will not use them even as manure. For the arrangement and

length standing in a semicircle, the middle ones broad and sharp-edged, like human incisors, as in *Pyrodon*. Profile arched, with a broader forehead. Large scales at the gill-opening. Tail more or less forked. A canal before the eyes. Two species.

GENUS III. XANTHICHTHYS, Kaup. Naked furrows on the face; two rays in the first dorsal. No shields before the gill-opening. One species. *X. curassavicus*. Fig. 127. (Squamation badly shown.)

GENUS IV. CANTHIDERMIS, Swain. A canal before the eyes. Teeth conical; no separate corner teeth. Broad forehead; arched profile. Small shields behind the gill-opening. No spines on the tail. Second dorsal and anal fins in the older fish very high; caudal slightly crescentic. Scales in the young very rough, but in the old there are only traces of roughness in the fore angle of the rhombs. One species, *C. maculatus*.

GENUS V. BALISTES, Linn., Kaup. Canal before the eye. Shields behind the gill-opening. Conical, elongated, cutting teeth; no jutting corner teeth.

(a.) Two to seven rows of spinules or elevated lines on the tail. Face scaly, without naked streaks. Caudal round or blunt. Four species.

(b.) Face naked, above which a row of scales. Two species.

(c.) A more or less hollow profile; face scaly. Tail destitute of rows of spines or raised lines. Second dorsal and anal more or less falcate. Tail more or less forked. Four species.

GENUS VI. BALISTAPUS, Tilesius. No furrow before the corner of the eye. Two or three rows of spines on the tail. Traces of ventrals; caudal round or truncated; the second dorsal containing from twenty-three to twenty-seven rays; the anal from twenty to twenty-four. Six species.

SUB-FAMILY II.—MONACANTHINI.

Very small scales which are scabrous, with stiff bristles as densely crowded as the pile of velvet. The point of the pubic bone projects, and is spiny as in the *Balistini*; but there is one spine in the first dorsal, and it is large and denticulated; or, if a second spine exists, it is almost imperceptible.

GENUS VII. MONACANTHUS, Cuv. (a.) In one division the pelvis is very moveable, and is connected to the belly by an extensible dewlap; these have often strong spines on the side of the tail.

(b.) Another division is distinguished by a tuft of coarse bristles on the side of the tail.

(c.) A third group has the body covered with small pedicellated tubercles.

(d.) The skin in a fourth group is clothed throughout by slender hairs, which are often branched.

(e.) And there are some which have none of these distinguishing characters.

GENUS VIII. ALUTERIUS, Cuv. Body elongated; densely and minutely granular. A single spine in the first dorsal. The pelvic bones entirely concealed beneath the integument, without any bony projection.

GENUS IX. TRIACANTHUS, Cuv. Profile subtriangular. The first dorsal placed on one angle, and the tail, which is more slender and tapering than in others of the family, ending in a second, on which is the crescentic caudal; while the mouth occupies the third. Scales small, rough, with sharp spinules. Ventrals each consisting of a strong rough spine. Pubic bones long, narrow, not projecting, covered with scales like the rest of the integument. Two species. *Tr. aculeatus*. *Tr. strigilifer*, Cant.

FAMILY II.—OSTRACIONIDÆ.

Ostraciones, Müll.; *Ostracioidæ*, Cant. Teeth ten or twelve, conical. Lips fleshy. Body mailed in a tuberculated cuirass, or "tessellated quincuncial pavement of dermal scale bones," out of which the lips and teeth, the pectorals, and three vertical fins, together with the tail, protrude. Exteriorly the gill-opening appears as a slit, bordered by a skinny edge, but interiorly composed of a gill-cover with six branchiostegals. Ventrals and pelvis wanting. Little muscular substance; a large oily liver. Stomach large, membranaceous. Vertebrae mostly coalescent.

GENUS I. CIBOTION, Kaup. (*Ostracion a corps quadrangulaire sans épines*, Cuv. *Reg. An.*; *Ostracion*, Swain.) Nostrils in a pit. No trace of spines. The completely naked tail destitute of shields or bony rings. Eight species.

GENUS II. DORYOPHRYS, Kaup. (*Lactophrys*, partim, Swain.; *Lactophrys*, De Kay.) Nostrils on the points of two small projections. Cuirass four-cornered, with spines above the eyes and on the edges of the belly. Three species.

GENUS III. OSTRACION, Linn. (*Rhinosomus* and *Tetrosomus*, Swain.) Body inclosed in a more or less quadrangular cuirass, with an acute dorsal ridge, which commences near the eyebrow. Nostrils situated in a flat membrane, also one or two prominences without apertures. No bony rings on the tail. 1. Some are without long

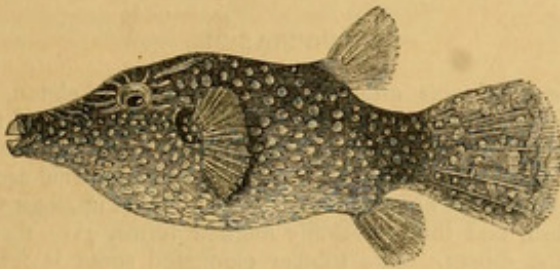


Fig. 134.

Tetraodon solandri.

generic characters of the Diodons, Ostracions, Balistes, and Lophobranchs, we are indebted to the labours of Dr Kaup. We refer to the *Philosophical Transactions*, vol. 76, for an account of *Tetraodon electricus*.

ORDER VI.—PLECTOGNATHI, Cuv.

Endo-skeleton partially ossified; exo-skeleton as ganoid scales or spines. Maxillaries and premaxillaries fixed together. Swim-bladder without an air-duct. No pancreatic caeca; merely vestiges of ribs; and no distinctly developed ventrals.

FAMILY I.—BALISTIDÆ.

Sclerodermi, Cuv.; *Balistini*, Müll. Snout conical. Teeth incisorial, more or less conical, and few in number. Skin either with shield-like scales or with small rough ones. Swim-bladder ovate, strong.

SUB-FAMILY I.—BALISTINI, Kaup.

Whole body mailed in a cuirass divided into rhomboidal disks by cross lines, and commonly displaying varying tints of colour that are generally lost in the preparation of the specimen. First ray of the anterior dorsal very stout and bony, followed by one or two small ones, all of them falling into a dorsal furrow; pubic bones more or less projecting, and carrying the spinules of linear ventrals.

GENUS I. PYRODON, Rüpp. (*Xenodon*, Rüpp.) Profile slightly convex, with the chin projecting. Four blunt front teeth, whereof the middle pair are the broadest, and the side ones worn away interiorly; two longer red-coloured, conical corner teeth in the upper jaw, and four with notched crowns in the mandible. A canal before the eyes. Shields behind the gill-opening. No lateral caudal spines. One species. *P. niger*.

GENUS II. MELICHTHYS, Swain. The front teeth all equal in

Classification—
Plecto-
gnaths.

spines over the eyes, and on the angles of the body. 2. Some have spines on the end of the ventral edges only. 3. Some have spines over the eyes, and on the edges of the belly. 4. Lastly, in some the body is almost three-edged owing to the gable-formed elevation of the back. Six species.

GENUS IV. ARACANA, Dr Gray. (*Acarana* and *Platycaanthus*, Swain.) Roundish compressed bodies, with a short tail, which is encompassed by bony plates or rings.

Sub-Genus I. Aracana, Gray. Having three pairs of flat compressed spines on the dorsal aspect (viz., one over each eye, and two pairs on the edge of the rounded back); one spine on the side, and two or three on the edge of the compressed belly. Six species.

Sub-Genus II. Capropygia, Kaup. Back and belly elevated in the middle; a pair of flat pointed spines on the line which incloses the back; another pair on the border of the belly before the anal. The dermal plates very rough, with small radiating tubercles. One species, *A. unistriata*.

Sub-Genus III. Kentrocapros, Kaup. No orbital spines; back concave, with two flat pointed spines on the middle of the dorsal border; border of the belly rough and denticulated with one spine. One species, *A. hexagona*.

Sub-Genus IV. Anoplocapros, Kaup. No trace of spines on the orbit. Body compressed, and acutely sloped on the back and belly. No spines developed on the borders of the back or belly. One species, *A. lenticularis*.

GENUS V. CENTAURUS, Kaup. A large rough tapering acute spine, standing forwards before the large eye; a still longer one pointing backwards from the end of the cuirass over the caudal, replacing the second dorsal. Two projections from the border of the back laterally; four from the border of the belly. One species. *C. boops*, South Shetland, fig 18.

FAMILY III.—DIODONTIDÆ.

Gymnodontes, Cuv., Müll. Upper and under jaws with which the teeth are incorporated, without a mesial division, resembling the beak of a parrot; behind the jaw is transversely forked. Skin wholly armed with spines of greater or smaller size. The *Diodons* and most of the *Tetraodons* have the power of inflation.

SUB-FAMILY I.—DIODONTINI.

GENUS I. DIODON, Linn. One nostril at the base of a leaf-like cutaneous process, and the other at the point of the same. Spines subulate, long, thin, and sharp pointed, with two radical processes, and capable of erection or depression. Nine species.

GENUS II. DICOTYLICHTHYS, Kaup. Each tentacle two-lobed. No nostril. Spines with three radical processes, which prevent motion; in the middle of the forehead a spine with two processes. One species, *D. punctulatus*.

GENUS III. CYCLICHTHYS, Kaup. Two nostrils, one at the base of a tentacle, the other at its point. Spines with three fully developed radical processes, which prevent all motion. Two species.

GENUS IV. CYANICHTHYS, Kaup. Nostrils squeezed together on the forehead in a leaf-like tentacle; one aperture on the inner border next the forehead; the other one, which is scarcely perceptible, on the border next the eye. Forehead concave, without a spine in the middle. Body armed with short immoveable spines. One species, *C. caruleus*. New Guinea.

GENUS V. CHILOMYCTERUS, Bibr. (Wieg. *Arch.* 1847.) Nostrils at the extremity of an extended tentacle. Three large radical processes to the immoveable spines. Body flat. In most instances a spine on the forehead, and two or three above the eyes. Three species.

SUB-FAMILY II.—TETRAODONTINI.

Tetraodon, Linn., Cuv. Upper and under jaws divided by a mesial suture, so that they appear to have two teeth above and two below. Spines of the skin much shorter than those of *Diodon*. The head and tail are generally smooth, but the rest of the body is, with a few exceptions, rendered rough by the presence of minute spines. A species which possesses electric powers is destitute of spines, in obedience to a law ascertained by observation, that none of the electric fishes possess scales or spines.

The following groups are indicated in the *Regne Animal*, and are likely to receive generic names from the first ichthyologist who publishes descriptions of all the species.

GENUS I. TETRAODON, Cuv.

I. Head short, body inflatable.

1. Body rough throughout.
2. Body smooth throughout.
3. The sides only smooth; lateral tubercles.
4. The sides smooth; no lateral tubercles.

II. Head oblong.

1. The sides only smooth.
2. Back and sides smooth; the belly alone rough.

III. Back keeled.

Müller has proposed the following sub-genera:—

Sub-Genus I. Physogaster, Müll. In the nasal depression a hollow papilla, with a nostril that is not lengthened out into a tube. A dermal keel on the side of the belly from the throat to the tail. *T. oblongus*, *lunaris*.

Sub-Genus II. Chelonodon, Müll. No trace of a nostril, but in place of it a skinny funnel-shaped tentacle.

Sub-Genus III. Cheilichthys, Müll. A shorter or longer nostril-tube, and no ventral keel.

Sub-Genus IV. Arothron, Müll. On each side of the nose solid tentacles, on which the olfactory nerve is expended; also a muscular ring round the eye, and a kind of eyelid.

SUB-FAMILY III.—ORTHAGORISCINI.

GENUS I. ORTHAGORISCUS, Schneid. (*Cephalus*, Shaw. Sun-fish.) Jaws of *Diodon*. Body compressed, generally destitute of spines and incapable of inflation, and with the tail so short and high that the fish appears as if its hinder parts were sliced off. Dorsal and anal both high and pointed, and joined to the caudal. No air-bladder; stomach small, entered directly by the bile-duct. A gelatinous layer immediately under the skin. The abbreviation of the tail is accompanied by a very reduced myelon, looking like a mere ganglionic process of the brain. *O. spinosus* has pointed tubercles on the body.

LOPHOBRANCHS.

Fishes of this order possess an osseous skeleton, and complete and free jaws, but the ultimate divisions of their branchiæ, instead of being pectinated, are divided into small tufts, which are ranged by pairs along the branchial arches. The armour in which these fishes are mailed up, their want of flesh, and their generally angular forms, give them a peculiar aspect. The tubular elongated snout is formed by the nasal, vomer, tympanals, preopercula, and subopercula. The nasal bone is a short compressed vertical plate.

Notwithstanding the odd and stiff appearance of many of the Sea-horse Fish and other small members of this order, some have prehensile tails (*Hippocampus*), like those of an American monkey (*Cebus*), and when kept in vases furnished with slender twigs, to which they can suspend themselves, they form pleasing objects of study. The *Hippocampi* resemble the Chameleon, in being able to direct one eye backwards and the other forwards, and Professor Lichtenstein observed a circular movement in the water near their gill-openings; on the right side the whirl revolved to the left, and on the left side to the right, the rotation being symmetrical and constant, like that of a *Rotifer*. The *Hippocampi* inhabit all parts of the ocean. Others of the order are remarkable for the singularity of their shapes, or of their cutaneous appendages, or for the brilliancy of their colours. The *Phyllopteryx foliatus*, from the seas between Australia and New Guinea, yields to no fish in the intensity of its red and purple tints, and in the variety of the leaf-like lappets that adorn it. A very beautiful drawing, by Bauer, of the recent fish taken on Flinders' voyage is in the possession of Mr Brown.

The most interesting peculiarity, however, in the economy of the Pipe-fishes is that of the males of most species carrying the eggs about with them until they are hatched. Dr Kaup considers that they show an analogy in this respect to the Marsupials, or the Wandering Penguin (*Aptenodytes Patagonicus*), which transports its solitary egg in a fold of its skin. In some the egg-pouches are on the breast or belly, in others on the tail, or the eggs are merely glued on in rows, and not covered in by membrane.

Classification—
Lopho-
branchs.

Classifica-
tion—
Lopho-
branches.

ORDER VII.—LOPHOBRANCHII, Cuv.

Endo-skeleton partially ossified; exo-skeleton ganoid. Gills tufted; opercular aperture small. Swim-bladder without an air-duct. Body almost fleshless, protected by bony rings. In most the male carries the eggs till they are hatched.

FAMILY I.—SOLENOTOMIDÆ, Kaup.

Breast and belly distinctly separated. Oral aperture at the end of a long, compressed, leaf-like snout. When the gill-plate is raised the whole gills are exposed.

GENUS I. SOLENOTOMUS, Seba, Lacép. Snout sharply edged on its dorsal and ventral aspects. A sharp denticulated ridge, passing from the occiput over the eyes and nostrils, disappears in the acute rostral crest. Back and breast acutely ridged. Pectorals broad and short. Belly down to the caudal fin divided into rings and armed by three longitudinal rows of short spines. First dorsal very long; the second and the anal rudimentary. Egg-pouch of the males formed by the union of the inner borders of the ventrals to the skin of the belly; the females have free ventrals. One species.

FAMILY II.—PEGASIDÆ.

Breast very greatly expanded, much broader than high. Pectoral fin long, with nine or ten firm spine-like rays. Gill-opening lateral; gill-plate flat, depressed to the ventral plane. Mouth inferior, like that of a Sturgeon, at the base of the rostrum. Body having three knobbed or spinous rings; breast ring unusually broad, extended between the gill-plates, bispinous. Ventrals two-rayed, filamentous. Tail flat, quadrangular, spinous. Dorsal and anal occupying two to four rings; caudal ten-rayed.

GENUS I. PEGASUS, Linn. Three species.

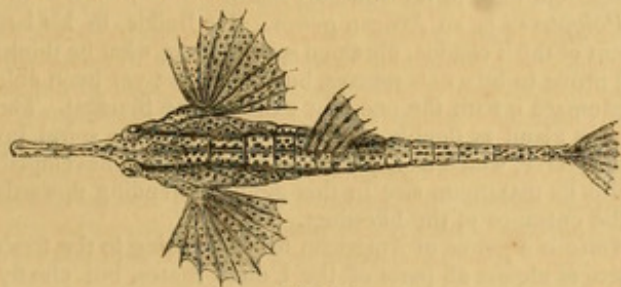


Fig. 135.
Pegasus natans.

FAMILY III.—SYNGNATHIDÆ, Kaup.; Bonap.

The small gill-opening circular and high up. One dorsal only, near the anus. Form elongated. First dorsal and ventrals wanting; pectorals in some present, in others absent; anal fin very small, in some wholly wanting. The males have egg-pouches varying in position with the genus. *Solenognathus* and *Phyllopteryx* have no egg-pouches.

SUB-FAMILY I.—HIPPOCAMPINÆ, Bonap.

Tail generally prehensile at the tip; destitute of a fin. Occiput more or less elevated.

GENUS I. HIPPOCAMPUS, Cuv. Head more or less elevated posteriorly; an occipital coronet with spines or knobs. Orbits spiny. Pectoral ring with two or three spines. Body with ten to thirteen rings, more or less spiny. Tail-pouch of the male opening at its commencement only; tail prehensile. Eighteen species.

GENUS II. ACENTRONURA, Kaup. Edge of the back forming one line with the upper tail-ridge. Gill-opening at the point of the occiput. No protuberances either on the body or tail. No coronet. Egg-pouch of the male on the tail as in *Hippocampus*. One species, *A. gracillima*.

GENUS III. GASTEROTOKEUS, Heck. (*Syngnathoides*, Bleek.; *Solegnathus*, Bleek. nec Swains.) The lateral lines forming the edges of the expanded belly. No nuchal shield. Tail prehensile. Dorsal standing in a furrow and occupying ten to twelve tail rings. No coronet. One species, *G. biaculeatus*.

GENUS IV. SOLENOGNATHUS, Swains. Body laterally compressed, higher than broad. Lateral line confluent with the upper angle of the tail, forming an arch. Twenty-two to twenty-six body rings; fifty-five to sixty tail rings. Dorsal fin in a furrow occupying ten to eleven tail rings. Tail prehensile. One species, *S. Hardwickii*.

GENUS V. PHYLLOPTERYX, Swains. Body much compressed.

Neck elongated, slender; back arched; belly prominent. Dorsal fin placed on an elevation. Flat denticulated bones, supporting leaf-like cutaneous appendages on the body and tail. Tail finless, not prehensile. One species, *Ph. foliatus*.

Classifica-
tion—
Lopho-
branches.

SUB-FAMILY II.—SYNGNATHINÆ, Kaup.

Males possessing a caudal egg-pouch which is open throughout. Tail never prehensile.

GENUS I. HALICAMPUS, Kaup. Snout thin and short, set with three rows of small spines and distinctly separated from the high forehead and elevated spinous orbits. Eyes projecting. Hind-head, nape, and pectoral shield crested; pectoral ring broader than the body. Dorsal fin standing on an elevation formed by three rings only. Body rough-edged, filamentous. One species, *H. conspiciellatus*.

GENUS II. TRACHYRKAMPUS, Kaup. Resembling *Halicampus*, but with a longer head; the snout denticulated on its dorsal aspect only, and not so distinct from the head. Dorsal fin elevated on five or six rings, three of which belong to the body. Pectoral ring no wider than the head; form more elongated than that of *Halicampus*. Three species.

GENUS III. CORYTHOICHTHYS, Kaup. Body tolerably long. Fins small; caudal diminutive. Snout half the length of the elevated head. Orbits large. Dorsal fin commencing in a concavity of the tail over the anus, and not on an elevated base like that of *Hippocampus* or *Trachyrhynchus*. Breadth greatest just behind the dorsal. Body varied by light cross-bars. Six species.

GENUS IV. ICHTHYOCAMPUS, Kaup. Edges of the concave back and tail running in the same line to the caudal fin. Head short. Tail almost as thick as the body, suddenly pointed at the base of the rudimentary caudal; more tetragonal than *Corythoichthys*. Three species.

GENUS V. SYNGNATHUS, Linn. No spines on the straight cylindrical snout. Body heptagonal. Dorsal fin on the plane of the back, not on an elevated base. Upper border of the back never in the same line with that of the tail; upper border of the tail either continuous with the lateral line or interrupted where that line terminates. Dorsal surface of the body flat or flatly concave, and never much compressed or bent into an arch. Body rings never amounting to twenty-four or twenty-seven. Twenty-two species.

GENUS VI. LEPTONOTUS, Kaup. In the females the body is much compressed, and the back is acute like the edge of a knife. Belly also acute, and in old fish the height of the body is five times its breadth, but in the young the body is not so high. Dorsal profile suddenly rising behind the pectoral fin. Tail nearly twice the length of the body. Two species.

GENUS VII. SIPHONOSTOMUS, Rafin. Pectoral ring cleft on its ventral aspect in the middle of its length. Long and pretty thick, with a greatly compressed snout that projects evenly in the plane of the forehead. Five species.

GENUS VIII. LEPTOICHTHYS, Kaup. Snout very long, thin, and much compressed; extended in the same plane with the finely shagreened head. Body unusually elongated; hexagonal, with a flat back and belly without intermediate scales. All the fins large, especially the caudal. Gill-opening longer than usual. One species, *L. fistularius*.

GENUS IX. STIGMATOPHORA, Kaup. A pectoral fin; no caudal. Snout acutely ridged; prolonged. Mouth turned upwards. Anal fin three-rayed. Two species.

SUB-FAMILY III.—DORYRHAMPHINÆ, Kaup.

Males with their egg-pouch on the breast and belly, not on the tail.

GENUS I. DORYRHAMPHUS, Kaup. No pits on the nuchal shield. Rows of spines on the snout, and two projections on its under part. All the angles of the body serrated. The border of the egg-pouch developing two tender membranes which completely cover the eggs. Tail shorter than the body. One species, *D. excisus*.

GENUS II. CHÆROICHTHYS, Kaup. Body short; arched above and below. Snout without spines or projections beneath; slender and rising upwards near the mouth. Lateral line unusually projecting, and uniting with the under edge of the tail. No pits on the small nuchal shield. Egg-pouches furnished with a membrane. Fins not much developed. One species, *Ch. Valencienni*.

GENUS III. DORYICHTHYS, Heck. Snout elongated, compressed, spineless. Two long thin bones near the gill-cover, joining the occiput, and bounding a slit-like opening. Tail quadrangular, shorter than the body; hexangular to the end of the dorsal. Nine species.

GENUS IV. HEMITHYLACUS, Kaup. Snout exceeding the body in length, with a two-edged border on its dorsal aspect, rounded beneath. Body compressed. Egg-pouch of the males reaching from the pectoral ring to the anus. One species, *H. leiaspis*.

Classification—
Lophobranchs.

SUB-FAMILY IV.—NEROPHINE.

The eggs distributed in rows on the breast and belly of the males, not covered by membrane.

GENUS I. MICROPHIS, Kaup. Body heptangular, composed of very rough rings, and of equal thickness to the setting on of the elongated tail. Five fins. Two species.

GENUS II. NEROPHIS, Rafin. Neither pectoral nor anal fin. Body cylindrical without distinct edges. Nine species.

GANOIDS.

Müller remarks that the difference between Cycloid and Ctenoid scales is slight, and its systematic application is consequently confined to narrow limits; but that the case is very different with regard to *Ganoid* scales. These are bony, generally of a rhombic form or quadrangular, seldom rounded in outline or imbricated in position, and their surface is always smooth and coated with a layer of enamel; they are generally arranged in oblique rows, those in each row being usually united to one another by a hinge-like prolongation of the anterior angle. The Ganoid scales are imbedded, like ordinary scales, in depressions of the skin; but the epidermis is extremely thin, and adheres closely, so as to appear wanting. This is the case in *Polypterus*, but in *Lepidosteus* the epidermal covering is more evident. The living Ganoids have completely bony skeletons, but in the fossil ones many have had skeletons soft and cartilaginous like those of the Sturgeons. Müller sums up the Ganoid character in the following words:—Fishes provided with either tabular and angular or round enamelled scales, or with bony plates, or a perfectly naked skin. Their fins frequently, but not always covered on their anterior border with a single or double row of spiny plates or laminæ (*fulcra*); their caudal fin sometimes involving in its upper fold the extremity of the vertebral column, which may continue to the end of that fold; their nasal apertures double; their gills free and lying in an operculated cavity, as in the osseous fishes. Several have an accessory organ in form of an opercular gill, which is different from a pseudobranchia, and may occur at the same time with it; many have also *blowing holes* like the *Plagiostomi*. They have several valves in the arterial trunk, like the latter; their ova are conveyed from the abdominal cavity by tubes; their optic nerves do not decussate, but merely cohere laterally; their intestine often contains a spiral valve, like the *Plagiostomi*; they have a swimming bladder with an air-tube, like many osseous fishes; their skeleton is either bony or partly cartilaginous; and their ventral fins are abdominal. If, however, reference be made to the absolute characters only which are never absent, the Ganoids are fishes with numerous valves in the arterial trunk, no decussation of the optic nerves, free gills and opercula, and with abdominal ventral fins.

Agassiz included the *Sclerodermi*, *Gymnodontes*, *Loricarini*, *Siluridæ*, and *Lophobranchii* among the Ganoids; but, according to Müller, all these groups belong to the ordinary osseous series, and have only two valves in the arterial trunk. The existence of an accessory opercular gill is a character of the Ganoids and Sturgeons, and does not occur in other osseous fishes. Müller further observes that the Ganoids resemble the *Selachii* in having a thymus gland. This organ was described by Dr Simon as it exists in the Sturgeons, and it is found in the same position in *Polypterus* and *Lepidosteus*; that is, between the anterior basibranchials and the sternohyoid muscles. It was considered by Retzius to be a sublingual salivary gland, but it is a vasoganglion; and Professor Owen is of opinion that Dr Simon's view of its homology with the thymus gland is more in accordance with its nature; but he also thinks that Dr Simon has described as a thymus gland in various osseous fishes the same parts which Müller has called pseudobranchiæ in those fishes.

Classification—
Lophobranchs.

Characters distinguishing the *Polypteri* from *Lepidosteii* exist in the solitary arrangement of the rays of the vertical fins, the want of accessory gills, and the incompleteness of the fourth gill, which has only one layer of leaflets, and wants also the slit behind it. There is only one pancreatic cæcum, whereas the *Lepidosteii* have many; both have muscular coats to the air-bladder, but in the *Lepidosteii* that viscus is cellular, and the muscular fibres are in bundles between the folds of the bladder. The air-tube or *trachea* in the *Lepidosteii* is wide, and opens through the dorsal wall of the œsophagus, its orifice being regulated by a sphincter muscle. But the *Polypteri* differ from all other known fishes in the air-duct entering the beginning of the œsophagus or gullet on its ventral side. The arteries of the swim-bladder of the *Lepidosteii* arise in great numbers from the aorta, and the veins empty themselves into the two sub-vertebral veins. In this case, therefore, the cellular swim-bladder cannot be considered as a lung. In the *Polypteri* the artery of each of the two air-bladders is formed by the union of the bloodvessels coming from the last gill, and therefore carrying blood already oxygenized. The *Lepidosteii* have sacciform ovaries, with oviducts issuing from the middles of the sacs. These fish are by no means rare in the North American waters, and a few years ago the researches of Agassiz had raised the number described to ten. It is probable that since then more have been discovered; as he was of opinion, from what he had then observed, that every separate river, basin, or watershed, had its peculiar species. The *Lepidosteii* frequent shallow, reedy, or grassy places, and bask in the sun like Pikes.

Polypterus is an African genus. Dr Baikie, in his late ascent of the Tchadda, obtained specimens of what he thinks will prove to be a new species, but he has not yet been able to compare it with the one that exists in the Senegal. The thymus gland is double in *Polypterus*; and the spiral intestine valve, which in *Lepidosteus* is but slightly developed, attains its maximum size in this genus, extending upwards to the entrance of the bile-duct.

Amia is a genus of American fishes, existing in the fresh waters of almost all parts of the United States, but chiefly abounding in the muddy streams and lakes of Georgia and Florida. At New Orleans the *Amiæ* are named "Mud-fish." M. Valenciennes describes the genus among the Malacopterygians, and says that it exhibits numerous affinities with other families of that order, agreeing with the *Cyprinidæ* in the simplicity of the intestinal canal and want of pyloric cæca, though no Cyprinoid resembles it in having a spiral valve in the intestine. Like *Elops* and *Megalops*, it possesses a sublingual buckler. By the large size of its suborbitals, it is allied to *Erythrinus*; in its dentition, and in the structure of its ovaries, it has marked connections with the Salmonoid fishes; lastly, in its general aspect, the length of the dorsal, the form of the scales, and in the length and flexibility of the body, it evinces close similarity to *Ophicephalus*. These remarks of M. Valenciennes are enough to show that ichthyologists were at a loss to find the proper place of this genus when Dr Vogt, in 1845, discovered it to be a Ganoid, for he found in its arterial trunk two oblique rows of five or six valves each, and the arterial trunk itself covered with a well-defined layer of muscular fibres, as in other Ganoids. It has, moreover, a spiral valve of several turns in the intestine, though it does not ascend so high up as in *Polypterus*. But the scales of *Amia* are not Ganoid, and have not the slightest resemblance to those of that genus or of *Lepidosteus*; and from this Müller infers that the structure of the scales is not to be trusted as an ordinal character. The scales of *Amia* are not osseous plates; they are flexible and rounded, and destitute of enamel. Similar scales belong to the fossil *Megalurus* and *Leptolepis*, which are considered by Agassiz to be Ganoids. In habit *Amia* resembles the osseous fishes rather than the Ganoids. As *Amia* agrees

Classification—
Lophobranchs.

with the other Ganoids in the valves and muscularity of the arterial trunk, and in the spiral intestinal valve, Müller infers that it will be found also to possess a *chiasma* of the optic nerves (no decussation), a thymus gland, and an uncleft retina. He concludes by saying that it cannot be referred either to the *Lepidosteini* or *Polypterini*, being separated from the former by the absence of *fulcra*, and from the latter by not possessing the dorsal polyptery; and he therefore regards it as the living representative of a peculiar family of Ganoids, and finds analogous genera in the fossil *Megalurus*, *Leptolepis*, *Thrissops*, and their allies. All of these have soft scales, an osseous vertebral column, and a similarity in form of body and structure of fins. Questions of such interest to ichthyologists have doubtless long ago been solved by Agassiz, who has such ready access to many species of *Amia*, but the results of his investigations have not reached us. Cuvier compared the air-bladder of *Amia* to the lung of a reptile on account of its great cellular subdivision; and in his list of affinities or analogies above quoted, M. Valenciennes might have added the similarity of the air-bladder of the *Amia* to those of *Erythrinus*, or of the Siluroid *Bagrus*, which have that viscus subdivided by transverse septa.

The Sturgeons are very abundant in the rivers of Siberia which flow to the southward, and no less so on both sides of North America. They do not inhabit any of the rivers of that country which flow into the Arctic Sea, and consequently are not found to the N. of the watersheds between the 53d and 54th parallels of latitude, where the mean temperature of the year is about 33° of Fahrenheit's scale. They seldom enter clear cold streams, but in the season ascend the muddy rivers in vast numbers, so that many populous native tribes subsist wholly on the Sturgeon fishery during the summer. In most localities two forms are readily recognised by the comparative length and acuteness, and shortness and bluntness, of their snouts; but every watershed has its own species, varying in the osseous shields, positions of the rostral barbels, form of the tail, fins, and other characters.

ORDER VIII.—GANOIDEI, Müll.

Endo-skeleton in some osseous, in some cartilaginous, in some partly osseous partly cartilaginous; exo-skeleton ganoid. Fins usually with the first ray a strong spine. A swim-bladder and air-duct. Numerous valves in the arterial trunk. No decussation of the optic nerves. Free gills and opercula, and abdominal ventral fins.

FAMILY I.—LEPIDOSTEIDÆ.

Lepidosteini, Müll. Upper jaw composed of several pieces; the vomer divided in two by a median cleft; the basisphenoid is confluent with the basioccipital; the nasal bone dentiferous; the mandible composed of as many pieces as in Reptiles; the vertebrae articulated by ball and socket; the olfactory organ, situated at the extremity of the greatly elongated jaw, contains the ordinary nasal folds which are arranged simply; a respiratory opercular gill is present as well as a pseudobranchia, but no blowing hole. The gills on the four arches have the perfect bifoliate structure, and behind the last arch and the hyoid bone there exists, as usual, a fissure. Branchiostegals three, the membrane passing from side to side like a mantle, and undivided. Anterior edge of all the fins protected by two rows of spinous scales. Fin-rays all articulated; caudal fin abruptly truncate, its rays inserted partly at the extremity of the vertebral column, partly beneath it. Stomach not caecal; several pancreatic caeca; no spiral valve in the intestine; swim-bladder cellular, containing *trabeculae carneae* between the cell divisions, and opening by a long slit into the upper wall of the throat.

GENUS I. LEPIDOSTEUS, Lacép. An elongated snout varying in breadth in different species, formed of the premaxillaries, maxillaries, palatines, nasal, and vomer; mandible equal to it in length; both covered on their surfaces with raduliform teeth and bordered by a row of long pointed ones. Ten species, American.

FAMILY II.—POLYPTERIDÆ.

Polypterini, Müll. The upper jaw is not divided into pieces, the

vomer is single, and the mandible and skull generally are constructed as in other osseous fishes. A labial cartilage exists at the corner of the mouth, supporting the upper and under lips. The fourth gill is only unfoliate, and there is no slit behind it; the opercular gill is wanting, and no pseudobranchia ever occurs; but there is a blowing hole on each side, covered by an osseous valve. The inferior pharyngeal bones are wanting. A series of separate fins extends along the back, each consisting of a spine and a plume of articulated rays behind it. The rounded caudal and the anal are composed of jointed rays, which in the former are inserted above as well as below the spines; the pectoral has a somewhat elongated scaly limb. The nostrils are more complicated than in any other fish. In a large cavity there is a labyrinth of five nasal passages, each with a gill-like arrangement of folds; anterior nostril prolonged into a membranous pipe; the posterior one a small cleft anterior to the eye. The stomach is caecal, and there is a pancreatic caecum. The intestine contains a spiral valve; swim-bladder double, consisting of two sacs differing in length, and opening into a short common cavity that communicates with the ventral floor of the throat by a long fissure.

GENUS I. POLYPTERUS, Geoff. Three species, Nile, Senegal, Tchadda.

FAMILY III.—AMIIDÆ.

GENUS I. AMIA, Linn. Excepting in the absence of lingual teeth, the mouth of an *Amia* is that of a Trout. Head covered with a very thin mucous skin, easily removed, and then the naked cranium, supratemporals, suborbital scale bones, and operculum appear as sculptured bony plates. The sublingual bone is naked and furrowed. Upper part of the snout smooth and fleshy; inferior lip large and thick. Cheek almost wholly covered by the suborbitals. Each nostril with two openings, the anterior one a projecting tube like a barbel, the posterior one an aperture near the eye. Upper arch of the mouth formed by small premaxillaries and large moveable maxillaries. Teeth on the jaws; vomer, pterygoids, palatines, and large double branches of the mandible, mostly in rows of conical teeth, with small tessellated patches behind; on the pharyngeals the teeth are cardiform, and rough granular patches exist on the internal face of the operculum, a singular piece of structure which M. Valenciennes regards as the rudiment of an accessory branchia. The tongue is edentate, thick and fleshy. Large gill-openings. Branchiostegals eleven to twelve; broad and flat. Scales of the body thick, but not osseous. Caudal coming farther forward on the upper edge of the tail than below; ventrals median; dorsal long; anal small. Stomach caecal, with a large pyloric valve. No pancreatic caeca; a very large air-bladder, forking anteriorly, and communicating with the œsophagus; cellular within, in the upper and lateral parts, but not below. Ova dropping into the cavity of the abdomen. Fresh waters of America. Ten species.

FAMILY IV.—STURIONIDÆ.

Sturiones, *Sturioniens* ou *Chondropterygiens*, *abranchies libres*, Cuv. *Chondrostei*, Müll.; *Accipenserini*, Müll.; *Accipenseridae*, Bonap. Skeleton partly cartilaginous, vertebral column a soft chorda instead of vertebrae.

GENUS I. ACCIPENSER, Linn. Form squaloid. Body more or less protected by rows of bony shields. Head cuirassed. Mouth beneath the snout, small and toothless. The premaxillaries form the anterior inferior border of the upper jaw; the maxillary is a small oblong plate articulated to the outer process of the premaxillary, and by the whole of its inner posterior side to the palatine bone. The mandible consists principally of a single bony limb, which is joined to its fellow at the symphysis, and its joint is formed by a trochlear cartilage attached to the pterygoid process of the palatine. The mouth thus formed is more protractile than that of the Sharks. Rostral barbels on the ventral aspect. Labyrinth in form and position resembling that of the osseous fishes. No vestige of an external auditory opening. An aperture behind the temples conducts merely to the gills. Dorsal and anal opposite, behind the ventrals; caudal encircling the extremity of the spinal column, the upper lobe the principal one, a smaller and shorter one beneath. Spiral intestinal valve, and conglomerated pancreas as in the Sharks; a very large swim-bladder communicating with the œsophagus by a large hole.

GENUS II. POLYODON, Lacép. *Spatularia*, Shaw. *Planirostra*. *Scaphirhynchus*. Technically distinguished from *Accipenser* by the naked skin destitute of bony shields; recognisable at once by the enormous leaf-like expansion of the snout. In general form Sturgeons, but the gill-openings are larger, and the membranous tip of the gill-flap reaches the middle of the body. Mouth very wide, with a multitude of little teeth. A gelatinous chord in the spine like that of the Lamprey. A spiral intestinal valve; pancreas partially divided into caeca; an air-bladder. Müller says that the opercula are absent in *Polyodon*. (*Osteol. der Myxin*.)

Classification—
Sirenoids.

Classifica-
tion—
Sirenoids.

SIRENOIDS.

Two distinct species of this order, family, and genus are known; one an inhabitant of the River Amazon, whose structure has not been so fully investigated, and the *L. annectans* from the Gambia, which has been minutely dissected by several of the first comparative anatomists of the day, and been the subject of much scientific controversy as to its station in the animal scale, whether it ought to be ranked with the reptiles or fishes. Professor Owen from the first advocated its ichthyic constitution, and Bischoff maintained its reptilian character; but Owen's reasoning appears to us to be perfectly conclusive. In a preceding page we have briefly noticed the habits of the Siluroid Hassars (*Callichthys*) in taking shelter in the muddy bottoms of marshes, and when these dry up, digging burrows for themselves to a considerable depth. They can live long out of the water and make overland journeys in quest of it; but if we understand the accounts given by travellers, they can, in the event of being cut off from water, pass the dry season in an inactive state in their burrows, from whence they are dug out by the natives, who use them for food. Some moisture will, doubtless, always remain about them in their subterranean abodes, but still their condition until the rains commence must be analogous to the hibernation of animals in higher latitudes; they enjoy but a torpid kind of existence, and use no exhausting muscular exertion until the refreshing water flowing in recalls them to an active employment of all the organs they possess as fishes. The conditions of existence of the *Lepidosiren annectans* must, as far as regards external circumstances, be similar during the dry season, though that internal organization which enables it to pass much of its life out of water is of a very different kind. This fish inhabits the Gambia, which in the rainy season floods extensive tracts of country. On the waters retreating after the rains have ceased to fall, the *Lepidosiren*s that are left behind burrow into the mud, which a tropical sun soon converts into a hard cake. An aperture is left, however, that admits air, and they remain in their chamber, torpid and clothed in a thick secretion of mucus, until the water again overflowing the muddy lands, releases them to the enjoyment of the swimming powers, which they employ in search of food to allay the cravings of a keen appetite. They have been brought to this country imbedded in clay round the roots of plants imported from the Gambia, and their presence only became known after the plants were placed in the stove and well watered. It is by a modification of the air-bladder rendering it analogous in function to the lungs of an Amphibian, and also by a peculiarity in the gills, that the *Lepidosiren* is adapted to the alternate conditions of an active tadpole-like fish, and an air-breathing dweller on the dry land. As a general rule, all fishes more highly organized than the *Dermopteri* have, in their embryonic stage, five branchial arches and five branchial arteries. In osseous fishes the anterior or hyoid arterial arch develops either a gill of a single layer only, or a rudimentary gill consisting of a network of vessels, or both, or neither. The normal number of branchiæ, with double pectinated lamellæ in osseous fishes is four;—most of the Labroids, the genera *Cottus*, *Scorpena*, *Sebastes*, *Apistes*, *Zeus*, *Cheironectes*, *Gobiesox*, *Lepadogaster*, and *Polypterus* have three bilamellated or biserial gills and one uniserial one; *Lophius*, *Batrachus*, and the *Gymnodonts* have three biserial gills; and *Malthæa* and *Lepidosiren* have two biserial gills and one uniserial gill. Two of the arterial arches, which in other fishes supply a pair of branchiæ, remain undivided in *Lepidosiren*, and in their primitive condition of vascular hoops, which end directly (in a manner analogous to the *ductus arteriosus* of young mammals) in arterial trunks going to the air-bladders, and ramified over their cellular surface. While passing through the ultimate twigs of these arteries, the blood is sufficiently oxy-

genized to sustain life during the dry season, supplies of air being introduced into the air-bladders by a trachea whose œsophageal orifice is kept open by a laryngeal cartilage. Mr Owen sums up in the following words the particulars of structure which induced him to consider the *Lepidosiren* to be a fish:—"It may be presumed," he says, "that its gelatinous chorda dorsalis, its vertebral inferior transverse processes (parapophyses), the normal attachment of the scapula to the occiput, the branchiostegal covering of the permanent gills, the opercular bones, the absence of a pancreas, the presence of a spiral intestinal valve, the relative position of the anus, the extra-oral nasal sacs, the scaly integuments, the mucous tubes and pores on the head, the 'lateral line,' and, in short, the totality of the organization of the *Lepidosiren*, will be deemed fully to prove its true ichthyic nature." This passage gives, in fewer words than we could have employed, the reasons for introducing the order of Sirenoids into our table of the class of fishes. In a discussion which took place at a meeting of the British Association soon after the publication of Mr Owen's paper on the *Lepidosiren* in the *Transactions of the Linnean Society*, the debate turned much on the presence of a posterior nasal orifice in the cavity of the mouth, but the *Lepidosiren* has an elongated nasal sac, with the biserial pituitary folds usual in fishes, and two apertures, neither of which communicate with the mouth; and Owen attributes to the position of the nasal sac in the under part of the thick lip the mistake of those naturalists who affirmed that the posterior opening was within the mouth. We have in a preceding page mentioned an instance in the *Synbranchide* of the posterior nasal opening being as much on the interior side of the lip as in *Lepidosiren*. Though the homology of the air-bladder of *Lepidosiren* with the lungs of *Batrachia* is undeniable, and by a legitimate train of reasoning, the air-bladders of other fishes are also proved to be homologous with the lungs of the higher classes of vertebrals, there is no ground, Mr Owen remarks, for asserting that the air-bladders of fishes in general perform the functions of a lung. Such oxygenation of the blood as a fish requires is effected through the agency of gills, though the relationship of these organs to the tracheæ and lungs of the higher vertebrals is one of analogy merely. The branchiæ of fishes are, however, homologous with the persistent or deciduous branchiæ of *Batrachia*, and with similar organs in embryos.

In *Lepidosiren* the optic nerves do not cross each other, agreeing in this respect with the same parts in *Polypterus*, the Sturgeons, and the Plagiostomes. In ordinary osseous fishes the nerves cross, but without an intermixture of nervous fibrils.

ORDER IX.—PROTOPTERI, Owen.

Sirenoidei, Müll. Endo-skeleton partly osseous, partly cartilaginous; exo-skeleton as cycloid scales. Pectorals and ventrals as flexible filaments. Gills filamentary, free. No pancreas; swim-bladder as a double lung with an air-duct; intestine with a spiral valve.

FAMILY I.—SIRENIDÆ.

Sirenoidei, Müll. General form resembling that of an *Ophidium*, with a more tadpole-like tail. Pectorals and abdominal ventrals single, slender, tapering barbels, supported internally by a soft cartilaginous ray. Gills operculated.

GENUS I. LEPIDOSIREN. (*Protopterus*, Owen.) Two species, *L. annectans*, Gambia; *L. paradoxa*, Amazon.

ORDER X.—HOLOCEPHALI.

Endo-skeleton cartilaginous; exo-skeleton as placoid granules. Most of the fins with a strong spine for the first ray. Ventrals abdominal. Gills laminated, attached by their margins; a single external gill-aperture. No swim-bladder; intestine with spiral valve. *Copula gaudens*.

FAMILY I.—CHIMÆRIDÆ.

Chimæroidei. Interiorly five gill-apertures which communicate

Classifica-
tion—
Sirenoids.

Classification—
Chondropterygians. with a single common passage, having only one external opening. Rudimentary operculum concealed by the skin. Upper jaw represented by the vomer, the palatines, and tympanals, rudimentary on the sides of the snout. Hard bony plates supply the place of teeth on the jaws, four above, two below. Snout projecting, with regular rows of pores; a fleshy club-shaped process with spiny point between the eyes. First dorsal armed by a strong spine placed over the pectorals. Claspers of the males trifid; eggs large, leathery, with flat velvety borders.

GENUS I. CHIMERA, Cuv. Snout conical. Dorsals contiguous, the second reaching to the point of the filamentous tail; caudal like that of the Sharks under the end of the tail.

GENUS II. CALLORHYNCHUS, Gronov. Snout ending in a fleshy hatchet-shaped appendage. Second dorsal commencing over the ventrals, and ending opposite the beginning of the caudal.

CHONDROPTERYGIANS,

Or Cartilaginous fishes, are called by Cuvier the *second series* of the class, and he considers them to be neither inferior nor superior to the Osseous fishes forming the bulk of the first series, for many of the genera come near the Reptiles in the structure of the acoustic organ, and in the genital apparatus, whilst others have so simple an organization, and such imperfect skeletons, that they can scarcely be classed with confidence as vertebrals. He therefore looks upon them as a parallel series to the ordinary fishes analogous to the relationship that exists between the Marsupials and the ordinary Mammals. It is right to observe, however, that the very low organization of some Chondropterygians here alluded to has reference to the *Cyclostomi* placed at the commencement of our table, and their exclusion, leaving only the Sturgeons, Sharks, and Rays, presents the organization of the Chondropterygians, as of a higher and more equable general character, by which strength is added to Cuvier's reasoning. Yet there are many embryonic characters persistent in the Chondropterygians of which the cartilaginous and confluent vertebræ, as departing most from the indurated endo-skeleton of the highest and newest vertebrals, is the most striking. We have already observed that many of the characters assumed by the embryos of existing fishes in the progress of their development were the permanent condition of the fossil fishes found in the oldest fish-bearing strata, and (as will be more fully explained in the article on FOSSIL ICHTHYOLOGY, which follows) the researches of Agassiz have shown that as we ascend from the older to the newer deposits there is a progressive predominance of the endo-skeleton over the exo-skeleton, so that the Placoids of that author, or the Plagiostomous Chondropterygians are few in number in the present day compared to the osseous fishes, and the Ganoids with their heavy armour are much more sparingly represented still. During the chalk epoch both Ganoids and Placoids were in much greater numbers, and they are the only members of the class of fishes which have been found in the deposits below the chalk. Mr Owen has some most instructive sentences bearing on this point in his remarks on the *genesis of fins*. The development of fins, he observes, is at first restricted to the region of the head, as in most of the ancient Cephalaspid fishes—*Pterichthys* and *Pamphractus* for instance—in which the cephalic fins project from the opercular region before the nuchal plates, and there is no trace of true pectoral, ventral, or of vertical fins. In existing fishes the only thing analogous to these cephalic fins is the envelopment of the sides of the skull in the Rays by the fore corners of the pectorals, or in *Cephaloptera* and *Ceratoptera*, by what Müller calls "cephalic fins," but which he considers to be merely detachments of the pectorals, though connected with them only by integument, and not by a continuous succession of fin-rays. In others of the ancient fossil genera there are two closely approximated dorsals and two anal fins, and both are situated near the end of the tail, which runs into the upper lobe of an un-

symmetrical caudal fin. Now, in the embryos of existing osseous fishes these vertical fins are developed from a single continuous fold of integument, which is extended round the point of the tail from the dorsal to the ventral surface; a condition which may be observed in the tadpoles of Batrachians, and which is persistent in the Eel and *Lepidosiren*. The growth of this fold is progressive at certain parts, and checked at others; and in places where development is active, the supporting dermal rays make their appearance, and the transformation into dorsal, caudal, and anal fins is thus effected. At first the caudal fin is unequally lobed, and the terminal vertebræ extend into the upper and longer lobe; the dorsals and anals are also at first closely approximated to each other and to the caudal fin. M. Agassiz has shown that all these embryonic characters were retained in many of the extinct fishes of the old red sandstone; and the caudal fin did not pass the heterocercal stage in any fish until after the jurassic or oolitic epoch. The heterocercal caudals are the predominating and almost exclusive form in the existing Sturgeons, Sharks, and Rays, and in most of these one, or both dorsals when there are two, are situated upon the tail, and not rarely near its extremity. The cutaneous seams without rays and other embryonic conditions are also common, as may be learnt by consulting the generic characters in the table.

Cuvier observes that the parts of the skeleton of the *Selachians* (under which epithet he comprehends the Sharks and Rays) do not assume the fibrous structure of bone; their interior remaining always cartilaginous, and the induration of their exterior proceeding from the deposition of the earthy matter in a granular state, whence their characteristic dotted surface. It is on this account he infers that their *calvaria* are not divided by sutures, but are composed of a single shell, modelled, however, in other respects after the general plan of an ordinary fish-skull; so that we can distinguish the same regions, similar depressions and eminences, and the same holes. He gives an analysis of the vertebral cartilage of *Selache maximus*, which shows that water alone forms ninety per cent. of the mass, while nearly seven are oil and other animal matters, and little more than three of earthy salts.

Owen selects *Squatina* (the Monk-fish), an intermediate form between the Sharks and Rays, as a good typical example of the characters of the skull of a Plagiostome. The cranial end of the "chorda dorsalis" and its capsule are converted into firm granular cartilage, which, extending forwards from a prominent median basal-ridge, and also expanding laterally, constitutes the oblong flattened plate or base of the cranium. Two convex condyles are formed on the posterior margin of this "occipito-sphenoidal" plate for articulation with the end of the spine. Two notches on the side of the basal cartilage define a prominence representing the sphenoidal arch, which sends off a rudimental pterygoid; and further forward there is an expansion and groove forming the point of suspension of the palato-maxillary arch. Then the cartilage suddenly contracts, and is continued forwards to form the vomerine anterior base of the cranial cavity. The walls of this cavity are as firm and granular as the base, except at the antero-superior end which is closed by membrane only. The foramen magnum posteriorly gives passage to the spinal chord, and there are perforations for the exit of the cerebral nerves.

The cranial cavity is of larger size than the brain, and communicates only by nervous and vascular foramina with the acoustic labyrinth, which is buried in the side of the cartilage. In the *Chimæra*, this insulation of the ear-capsules, denoting a high grade of development, is much less complete. The parts of the cranial cartilage, corresponding to the separate bones of the skull of an osseous fish, may be recognised by the foramina through which the several pairs of nerves pass; but the exterior of the skull

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is variously and singularly modified in the different Plagiostomous genera.

In the appended arches of the cranium there is a similar confluence of cartilage. A single strong suspensory pedicel articulated to the lateral posterior or mastoid process gives attachment to the hyoid arch by a close joint, and to the mandibular arches by two ligaments. The maxillary arch is suspended by a ligament passing from its ascending palatal process to a notch between the vomerine and the anterior supracranial cartilage. From this point the upper jaw is continued in one direction forwards and inwards, completing the arch by a ligamentous symphysis with its fellow; and in the opposite direction to coalesce with the outer side of the tympanic pedicel, and form the more immediate articulation for the lower jaw or mandibular arch. Each half of the mandible consists of a single cartilage, the two being united together at the symphyses by ligament. Two slender labial cartilages are developed on each side of the maxillary, and one on each side of the mandibular arch. (The parts described in this paragraph, with the teeth which they support, are the "Shark's jaws" usually brought home by seamen.)

Four or five short cartilaginous rays, in *Squatina*, diverge from the posterior margin of the tympanic pedicle, and support a membrane answering to the opercular flap of osseous fishes; these rays are the skeleton of the diverging appendage of the tympano-mandibular arch. The hyoid arch in the *Squatina*, as in most other Plagiostomes, consists of two strong lateral cerato-hyoids, and a median flattened basi-hyoid. Short cartilaginous rays extend from the back part of the cerato-hyoid to support the membranous wall of the branchial sac; these are the homologues of the branchiostegal rays of osseous fishes.

The *Cestracion* is not so far advanced in cranial development as the *Squatina*, and the cartilaginous basioccipital has a hollow conical articulation with the end of the spine; but the Skates and Rays have the skull moveably articulated by two condyles and an intervening space, as in *Squatina* and *Zygæna*. The skull of the Rays is flat and broad; the upper wall membranous to a greater or less extent, except in *Narcine*, where it is closed by cartilage. The anterior or vomerine part forms a long pyramidal rostrum, to which are articulated cartilages connecting its extremities with the radial or anterior angles of the pectoral fin, or largely expanded hand; in the space between the pectorals and skull the *Torpedidæ* carry their electric batteries. The tympanic pedicels are short and thick; the maxillary and mandibular arches long and wide, stretching across the under part of the head.

The capsules of the organs of sense are all cartilaginous; that of the ear is involved, as we have said above, in the lateral walls of the cranium; that of the eye is articulated by a cartilaginous pedicel with the orbit; and the olfactory sacs are covered by vaults of the nasal processes. The long lateral processes supporting the eye-balls of the "Hammer-headed Sharks" have already been alluded to. In *Myliobates* and *Rhinoptera* a cartilage is attached to the prolonged anterior angle of the pectoral fin, connecting it with the internasal cartilage, and supporting a number of branched and jointed cartilaginous rays. A like series of rays on the other side of the head meet these before the skull on the median line, and form what Müller terms, as we have said in a preceding page, "cranial fins;" but Owen considers them to be merely dismemberments of the pectoral fins, and thinks that the real cranial fins are the opercular and branchiostegal appendages of the tympanic and hyoidean arches.

In tracing the progressive rise of organization of the spinal column in the Cartilaginous fishes, Owen commences with the Myxinoid fishes, whose spine is a gelatinous chorda with fibrous investments. The separation of the upper

layers of the fibro-membranous sheath forms a neural canal, and a hæmal canal is produced below in like manner. In the Sturgeon there is a continuous central gelatinous chorda, but the inner layer of the fibrous investment assumes the texture of tough hyaline cartilage, while distinct, firm, and opaque cartilages are developed in the outer layer. Above the coalesced centra these cartilages have a similar arrangement to the homologous parts of osseous fishes; a neural canal is formed by two cartilaginous neuropophyses, each in the young fish formed of two superimposed pieces, and the arch is crowned by a single short neural spine. There is a short thick parapophysis on each side, with their bases expanding below to form a hæmal canal in the tail, by their union beneath the centrum. They include a small inter-hæmal cartilage on each side, and towards the end of the tail, hæmal cartilaginous spines are developed. Short pleuropophyses or ribs are articulated to the ends of the parapophyses. A beautiful progression, in the development of the spinal column and of the proper vertebral structure, is traced out by Müller in his *Anatomie der Myxinoiden*, and referred to by Owen, from whom we quote. In the Basking Shark (*Selache*) the vertebral centra are formed of hollow cones, meeting at their apices in the interior, and having their cups filled with the remains of the gelatinous chorda. This semi-fluid, slightly compressible, and very elastic, gives flexibility to the spine, while it sustains the shocks of violent inflexions. Strength and lightness are imparted to the centra by concentric plates of bone, crossed by others radiating like the spokes of a wheel from the apices of the cones. The highest stage of vertebral development occurs among *Galei* and other *Nyctitantes* or Sharks, which have a nictitating eyelid. In them the external surfaces of the centra, and their internal cones, are covered by a smooth osseous crust. A few Sharks only, as *Carcharias*, *Heptanchus*, and *Alopias*, have the ribs connected to the centrum at the base of the parapophyses; in most they are attached, as in the Sturgeon, to the ends of these processes.

The gills of the *Plagiostomi* do not present the pectinated arrangement of slender tapering processes in a double row, like the osseous fishes, but consist of folds of membrane on plane surfaces. A pseudobranchia coexists with a hyoid uniserial gill in most Plagiostomes, and in those which have spout-holes it is developed on the anterior wall of these outlets from the branchial cavity. The Plagiostomes have two or more transverse rows of semilunar valves in the bulbus arteriosus, or beginning of the arterial system; *Galeus* has two rows of three valves; *Sphyrna*, *Mustelus*, *Acanthias*, *Alopias*, *Lamna*, *Rhinobates*, *Torpedo*, and *Accipenser* have three rows of valves; *Hexanchus*, *Heptanchus*, *Centrophorus*, and *Trygon* have four rows of valves; *Scymnus*, *Squatina*, *Myliobates*, and *Raia batis*, or the common Blue Skate, have five rows. *Cephaloptera* has a very large bulbus arteriosus, and presents internally three longitudinal angular ridges, at the sides of which are small valves disposed in pairs, and in four or five rows; besides these there are three larger valves at the beginning, and three at the end of the bulb. The optic nerves of the Plagiostomes are connected by a commissure, but do not decussate as in the osseous fishes. And in this order the plexus of arteries, termed a vasoganglion, which lies between the layers of the choroid coat of the eye of most osseous fishes, does not exist. Müller found that generally when a fish possessed pseudobranchiæ, it had also the optic vasoganglia; but the Plagiostomes, Sturgeon, and Lepidosiren are exceptions, having the pseudobranchiæ, but wanting the vasoganglia. *Mormyrus*, *Cobitis*, *Silurus*, *Pimelodus*, *Synodon*, *Muræna*, and some other genera of the serpentiform apodals, have neither the pseudobranchiæ nor the vasoganglia, but in most osseous fishes in which they have been sought for they have been found existing together.

The only other parts of structure of the Plagiostomes that

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we think it necessary to mention in the summary that our restricted limits compel us to resort to, are the organs of reproduction. In these fishes the secreting organs, or melts, are of compact oval or oblong form, and their efferent tubes communicate with the ureters, and terminate upon a rudimental organ in the cloaca. The claspers are present in the *Chimæridæ* as well as *Plagiostomi*, as appendages to the posterior edges of the anal fins, and have a fissure towards their ends, leading to a blind subcutaneous sac, which is well lubricated with mucus. In the Rays a glandular body adds its secretions to this mucus. The ovaria are smaller than those of osseous fishes, and the ova comparatively few in number. Some of the genera are viviparous, others ovo-viviparous, and others again merely oviparous.

SHARKS.

The SCYLLIDÆ or Dog-fishes, have the anal fin situated either before or beneath or behind the second dorsal, and are mostly spotted or coloured with lively tints. Their French names are *Rousette* or *Rocher*. The typical genus *Scyllium* has two representatives on the British coasts, *Sc. canicula* and *Sc. catulus*, both very common, and constantly taken by the fishers with bait at all the fishing stations round the coast, but more plentiful among the Orkney Islands than elsewhere. They are scarcely ever brought to market, but the fishermen do not disdain to eat them. Their flesh is remarkably white, but a little fibrous and dry. In the Orkneys they are skinned, split up, cleaned, and then spread out on the rocks to dry for home consumption. The skins are used for smoothing down cabinet work. There is no reason why the fins of these and other Sharks, so extensively used in China for making gelatine soups, should not be applied to the same purpose in this country, or dried for exportation to the East. Both the British species exist in the Mediterranean also. Six different species frequent the seas that wash the Cape of Good Hope, and there are at least two on the coasts of Japan and China. The only described species of *Pristiurus* is a Mediterranean one, but individuals sometimes stray northwards to the British Channel; and one procured by Mr Couch, at Polperro in Cornwall, is figured by Mr Yarrell under the appellation of the "Black-mouthed Dog-fish." It is known at Madeira as the "Leitao de Mar," but is considered to be extremely rare. The handsome *Hemiscyllia* are Australian, and the *Chiloscyllia* belong to the Indian Archipelago and Polynesia. The curious bearded *Crossorhynchus* frequents the seas of Japan as well as those of Australia, where it was first discovered, having thus a range extending over many parallels of latitude. *Ginglymostoma* has a representative in the Indian Ocean and Red Sea, and another on the coast of Cayenne, and *Stegostoma* belongs wholly to the Eastern seas. *Stegostoma fasciata* is one of the most beautiful of the order, and has been observed of the length of fourteen or fifteen feet, with a large and blunt head, and tapering body. A few years ago one of them followed for several hours a Liverpool East Indiaman off Madagascar. It was elegantly transversely banded with alternate whitish and dark brown or blackish fasciæ; and was further variegated by ocellated spots or rings on various parts of its body, which seemed to be about fourteen feet long. Its head appeared to be four and a half feet across, but the thickest part of its body did not seem more than two feet in diameter. It was accompanied by several Pilot-fish, which often swam before and returned towards it. Several attempts were made to catch it with large baits of fresh meat, but it never ventured to seize one of them. The lower jaw was distinctly visible whenever it opened its mouth, into which the accompanying fishes seemed to the spectators to enter and to leave at pleasure. The *Scylliide* generally have the parts about the nose and mouth more divided into cutaneous

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lobes and barbels, evidently as organs of touch, and in harmony with their habits as Ground Sharks. For they require some guide to keep them from grazing against the bottom in their rapid pursuit of their prey.

Under the appellation of true *Squali* (*Squales proprement dits*), Cuvier comprehended all the remaining Sharks except *Zygæna* and *Squatina*, which he characterized as distinct genera. His genus *Squalus*, therefore, included the *Carcharidæ*, *Galeidæ*, *Lamnidæ*, *Alopeciidæ*, *Rhinodontidæ*, and *Scymnidæ* of Müller. In Mr Owen's table, the *Spinacidæ*, *Lamnidæ*, *Alopeciidæ*, and *Scymnidæ* are separated from the *Squali* of Cuvier, and the remainder of that group are denominated, after Müller, *Nyctitantes*, which are chiefly, therefore, *Carcharidæ* and *Galeidæ*. The presence of a nictitating membrane to the eye is accompanied with a greater induration of the skeleton. This membrane, as it exists in *Galeus*, is superadded to a well developed circular palpebral fold of the skin. A superficial membrane or conjunctiva is reflected from the circular eyelid over the third eyelid, which is placed on the nasal side of the orbit. The third or nictitating eyelid is raised, and the upper part of the circular one depressed at the same time by muscular action when the fish wishes to close the eye. In our arrangement of the genera, we have generally followed the *Plagiostomen* of Müller and Henle, whose generic characters we have abridged, not having access at present to Müller's later works.

The CARCHARIDÆ are armed with teeth which, by their arrangement in a linear series, make a sharp saw, each tooth in the majority of species being also serrated on the edge. The common form of the upper teeth is that of the tip of a lancet, frequently oblique, one shoulder of the lancet being more curved than the other. The teeth of the lower jaw are either similar to the upper ones, or have narrower cusps, according to the species. Each jaw supports several rows of teeth, the anterior row on the edge of the jaw being erected for use, and the posterior ones lying flat in the hollow of the cartilage, and coming forward in succession as they are required by the decay and loss of the front ones. No animal possesses a more perfect incisorial apparatus than these massive but powerfully active tyrants of the deep. They have been known to divide the body of a man in two at one bite, as if by the sweep of a sword, and we once had an opportunity of observing how clean a cut a Shark's jaws were capable of making. A piece of salt-beef weighing about 14 lbs. was hanging over a ship's stern, suspended by a strong cord in a net of sinnet. Sinnet is the sea term for a flat plait of rope yarns, more pliable but equally strong with rope containing the same quantity of material, and, from its looseness of texture, capable of stretching more, and less easily cut. In this instance, the sinnet forming the meshes of the net was of the wideness of two fingers' breadth. The beef just dipped below the surface of the water or rose above it, as the ship's stern rose and fell with the gentle swell of a tropical sea. Suddenly a Shark came up from the deep, and before the spectators could raise the beef on which a hungry party hoped to make a dinner, the monster turned his mouth gently upwards, and, without plunge or struggle, carried off the beef and half the net to the depths into which he immediately descended. The sinnet was cut evenly across as if with a razor. Had it been torn by the mere weight of the fish, the rope yarns would have hung out of unequal lengths, and the seamen considered that on exposure to a simple strain, the rope by which the net was suspended would have broken long before the net itself gave way. A Shark killed near Marseilles, is alleged to have had the entire body of a man and several fish in its stomach; and one captured off Santa Margareta is said to have contained the carcass of a horse. Its weight was 1500 pounds. The cartilaginous jaws of Sharks shrink at least a third in drying, and cannot, as they lose their moisture, be kept at full stretch without tearing, yet specimens are not very rare in museums which

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may be split over a stout man easily. The widest jaws usually met with are those of *Carcharias*, *Oxyrhina*, *Selache*, and *Odontaspis*.

Of the GALEIDÆ, or *Topes* and *Hounds*, we have two British examples, one the *Galeus canis*, named by the fishermen of different localities "Penny-dog" and "Miller's Dog," but more generally the "Tope," an appellation which Ardeï says is Cornish. *Galeocerdo arcticus* is a northern species that frequents the seas of Ferøe, Iceland, and Norway; another species of the same genus inhabits the Indian Ocean. The *Mustelus lævis*, or *vulgaris* of Müller and Henle, is frequent enough on the British coast. Its flat pavement-like teeth indicate crustaceans as its chief food, which they are adapted for crushing. It gives less trouble to the fishermen than the other Ground Sharks, which are constantly taking his bait or driving away the fishes he is desirous of catching. Its rich diet improves the quality of its flesh, which is considered in the Orkneys to be more delicate than that of the Sea-dogs or *Scyllii*.

LAMNIDÆ. Of this family the *Lamna cornubica*, so well known on the southern coast of England, and the only member of its own genus, is an example. It is, from its size and its dentition, the most formidable of the Sharks of common occurrence in the English Channel. One caught in 1834, off the coast of Caithness, and now in the College Museum of Edinburgh, measured eight and a half feet in length and four feet eight inches in circumference. Its teeth are upwards of an inch in length, flatly compressed, thin-edged, but not serrated; in outline each tooth is triangular, and the older teeth have one toothlet sometimes at the base on each side. In the upper jaw, the tooth which follows the first two is smaller than them or than the one which succeeds it. In *Oxyrhina* the teeth near the symphysis are long and strong, like spike-nails, tapering to a point and slightly curved; anteriorly they are flat, and posteriorly convex. They are the most formidable-looking teeth that any of the existing Sharks possess, but are calculated rather for holding and tearing their victims than for sawing or cutting. *Selache maxima* is a northern species that frequents the Greenland and Spitzbergen seas, and descends in the summer to the coasts of New Jersey on the American side, and to the British Channel on the European side of the Atlantic. The teeth are comparatively small, and the habits of the fish, as far as known, are not remarkable for rapacity. In the numerous instances in which it has been captured on the coast of Scotland, nothing has ever been found in its stomach but fragments of sea-weed. It attains a large size, growing to thirty-six feet or more, but it is indolent and not very sensible to slight wounds. It is often seen lying on the surface of the water with its dorsal fin raised in the air, whence it has obtained the names of Sail-fish, Sun-fish, and Basking Shark. While thus reposing, it may be easily approached by a boat and harpooned. It enters the bays on the northern shores of Great Britain in the months of June and July, sometimes in numbers but more commonly in pairs, and retires on the approach of cold weather. It is a profitable capture, since eight barrels of fine oil have been procured from the liver of a full-grown fish. Sir Everard Home described much of the anatomy of this fish, with the help of Mr Clift who was the operator, but Sir Everard was mistaken when he referred the supposed Sea-snake, driven on shore in the Orkneys in 1808, to be this species. The enormous length of the Orkney animal, the smallness of its head and of the adjoining vertebræ, still preserved in the Museum of Edinburgh University, prove it to have been some great cartilaginous fish yet to be made properly known to naturalists. The parts that were saved were described by Dr Barclay in the *Transactions of the Wernerian Society*.

The *Alopias vulpes* is distinguished from the rest of the sub-order by the extreme length of the upper lobe of

its tail, exceeding that of the body. It is from the resemblance of this fin to the long brush of a fox, that Mr Yarrell ascribes the origin of its appellation of Sea-Fox, a name by which Aristotle makes mention of it, and which has been handed down to us by Ælian and Pliny. It generally receives the name of "Thresher" from seamen, on account of its attacking the whale, and striking it violent blows with its tail. Mr Yarrell (i., p. 144) gives a lively account of a combat of this kind, in which a party of Threshers, assisted by a Sword-fish, had nearly mastered a whale when the observer lost sight of them. The species attains the length of at least fifteen feet; but its jaws are not constructed for swallowing a prey equal in bulk to that which a *Carcharias* of equal length would engulf.

CESTRACIONS. This family contains only two species, and perhaps only one, for the difference between the *Cestracion zebra* of Japan and the *Cestracion Phillipi* of the Australian seas, hitherto ascertained, are chiefly those of patterns of colour, which are certainly very dissimilar in fishes taken in the two localities. Müller and Henle considered them to be mere varieties of one species, and it is to be wished that some competent ichthyologist who has an opportunity of seeing recent specimens from both places, would strictly compare one with the other. The genus is one of much interest to geologists, as the fossil teeth of Cestracions are of older date than those of any other existing genus of fishes. The *Cestracion* received the name of the "Nurse" in Australia, and the Chinese call it "Cat-Shark" or "Kitten-Shark." Specimens of the young are often found in the Canton insect-boxes.

Hexanchus griseus, one of the *Notidanidæ*, inhabits the Mediterranean Sea, but occasionally strays to the English shores. The British Museum possesses one taken off the Isle of Wight.

The *Acanthias vulgaris*, the spined Dog-fish, is another of the Sharks that is confined to no one district of the ocean. It is found on both sides of the Atlantic, N. and S., in the Mediterranean, and in the South seas. It is very common in the British seas; and, according to Mr Couch, as quoted by Yarrell, sometimes occurs in almost incredible numbers, 20,000 having been taken in a sea, at one time, on the coast of Cornwall. It does much injury to the fishermen by cutting their lines and carrying off their hooks.

The Hammer-headed Sharks, *Zygæna* or *Sphyrnæ*, are very plentiful in the Bight of Benin, and are considered to be more blindly voracious than others, and therefore more dangerous. They may be often seen ascending from the clear blue depths of the ocean like a great cloud. The extraordinarily elongated orbits are flexible in the early stage of the fish's development, and in the fœtus are doubled in upon themselves, so that the head occupies less than half the space it would otherwise do; neither does the head attain its final shape till the fish is grown to a considerable size. These fœtal specimens, from their convenient size, of a foot in length or so, are the most common in museums, and have given rise to some misapprehension respecting the true shape of the head of the adult fish; and as the transverse distance between the eyes becomes proportionally greater with the age of the fish, several nominal species have been introduced into our lists. M. Valenciennes (*Mem. du Mus.* ix.), in a dissertation on this genus, has given the forms of the heads of several; and in the Supplement to Mr Yarrell's *British Fishes*, an outline of the head of a young specimen of *Sphyrna Blochii*, copied from M. Valenciennes, and one of an older fish captured by Dr Cantor, are placed side by side, and show well the remarkable change of form which age produces, for *Sph. Blochii* and *laticeps* are the same species. A female *Sph. Zygæna*, measuring nearly eleven feet, examined by the active naturalist just named at Penang, contained thirty-seven living young. This species is almost cosmopolitan, having been taken in the

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English Channel, or both sides of the Atlantic, in the Mediterranean, Bay of Bengal, Indian Archipelago, and seas of Australia, China, and Japan. We have transferred the family of *Zygenidae*, from its place after the *Carcharidae* in Müller and Henle's *Plagiostomen*, to the neighbourhood of the *Squatinae*, where it stands in Owen's table.

ORDER XI.—PLAGIOSTOMI.

Endo-skeleton cartilaginous or partially ossified; exo-skeleton placoid. Gills with five or more apertures. No swim-bladder. Scapular arch detached from the head. Ventrals abdominal; intestine with spiral valve. *Copula gaudent*.

SUB-ORDER I.—SQUALI.

Plagiostomi, with lateral gill-openings. Free supplementary eyelids; incomplete scapular arch; and no naso-pectoral cartilage.

ANALYTICAL TABLE OF THE *SQUALI* (Dum.)

<i>Pectorals not notched.</i>	
Head short, obtuse; teeth tricuspid; gill-openings over pectorals	} SCYLLIUM.
Spout-holes none.	
<i>Forehead abnormal, wide, eyes laterally stilted....</i>	ZYGENA.
<i>Forehead of the usual squaloid form.</i>	
Gill-openings before the pectorals.....	LAMNA.
Gill-openings over the pectorals.....	CARCHARIAS.
<i>Spout-holes present.</i>	
<i>Teeth serrated, denticulated.</i>	
Dorsals two.....	GALEUS.
Dorsal solitary.....	NOTIDANUS.
<i>Teeth not denticulated.</i>	
<i>Teeth flat.</i>	
<i>Anal distinct.</i>	
Dorsal pointed	MUSTELUS.
Dorsal rounded	CESTRACION.
<i>Anal wanting; dorsals with spines.....</i>	SPINAX.
<i>Teeth not flat.</i>	
<i>Teeth trenchant.</i>	
Dorsals with spines.....	CENTRINA.
Dorsals without spines	SCYMNUS.
<i>Teeth conical, pointed, very numerous.....</i>	SELACHE.
<i>Pectorals notched in front, affording space for the gill-openings.....</i>	} SQUATINA.

(A.) *Sharks, with an anal fin, and the dorsals far back; the first being behind the ventrals.*

FAMILY I.—SCYLLIIDÆ.

Scyllia, Müll. and Henle. Spout-holes. No nictitating membrane. Five gill-openings, the last one over the base of the pectoral fin. A furrow at the corner of the mouth; an upper and under labial cartilage. Teeth with a pointed medial cusp, and four or five radical toothlets on either side. Caudal longitudinally extended, truncated or rounded at the end, with or without a trace of an under lobe, but having a notch on the under side near the end; no caudal pit; oviparous. Eggs resembling those of a Skate; intestinal valve spiral.

GENUS I. SCYLLIUM, Müll. and Henle. First dorsal between the ventrals and anal; the second between the anal and caudal. Spout-holes close behind the eyes. Gill-openings equidistant, the last pair over the pectoral. Snout short, blunt; nostril near the mouth, connected with it by a furrow, and having a valve. Dermal ossicles or scales tricuspid. Eleven species.

GENUS II. PRISTIURUS, Bonap. *Scyllia*, but with an elongated snout. Upper edge of the caudal serrated by a row of flat spinelets; a trace of an under caudal lobe; second dorsal over the end of the anal. Eggs smooth as in *Scyllium*. One species.

GENUS III. HEMISCYLLIUM, Müll. and Henle. Nostrils reaching to within the mouth; nasal flaps distinct, outer one large, inner one with a barbel. Spout-holes large, longitudinal under the hinder half of the eyes. Gill-openings as in *Scyllium*. Both dorsals behind the ventrals and before the anal, which latter is close to the caudal; caudal notched, without an under lobe. Two species, *vide* fig. 11.

GENUS IV. CHILOSCYLLIUM, Müll. and Henle. A broad cutaneous under lip, with a transverse furrow behind it; the elongated under fold at the corner of the mouth attached in the middle. Teeth pointed, with one or two radical toothlets on each side. Spout-holes longitudinal, close behind the eyes. Fourth and fifth gill-openings close together. Dorsals placed as in *Hemiscyllium*. Six species.

Classification—
Sharks.

GENUS V. CROSSORHINUS, Müll. and Henle. Mouth large, nearer the end of the snout than in most Sharks. Head broad and flat; many cutaneous tags about the nasal flaps and sides of the head. Teeth trilobate. Spout-holes unusually long, beneath and somewhat behind the eyes. Gill-openings equidistant, decreasing in size from first to the last, which is over the pectoral. Dorsals between the ventrals and anal, the latter close to the caudal. One species.

GENUS VI. GINGLYMOSTOMA, Müll. and Henle. (*Nebrius*, Rüpp.) Snout blunt; a long barbel from the inner side of the nostrils; corner fold of the mouth divided by a deep transverse furrow, the under portion subdivided by a longitudinal furrow. Teeth very numerous, in ten successive rows, each having a simple rhomboidal base, a conical mesial point, and from two to four toothlets on each side. Fifth gill-opening almost concealed within the fourth. Spout-holes very small, directly behind the eyes. First dorsal over the ventrals; caudal very long, having a rudimentary under lobe; pectorals long. Two species.

GENUS VII. STEGOSTOMA, Müll. and Henle. Mouth small, quite transverse. Teeth small, tripartite. The skin between the nasal flaps wider than the flaps, and forming an outer upper lip. A stout barbel, formed by a prolongation of each nasal flap. Corner folds of the mouth short, with deep pits. Head depressed and rounded. Spout-holes perpendicular slits behind the eyes. Fifth gill-opening concealed within the fourth; the last three over the pectoral; caudal very long, almost of even height throughout, and notched as usual towards the end. One species.

(B.) *Sharks, with two dorsals and an anal; the first dorsal over the space between the pectorals and ventrals. A nictitating membrane. No spout-holes; the last two gill-openings over the pectoral.*

FAMILY II.—CARCHARIDÆ.

Carcharia, Müll. and Henle. Nostrils generally small, with a three-sided flap on their upper border. Pupil perpendicularly oval. Mouth boldly convex, with a small corner fold. Teeth compressed, triangular, with an entire or serrated cutting edge. Caudal always with a short under lobe, and a notch below near the end of the upper lobe. A pit above and below at the base of the tail. Intestinal valve rolled longitudinally, not spirally. Scales small. Skin smoothish.

GENUS I. CARCHARIAS, Müll. and Henle. Nostrils midway between the mouth and end of the depressed snout. Labial cartilages small or wanting. Yolk-bag connected with a kind of uterine placenta; oviduct smooth or villous.

Sub-Genus I. Scoliodon. A mesial tooth in the upper jaw, none in the lower one; cutting edges of the teeth entire, not serrated. Second dorsal over the anal or its hinder end. Tail-pits distinct. Upper and lower caudal lobes equal. Scales small, three-keeled. Oviduct villous. Three species.

Sub-Genus II. Physodon. Teeth like those of *Scoliodon*, but thicker and larger, and there are two small teeth on the mandible, opposed to the single mesial upper tooth. First back fin close before the ventrals, the second over the anal. One species.

Sub-Genus III. Aprion. Teeth not serrated; upper teeth straight or slightly inclined outwards; under ones straight, with a small point on a broader base. Three species.

Sub-Genus IV. Hypoprion. Base of the upper teeth strongly serrated or jagged on one or both sides; their cusps smooth; no serratures on the bases or points of the lower teeth. Two species.

Sub-Genus V. Prionodon. Teeth in one or both jaws finely serrated, oblique or straight, three-sided, or with a small cusp on a broad base; generally a solitary mesial under tooth. Oviduct smooth. Twenty species.

GENUS II. PRIONODON, Müll. and Henle. (*Leptocarias*, Smith.) Nasal flap broad or prolonged into a barbel. Orbits longitudinal. Corner folds of the mouth very small. Teeth of *Scyllia*, small and numerous, alike in both jaws. Second dorsal and anal opposite, or nearly so. Caudal as in *Carcharias*, or as in those *Scylliidae*, in which the under lobe is scarcely perceptible. Scales from three to seven keeled. Two species.

(C.) *Sharks, with two dorsals and an anal; first dorsal between the pectorals and ventrals. A nictitating membrane. Spout-holes. The last two gill-openings over the pectoral.*

FAMILY III.—GALEIDÆ.

Galei, Müll. and Henle. Nostrils, orbits, mouth, and its corner folds as in the *Carcharidae*, but with small labial cartilages. Spout-

Classification—
Sharks.

holes small, elongated or round. Teeth alike in both jaws, compressed, with cutting edges, and a cusp pointing obliquely outwards; edges smooth, or serrated on the outside or on both sides. Upper caudal lobe with one or two notches near its end. Tail-pits absent or present. Intestinal valve spiral, or rolled lengthways. Scales small, three-keeled, with a medial cusp.

GENUS I. GALEUS, Cuv. Spout-holes longish, half the length of the orbits behind the eyes; pupil round above, angular below. Teeth smooth on the inner edge, serrated on the outer one; cusp smooth, upright; mesial teeth straight, jagged at the base on both sides, and as large as the others. No tail-pits. A notch on the upper caudal lobe. Intestinal valve spiral. Two species.

GENUS II. GALEOCERDO, Müll. and Henle. Spout-holes very small, half the length of the orbits behind the eyes; pupils as in *Galeus*. Corner-pits of the mouth and labial cartilages indistinct. Teeth denticulated on both edges; outer edge prolonged in form of a coarsely jagged base; a single mesial tooth on both jaws, with the point turned to a side. Upper caudal lobe long and pointed; two notches on the under caudal border, one of them at the end of the spine. A tail-pit above and below. Gut-valve rolled lengthways. Two species.

GENUS III. LOXODON, Müll. and Henle. Pupil round. Teeth alike in both jaws, oblique-edged, not serrated, basal projection on the outside also entire; a mesial tooth in the upper jaw, none in the lower one. Spout-holes small, close behind the eyes. Tail-pits above and below. A single notch in the upper caudal lobe. One species.

GENUS IV. THALASSORHINUS, Valenciennes. Pupil perpendicularly oval. Nasal flap very short. Teeth triangular, without a serrated basal ledge. Spout-holes pretty large. Tail-fin as in *Carcharias*, with a single notch; tail-pits above and below conspicuous. Intestinal valve rolled lengthways. Two species.

GENUS V. TRIAKIS, Müll. and Henle. Head flat, blunt. Nasal flap broad, moderately long; large pits at the corners of the mouth. Labial cartilages. Spout-holes of medium size. Teeth and fins as in *Scyllia*. Under caudal lobe indistinct. Tail-pits wanting. Scales three-keeled and three-pronged. One species.

GENUS VI. MUSTELUS, Artdi. Large spout-holes. Long orbits. Nictitating membrane puffed out from the under eyelid. Teeth pavement-like, flat, without cusp or cutting edge, resembling those of the *Rays*. Labial cartilages at the corners of the mouth, and also deep pits. Nostril bordered above by a three-sided cutaneous lobe with a rounded tip and a short blunt lobule on the outside. First dorsal nearly in the middle between the pectorals and ventrals; caudal short. Tail-pits indistinct. Intestinal valve spiral. One species.

(D.) *Sharks, with two dorsals and an anal; the first dorsal over the space between the pectorals and ventrals. Spout-holes, but no nictitating membrane.*

FAMILY IV.—LAMNIDÆ.

LAMNÆ, Müll. and Henle. Gill-openings large, all anterior to the pectorals. Second dorsal and anal roundish, of equal size, and opposite to one another. Tail-pits evident. Caudal crescentic. Tail keeled on the sides. Spout-holes very small. Intestinal valve spiral.

GENUS I. LAMNA, Cuv. Snout a pointed three-sided pyramid; nasal flap short, three-sided. Spout-holes very small, far behind the eyes. Teeth compressed, not serrated, triangular, with an acute basal toothlet on each side of the older ones; surface of the base that rests on the jaw deeply concave; in place of mesial teeth, a vacant space above and below. Skin smooth. Scales very small. One species.

GENUS II. OXYRHINA, Agass. Snout, spout-holes, and fins of *Lamna*. Teeth very thick, narrow and long, nail-shaped, curved, without basal toothlets; each tooth flat before, convex behind, diminishing rapidly in size towards the corner of the mouth, and double rooted with a deep notch between the roots; a vacant medial space on both jaws, and the third tooth of the upper jaw smaller than its neighbours. Three species.

GENUS III. CARCHARODON, Müll. and Henle. Snout, position of fins and spout-holes, as in *Oxyrhina*. Teeth of *Carcharias*, but straight, equilateral, and without a basal ledge; no mesial tooth; the third upper tooth is a little smaller than the adjoining ones. One species.

GENUS IV. SELACHE, Cuv. Snout short, blunt; spiracles small. Gill-openings very large, nearly meeting on the throat. Teeth very small and numerous, conical, without toothlets or lateral notches, curved backwards. Scales small, with radiating curved points, so that the skin feels rough to the finger drawn over it in any direction. One species. *S. maxima*.

Classification—
Sharks.

GENUS V. ODONTASPIS, Agass. (*Triglochis*, Müll. and Henle.) Gill-openings large, wholly before the pectorals. Spout-holes very small. Transverse folds on the throat; a stout triangular flap above the nostril; no upper corner fold to the mouth. Second dorsal and anal large; upper caudal lobe elongated as in *Carcharias*. Tail-pits indistinct or wanting. Fore teeth very long, conical, simple, or with one or more very sharp basal toothlets; towards the corners of the mouth the upper teeth are more incisorial and diminish rapidly in size; the under teeth are similar in form; roots of the tooth divided into two branches by a middle hollow. Second dorsal over the space between the ventrals and anal. Scales three-keeled, the keels ending in sharp points. Two species.

FAMILY V.—ALOPECIIDÆ, Müll. and Henle.

Snout short and conical; spout-holes very small; nostrils small with a short superior flap; no labial cartilages. Gill-openings small as in *Carcharias*; the last one over the pectoral. Teeth compressed, not serrated on their cutting edges, alike in both jaws; no tooth on the mesial line; a smooth crescentic fold of skin behind the upper teeth. Second dorsal opposite to the anal, very small; pectorals falcate; upper caudal lobe very long, with a pit at its root. Scales small, three-pronged. Intestinal valve spiral.

GENUS I. ALOPECIAS, Müll. and Henle. (*Alopias*, Rafin.) Teeth having the outline of a sharp isosceles triangle in both jaws. Upper lobe of the tail as long as the body. One species, *A. vulpes*.

FAMILY VI.—CESTRACIONTIDÆ.

CESTRACIONTES, Müll. and Henle. Mouth at the fore end of the snout. Nostrils slit to within the mouth. Spout-holes distinctly visible, rather behind the eye. Gill-openings small, the last one above the pectorals; a spine forming the front of each dorsal. Tail short; its upper lobe notched underneath. Pavement-like teeth in rounded oblique scrolls, like the spines of some univalves.

GENUS I. CESTRACION, Cuv. Caudal wide, and strongly notched below. Two species, Pacific Ocean, from Japan to Australia.

FAMILY VII.—RHINODONTIDÆ, Müll. and Henle.

RHINODONTES, Müll. and Henle. Head flat. Mouth and nostrils at its extremity; nasal flap triangular. Teeth extremely small, and very numerous, card-like, conical. Spout-holes very small. Gill-openings diminishing in size as they recede from the head; the last one above the pectoral. Caudal crescentic, its upper lobe notched. Lateral keels on the keel and pits. Intestinal valve spiral.

GENUS I. RHINODON, Smith. One species.

(E.) *Sharks, with one anal and only one dorsal.*

FAMILY VIII.—NOTIDANIDÆ, Müll. and Henle.

Galei, without a first dorsal. Upper corner-fold of the mouth very large, under one small; no nictitating membrane. Spout-holes vertical, small. Six or seven gill-openings decreasing gradually in size, all before the pectorals. A mesial upper tooth; towards the corners of the mouth the teeth are low and flat; the others are triangular above, serrated below, the foremost ones crowded and curved. A small inferior caudal lobe, obliquely truncated and notched at the end. No tail-pits. Intestinal valve spiral.

GENUS I. HEXANCHUS, Rafin. Six gill-openings. One species.
GENUS II. HEPTANCHUS, Rafin. Seven gill-openings. Two species.

(F.) *Sharks, with spout-holes. Two dorsals; no anal; no nictitating membrane. Five gill-openings, all before the pectorals. Intestinal valve spiral.*

FAMILY IX.—SPINACIDÆ, Müll. and Henle.

Each dorsal fronted by a spine.

GENUS I. ACANTHIAS, Bonap. Head flat. Large pits at the corner of the mouth. Two labial cartilages. Mouth very flatly arched. Spout-holes large, behind and rather above the eyes, with a thick border springing from their fore edges; orbits long. Teeth on both jaws incisorial, the edge almost horizontal, with the point directed laterally, and the base keeled interiorly. First dorsal over the space between the pectorals and ventrals; second dorsal between the ventrals and caudal; upper caudal lobe the bigger one. An upper tail-pit in some. Male claspers tipped by a moveable spine. Scales heart-shaped, with a middle cusp and one or more keels. Four species.

Classification—
Sharks.

GENUS II. SPINAX, Bonap. Head arched. Snout blunt; nostrils at the extremity of the snout. Folds at the corner of the mouth very large, naked; under one encircling the under lip and uniting with its fellow; a labial cartilage at the upper corner of the mouth. Under teeth as in *Acanthias*, but without keel and basal apophysis; upper teeth as in *Scyllium*, but with a longer, straight, conical, mesial cusp, and two pointed lateral toothlets on each side. No tail-pits. Claspers not furnished with a prickle. Curved hairs in place of scales. One species.

GENUS III. CENTRINA, Cuv. Snout short, thick, and flat, with the nostrils near its edge; nasal flap quadrilateral. Fold at the corner of the mouth naked, blending on the mesial line with the rest of the integument. Spout-holes very large, behind and somewhat above the eyes, vertical, and crescentic, with a single flap. Upper teeth slender, conical, straight, and feebly incisorial, connected with the integument of the front of the jaw, and notched in the middle of their base; under teeth very nearly straight, broader and flatter than the upper ones, keenly cutting, sub-equilateral and finely serrated, with their bases nearly quadrangular; mesial tooth single, perfectly equilateral. Dorsal spines enveloped in skin to their points; no under caudal lobe and no notch. Male claspers soft, spineless. Scales consisting of an upright cusp on a quadrangular base. One species.

GENUS IV. CENTROPHORUS, Müll. and Henle. Head flat. Nostrils near the end of the snout. Folds at the corner of the mouth naked, large, and deep, with a slit running backwards from them. Spout-holes behind and above the eyes, furnished with a flap. Fourth and fifth gill-openings near each other. Teeth of the under jaw as in *Acanthias*, and either serrated or entire; their roots a middle upright keel with a transverse exterior lobe; upper teeth straight, equilateral with quadrangular bases traversed by two crossing keels, no denticulations, no accessory prongs or toothlets; no mesial tooth. No tail-pits. Male claspers with an exterior prickle near their tips. Two species.

GENUS V. CENTROSCYLLIUM, Müll. and Henle. Upper and under teeth similar, straight, pointed with one or two lateral cusps or toothlets, as in *Scyllium*. Distinguished from *Spinax* by the teeth being alike in both jaws. Scales pointed, with a stellate base. One species.

FAMILY X.—SCYMNIDÆ, Müll. and Henle.

Scymni, Müll. and Henle. Dorsal fins without spines. Upper teeth pointed; lower ones trenchant, not denticulated. No tail-pits.

GENUS I. SCYMNUS, Cuv. Head either flat, or compressed on the sides. Spout-holes far behind the eyes. Teeth of the upper jaw upright, curved; under teeth broader, with an upright or an inclined edge. Gill-openings small. No tail-pits.

Sub-Genus I. *Scymnus*, with lancet-shaped under teeth, convex anteriorly, sharp on the sides, rising from a high base; the mesial tooth below as large as the others, and a bilobed root longer than the cusp; upper teeth standing straight forwards, with their sides inclined outwards. Claspers without a prickle. Two species.

Sub-Genus II. *Læmargus*, Müll. and Henle. Upper teeth small, longer than wide, conical, feebly incisorial, without serratures; an upright anterior keel, and a notched base; under teeth broader and longer, with a recumbent edge as in *Acanthias*, no serratures; and a long flat root, concave lengthways, and keeled perpendicularly anteriorly. Male claspers with a prickle. Three species.

GENUS II. ECHINORHINUS, Blain. *Goniodus*, Agass. Head flat; corner-pits of the mouth widely apart. Teeth broad and low, with a nearly horizontal edge; on the lateral edge, from one to three small cusps or toothlets; a space at the symphysis of the under jaw, with a very small mesial tooth in its centre. First dorsal over the ventrals; no under caudal lobe. Gill-openings not wide, all before the pectorals. One species.

GENUS III. PRISTIOPHORUS, Müll. and Henle. Separated from *Pristis* by the want of a naso-pectoral cartilage, the posterior wall of the nose being in this genus formed by the skull itself. Snout greatly elongated, beset on both sides with spines, attached to the skin only. A long barbel from the under surface of the snout. Mouth transverse. Teeth pavement-like, with a short mesial cusp, as in the male rays. First dorsal over the space between the pectorals and ventrals. Side of the snout keeled. Fourth and fifth gill-openings approximating. Two species.

FAMILY XI.—SQUATINIDÆ.

Squatina, Müll. and Henle. Body flat above and below. Mouth at the extremity of the snout. Eyes on the dorsal aspect. Spout-holes large, behind the eyes. Pectorals large, their expanded roots interposing between the head and body, but divided from them by a furrow, in which are situated the closely approximated gill-openings.

GENUS I. *Squatina*, Dum. Both dorsals on the tail, which is keeled on the sides. Male claspers small and weak. Scales conical, with a terminal point. Teeth conical, irregular, with interspaces. Two species.

Classification—
Sharks.

(G.) *Sharks, similar to those of division B, in having a nictitating membrane and no spout-holes, and in the position of the spineless dorsals; but with a lateral extension of the skull at the orbits, which is greatest in the adults.*

FAMILY XII.—ZYGÆNIDÆ.

Sharks, head flat, with the orbits largely extended latterly, and the snout truncated, or hammer-headed; a form of head not found in any other group of fishes.

GENUS I. ZYGÆNE, Cuv. (*Sphyrna*, Rafin.) *Sphyrnias* and *Sphyrna*, Rafin. Front of the head transverse to the ends of the lateral orbital extensions of the skull. Nostrils on the front border; nasal flap small, triangular on the inner edge of the nostril. Labial cartilages small. Teeth alike above and below, being a compressed pyramid, with an entire or serrated exterior basal ledge; a mesial tooth in both jaws. First dorsal near the pectorals; second one over the anal. Distinct tail-pits. Oviduct villous; yolk-bag connected to the sides of the ovisac. Four species.

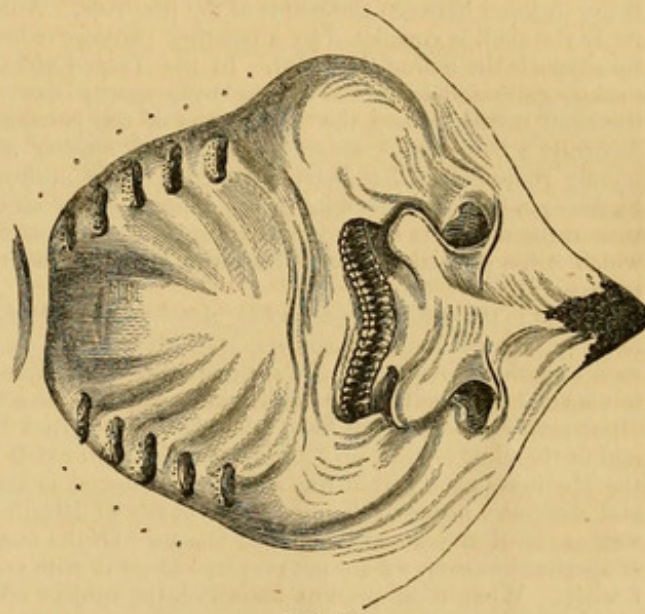


Fig. 136.
Head of *Raia Lemprieri*.

RAYS.

This sub-order, familiarly known by the name of Skates, has for the general character of its form the extreme depres-

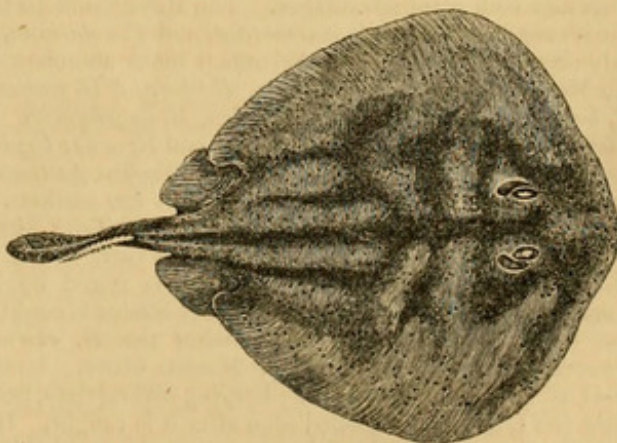


Fig. 137.
Urolophus ehippiatus, Australia.

sion of its body, and the lateral expansion of the pectoral

Classifica-
tion—
Rays.

fins forming a discoïd or subrhomboidal body, with an appended tail, which in the *Rhinobatidæ* is fleshy and tapering, and in the *Raiidæ*, *Trygonidæ*, and some other groups, is cartilaginous and slender, and sometimes elongated like the thong of a whip. In some a narrow lancet-shaped spine placed erect on the dorsal surface of this whip-like tail, with its cutting edges turned sideways, proves a dangerous offensive weapon, which the fish can use with great effect. The cartilaginous scapular arch is complete on the ventral surface, and running forwards at some distance, laterally from the skull in a crescentic tapering point, gives support to the long, jointed cartilaginous rays of the pectoral. In the space between the hinder horns of the scapulo-coracoid cartilages laterally, and the pelvic cartilages behind, lie the abdominal viscera; while the branchial apparatus and vascular centres occupy the posterior part of the spaces between the anterior cornua of the scapular arch and the narrow skull. On looking at the skeleton of a Skate, it will be seen that the skull is comparatively narrow; that the cartilages supporting the branchial apparatus stand out like wings behind, and those on which the eyes are placed also project laterally, exactly like the prominent orbits of the *Zygæna*, but that this lateral prominence is concealed in the entire Skate by being inclosed between the points of the pectorals. Anteriorly the skull is completed by a tapering cartilage whose tip supports the end of the snout. In the *Torpedinidæ*, a cellular galvanic battery fills up the wide spaces between the skull cartilages and the front horns of the pectorals. Recently a homologous apparatus, but much smaller and merely rudimentary, has been discovered in the ordinary Skates—an indication seemingly of a general plan of structure in the members of the group, irrespective of function, which it has pleased the Great Architect of the Universe to give.

Except in the genera *Anacanthus*, *Aëtobates*, and *Myliobates*, we are not aware of any species of Ray that is common to both the Atlantic and Pacific districts of the ocean, but several exist both in the Mediterranean and North seas. *Anacanthus africanus* has been taken both in the Red Sea and in the Gulf of Guinea. *Myliobates Nieuhoffii* exists in the Mediterranean, and in the Indian and Australian seas, and *Aëtobates narinari* frequents the coasts of Brazil, as well as the Red Sea and the Indian Ocean. Of the range of species, however, we are not prepared to speak with confidence. What is at present known on the subject rests chiefly on specimens in the European museums, examined by Müller and Henle, whose work on the *Plagiostomi* is the only one professing to include all the known species. The great advances that ichthyology has made since the publication of that work, and the attention now paid to anatomical structure in the definitions of species, will enable future ichthyologists to enter on the inquiry of distribution of species with great advantages. The Rays found on the British coasts are *Torpedo marmorata*, and *T. nobiliana*, of only occasional occurrence, and much more abundant in the Mediterranean; *Raia radula*, *R. clavata*, *R. radiata*, *R. batis*, *R. marginata*, *R. fullonica*, *R. oxyrincha*, *R. microcellata*, *R. intermedia*, *R. linteata*, and *R. acus*; *Cephaloptera Giorna*, *Myliobatis aquila*, and *Trygon pastinaca*. Some of these are of daily occurrence in our markets, as the *R. batis*, Blue or Grey Skate, Tinker or True Skate. The *R. oxyrincha* (L.), or *miraleta* (Yarr. Ed. 2^{da}), Homelyn, Spotted Ray, or Sand Ray, is stated by Mr Yarrell to be one of the two commonest Skates brought to the London market; the other being the *R. clavata*, Thornback, Young Maidens, or Maiden Skate. Unlike most fish, the Skate improves by keeping several days, being hard and tough when cooked soon after it is caught. It is one of the fish that the fishmongers are in the habit of crimping. Figure 7, p. 123, represents the *Raia Lemprieri*, an Australian Skate, which somewhat resembles the Ho-

melyn of our own coasts in general form, and fig. 136 shows the under surface of its head.

Classifica-
tion—
Rays.

Some of the *Cephalopteridæ* attain an enormous size. One mentioned by Risso, taken off Messina, weighed 1250 lbs.; the male is usually the smallest. Of a pair spoken of by this author, the female was first taken, and the male remained hovering about the boat for three days, and was afterwards found floating dead on the surface. But the size here spoken of is greatly surpassed by other fishes of this order, which have been but imperfectly described, such as the *Raia Banksii* of Lacépède, referred with doubt to the genus *Ceratoptera* by Müller and Henle. A fish of this kind taken at Barbadoes required seven yoke of oxen to draw it. A sketch of another, which was said to be 20 feet long, was sent to Lacépède; and Levaillant, in his second voyage to Africa, speaks of one which swam round the vessel, and appeared to be about 25 feet long and 30 wide. Sonnini also mentions one which seemed to him to be longer and wider than the ship in which he was sailing.

The *Torpedinidæ* all possess electric organs, and it is the space occupied by these batteries that gives the round or truncated outline to the fore part of the fish. The batteries lie one on each side of the head, bounded behind by the scapular arch, and laterally by the anterior crescentic tips of the pectoral fins. They consist of a congeries of vertical prisms, whose ends are in contact with the integuments above and below; and each prism is subdivided by delicate transverse septa, forming cells which contain a fluid, and are lined within by an epithelium of nucleated corpuscles. Between this epithelium and the transverse plates and walls of the prism, there is a layer of tissue, on which the extreme twigs of the nerves and vessels ramify. Hunter counted 470 prisms in each battery of the *Torpedo galvani*, and demonstrated the enormous supply of nervous matter which they receive. Each organ receives one branch of the trigeminal nerve, and four branches of the vagal nerve, the former and the three anterior branches of the latter being each as thick as the spinal chord. The fish gives the electric shock voluntarily, when excited to do so in self-defence, or when roused to kill its prey; but to receive the shock the object must complete the galvanic circuit by communicating with the *Torpedo* at two distinct points, either directly or through the medium of some conducting body. The shock received on handling the fish is described as too strong to be willingly encountered a second time, and it is said that a painful sensation may be produced by a discharge conveyed through the medium of a stream of water.

SUB-ORDER II.—RAIÆ.

Plagiostomi, with flat bodies, spout-holes. Five slit-like gill-openings on the ventral aspect before the ventrals and under the pectorals. Eyes and spout-holes on the dorsal aspect. A complete scapular arch. Naso-pectoral cartilages. No eyelid, or an adnate upper one only.

ANALYTICAL TABLE OF THE RAIÆ (Dum.)

Tail long, and	
Very thick at the root.	
Snout prolonged.	
Set laterally with teeth.....	PRISTIS.
With even, thin, smooth edges.....	RHINOBATES.
Snout rounded, smooth.....	RBINA.
Slender	
Dorsals two, caudal; disk rhomboidal.....	RAJA.
Dorsal single or wanting.	
Eyes on the dorsal aspect.	
Teeth small; tail spiniferous.....	TRYGON.
Teeth broad, flat, grinders.....	MYLIOBATES.
Eyes lateral; head truncated, horned.....	CEPHALOPTERUS.
Tail short; body smooth; electric organs visible.....	TORPEDO.

Classification—
Rays.

FAMILY I.—PRISTIDÆ.

Pristides, Müll. and Henle. Form of Sharks, with the gill-openings on the ventral surface as in the Rays; characterized by a long flat narrow snout, set on the sides with strong bony spines, or teeth forming a saw, with two edges; true jaw-teeth like those of *Mustelus*.

GENUS I. PRISTIS. (*Pristibatis*, Blain.) Six species.

FAMILY II.—RHINOBATIDÆ.

Rhina, Müll. and Henle. Of an intermediate form between the typical Rays and the Sharks. Fore part of the body forming a disk by the conjunction of the pectoral fins with the snout; pectoral fins quadrangular, divided from the proper head part of the disk by a furrow, and not reaching back to the ventrals. First dorsal over the ventrals; caudal bilobate; upper lobe a little larger; the keels of the sides continued along the caudal fin. Margins of the mouth undulated; three protuberances of the under jaw fitting corresponding incurvations of the upper one. Nostrils longitudinal near the mouth, with flaps.

GENUS I. RHINA, Bloch, Schneid. Snout broad, rounded. Spout-holes close behind the eyes. Nasal flaps reaching to the inner corner of the nostril. Undulations of the jaws bold. Teeth almost round, not broader than long. One species.

GENUS II. RHYNOBATES, Müll. and Henle. Snout pointed, with a mesial tapering keel. Spout-holes close behind the eyes; nasal flaps not reaching to the inner corner of the nostril, but only halfway. Undulations of the jaws feeble. Teeth broader than long. A transverse curved row of pores on the ventral aspect of the scapular arch. One species.

GENUS III. RHINOBATUS, Bloch, Schneid. Pectorals blending imperceptibly with the sides of the snout; the space between them and the skull cutaneous. Both dorsals on the hinder part of the tail; ventrals longer than the head, rounded before, pointed behind; no under caudal lobe. Mouth transverse, straight, or gently curved. Teeth pavement-like, with a transverse ridge more or less acute. Spout-holes close behind the eyes. A row of pores on the scapular girdle. Two sub-genera, *Syrrhina* and *Rhinobatus*, varying in the extent of the nostril flaps. Eighteen species.

GENUS IV. TRYGNORHINA, Müll. and Henle. *Rhinobati*, but the nasal flaps uniting with one another to form a single flap, which hangs over the mouth as in *Trygon*, leaving a round nasal aperture on each side. Upper eyelid adnate, crescentic; fore margin of the disk with a single incurvature. One species.

GENUS V. PLATYRHINA, Müll. and Henle. Pectorals approaching one another at the point of the snout, and inclosing the front of the skull. Tail more slender than in the other *Rhinobatidæ*. All the fins rounded. Upper nasal flap triangular, extending above the inner angle of the nostril. Upper eyelid as in *Rhinobatus*. No raised edge at the spout-holes. Two species.

FAMILY III.—TORPEDINIDÆ.

Les Torpilles, Cuv.; *Torpedines*, Müll. and Henle. Tail short, less thick and fleshy than in the *Rhinobatidæ*, depressed, towards the end cylindrical, keeled on the sides. Disk naked, rounded, without scales or prickles. Ventrals immediately behind the pectorals; dorsals none, or one or two on the tail; caudal sub-triangular. Upper eyelid adnate. A quadrilateral flap, with a free edge between the nostrils, furnishing folds which embrace all the nostril except its lateral corner; the flap is connected to the upper lip by a bridle. Teeth pointed or flat. A galvanic battery occupying the space bounded by the skull, gills, and pectorals. Teeth flat or cuspidate.

GENUS I. TORPEDO, Dum. (*Narcobatis*, Blain.) Two dorsals. Disk rounded, anteriorly truncated evenly or with a slight incurvature. Mouth crescentic. Teeth pointed, attached to a jaw cartilage, and not extending outwards beyond the margin of the lips; base of each tooth widest transversely. Spout-holes at a distance from the eyes, with a cuticular fringe round the orifice. First dorsal bigger than the second one, and situated over the hinder part of the ventrals; caudal triangular with a straight terminal edge. Four species.

GENUS II. NARCINE, Henle. Two dorsals. Disk roundish, elliptical or angular, rounded in front. Mouth small, surrounded by a fold of skin which passes on the mesial line above into the bridle of the nasal flap; this flap is transverse, straight, or with a medial convexity, so as to become faintly three-lobed on the edge; a labial cartilage above and below. Teeth in quincuncial order, with a middle cusp, forming in the aggregate an elliptical plate, not adhering to the jaw, but moving with the skin; a velum within the upper jaw. Tail longer than the disk. Edges of the spout-holes not fringed. Five species.

GENUS III. ASTRAPE, Müll. and Henle. One dorsal. Snout short, without a keel. Mouth as in *Narcine*. A cylindrical carti-

Classification—
Rays.

lage in the bridle of the nasal flap. Cusps of the teeth on a quadrangular base; dental plate overpassing the border of the mouth a little; velum within the mouth, above and below. Spout-holes near the eyes, with smooth borders. Three species.

GENUS IV. TEMERA, Gray. No dorsal. Mouth, *vela*, and nostrils as in *Astrape*. Tail proportionally short. Spout-holes close behind the eyes, with smooth borders. Teeth flat. One species.

GENUS V. DISCOPYGE, Heck. Disk orbicular. Mouth transverse, with thick lips at the corners; upper jaw having a dental lamina, turning outwards, covered with minute teeth, in quincuncial order. Teeth flat, rhomboidal, their hinder angle acute. Nasal valve truncated, with a notched process in the middle; beneath joined by a bridle to the circle of the mouth. Spiracles adjacent to the eye, with naked borders. Ventrals united under the tail; dorsals two, equal; caudals obliquely ovate.

GENUS VI. HEMIGALEUS, Bleek. Temporal openings minute, triangular; pupil convex above, narrow beneath. Premaxillary teeth serrated on their outer edge, smooth internally; mandibular teeth slender, with a broad base not serrated. Conspicuous caudal furrows above and below. Valve of the great intestine rolled up longitudinally. Batavia. Two species.

GENUS VII. HYPNOS, Dum. Disk longish, somewhat notched in the middle of the front border. Spout-holes close to the eyes, surrounded by a wreath of long and numerous fringes. No labial cartilages. Mouth crescentic, not protractile. Pointed teeth on the edge of the jaws, whose whole length they occupy, but do not go beyond. Bridle of the nasal flap connected with the fore border of the upper lip. Tail extremely short.

FAMILY IV.—RAIIDÆ.

Disk broad, rhomboidal, the two sides which meet to form the lateral angle belonging to the pectoral fins; these are attached posteriorly, as far back as the root of the ventrals, and flank the point of the snout anteriorly; dorsals near the tip of the tail. Tail depressed, with a cuticular keel on the sides. Caudal wanting, or existing as a mere cuticular seam. Upper eyelid adnate. Spout-holes separated from the orbits by a slender cutaneous bridge, smooth-edged. Nasal flap confluent with the upper lip, forming an even surface, with a free rounded lobe on each side, that folds over the nasal aperture. Mouth curved, with its convexity towards the tip of the snout; no labial cartilages. Teeth of the males with a central cusp in spawning time; an upper velum only. Skin smooth, or studded with prickles pointed backwards, among which, chiefly on the dorsal ridge, and on the sides of the tail, there are often larger spines. In the males, sharp prickles are developed on the borders of the pectorals in the spawning season. Oviparous.

GENUS I. RAIA, Cuv. (*Dasybatis*, Blain.) Snout keeled, with the interior limits of the pectorals parallel to the keel, but separated from it by a cuticular space. Ventrals deeply notched behind, hence bilobate; anterior or outer lobe more narrow. Terminal caudal seam low, and more conspicuous above than below, generally interrupted at the point. Thirty species.

GENUS II. SYMPTEGYIA, Müll. and Henle. Pectoral fins uniting before the head and forming the point of the disk as in *Trygon*. Ventrals not notched, being merely undulated posteriorly; caudal as in *Raia*. One species.

GENUS III. URAPTERA, Müll. and Henle. Snout and ventrals of *Raia*; no caudal. One species.

FAMILY V.—TRYGNIDÆ.

Trygones, Müll. and Henle. Point of the disk formed by the pectorals. Upper eye-lid adnate. United nostril flaps free and fringed, but bound to the upper lip by a slender mesial bridle; nostrils closely approximated under the flap. Skull higher than in the Rays. Spout-holes large and close behind the eyes. Teeth transversely elliptical, with a ridge which is blunt, sharp, or cuspidate. Ventrals not notched. Tail slender, often whip-like, without lateral keels; naked, or bearing one or more barbed spines. No caudal. Skin smooth or tuberculated, or prickly. No prickles are developed on the pectorals of the males, as in the Rays.

GENUS I. ANACANTHUS, Ehrenb. No spine on the tail; which also wants a fin with rays, but is either naked or furnished with a cuticular seam merely. Two species.

GENUS II. TRYGN, Adan. (*Trygonobatus*, Blain.) Disk oval or rhomboidal. Tail equal in length to the body, or longer, bearing one or more spines without cuticular ridges, or with short ones merely, not reaching the point. Teeth cuspidate, or transversely ridged with cross furrows; upper velum deeply fringed with a second crescentic one behind; generally a papilla behind the under teeth. The species may be divided by the wholly finless condition of the tail, or the existence of a cuticular seam below, or of a seam above as well as below. Eighteen species.

Classification—
Rays.

GENUS III. PTEROPLATEA, Müll. and Henle. Disk nearly twice as broad as it is long. Tail for the most part shorter than the body, bearing one or more spines, with low cuticular seams, or quite naked. Mouth crescentic, with the dental plate reaching to its corners. Teeth having from one to three cusps; upper velum not fringed; no papillæ behind the under teeth. Skin smooth or tuberculated. Three species.

GENUS IV. TENIURA, Müll. and Henle. Disk roundish. Tail little longer than the body, depressed before the spine, which is near its middle, compressed posteriorly, with a high under-fin running from near the spine to the end, together with a shorter or longer cuticular hem above, also reaching the point. Nostrils approximating as in *Trygon*. Teeth with a transverse ridge or a cusp. Mouth straight or undulated. Upper velum straight. No papillæ below. Five species.

GENUS V. UROLOPHUS, Müll. and Henle. Disk roundish, egg-shaped or rhomboidal. Tail destitute of a dorsal, but with a caudal which has cartilaginous rays, and reaches further forwards below than above. Teeth and mouth as in *Trygon*; upper velum gently scalloped; under one with five warts. Four species.

GENUS VI. TRYGONOPTERA, Müll. and Henle. Tail short, broader at the end, with a small rayed dorsal immediately before the spine. Teeth rather acute. Disk as in *Trygon*. One species.

GENUS VII. AËTOPLATEA, Valenciennes. A *Pteroplatea*, except that it has a dorsal before the spine. One species.

FAMILY VI.—MYLIOBATIDÆ.

Head more elevated than in *Raia*, projecting as far as the gills, beyond the pectoral disk, having no fin-rays on its sides, but a kind of head fin is developed before the skull, making the point of the disk. Nasal flaps forming the sides of a quadrangular flap which reaches to the mouth, and is fringed posteriorly; nostrils separated by a thin fillet merely, which comes from both angles of the mouth over the quadrangular flap, and is slightly pointed in the middle. Mouth transverse; dental plates reaching far back in the cavity of the mouth. Teeth large like mosaic pavement, even; upper velum very long, with a convex border fringed in the middle; under velum close to the teeth, with only one papilla behind. Eyes and spout-holes in the sides of the skull; a broad bridge between the spout-holes and eyes. No eyelids. Tail long, whip-like; a dorsal fin on its root, and a spine behind the dorsal.

GENUS I. MYLIOBATES, Cuv. (*Aëtobates*, Blain.) Union of the antecephalic rays of the pectoral forming a pointed snout; nasal flaps joined by a straight-edged membrane. Mouth transverse. Teeth arranged in a mosaic pavement of long hexagonal plates in the middle, and two or three rows of short quadrangular or hexagonal pieces on the sides; on the upper jaw the dental surface is convex both longitudinally and transversely. Five species.

GENUS II. AËTOBATES, Müll. and Henle. Snout pointed, not notched; under edge of the coalescent nasal flaps deeply notched; the nasal bridle papillose. Upper jaw straight-edged; crowns of the teeth in rows; the dental plates not extending to the sides of the jaws. Two species.

GENUS III. RHINOPTERA, Kuhl. Snout deeply notched in the middle. The antecephalic fin in a lower plane to that of the pectoral, and joined to the inferior base of the latter. Nasal flap straight posteriorly; its lateral angles pointed. Jaws straight; teeth occupying the whole transverse breadth of the jaw, and forming from three to five rows of transversely long, antero-posterior narrow hexagonal plates, with smaller lateral ones as wide as they are long. Six species.

FAMILY VII.—CEPHALOPTERIDÆ.

Head straight transversely in front. The precephalic fins proceed from the under edge of the pectorals, and project like ears on the sides of the head, and curl upwards and inwards. Under edge of the coalescent nasal flap straight; nostrils near the precephalic fins, wide laterally. Teeth very small. Eyes on the sides of the skull immediately before the commencement of the pectorals. Spout-holes on the dorsal aspect, widely separated from the eyes. Tail as long, or longer than the body, bearing a dorsal fin, and behind it a spine.

GENUS I. CEPHALOPTERA, Dum. (*Dicerobatis*, Blain.) Mouth on the ventral aspect. Teeth of both jaws small, flat, pavement-like, of diverse forms. Pectoral fin prolonged forwards to a point beyond the truncated head, looking like a horn; the edge of the fin from this point to behind the eyes being convex. Four species.

GENUS II. CERATOPTERA, Müll. and Henle. Mouth at the end of the snout; upper jaw crescentic on the edge; under one convex; no teeth in the upper jaw; on the under jaw they are small and scale-like. Pectorals not passing the front of the head, a rayless space between the cephalic portion and the body of the fin; lateral

edge of the fin incurved at the head, and spreading outwards at the third gill-opening. Three species.

Classification—
Rays.

In our preceding compendious review of the class of fishes, we have, as already stated, taken as our almost exclusive authority, with regard to structure, Professor Richard Owen, late Curator of the Museum of the College of Surgeons of London, and now Zoological Superintendent of the British Museum. From his lectures delivered in 1844 and 1846 before the college our facts have been taken. The great *Histoire des Poissons* of Cuvier and Valenciennes, which closed with the 22d volume in 1849, has been our text-book for the characters of families and genera of most of the osseous fishes, as well as for the few remarks we have made on their species. Several families and groups of families not included in that work have been characterized by the labours of Dr Kaup of Darmstadt; and for our analysis of the *Plagiostomi*, we have taken for our sole text-book the treatise of Müller and Henle on that subject, published in 1838. Some other works of Johannes Müller that we wished much to consult, were not to be found in those public libraries to which we had access, and we have been unable therefore to give the latest views of that very distinguished physiologist. We could not within encyclopædic limits enter into the discussion of disputed points, or entertain questions respecting priority of names, and we therefore have with scarcely an exception adopted the generic names of the authorities we have mentioned, and also their family groups, occasionally, however, for the sake of uniformity changing the few terminations of the names of the latter into *idæ* where that had not been previously done, intending by such uniformity of termination to denote more readily the rank of the group in the system. The labour of clearing up the intricate synonyms that have crept into the science, is one of the greatest, and is certainly the most irksome, that the ichthyologist has to encounter, and one whose successful results are generally shown by the adoption of a single word, giving no indication to the uninitiated of the time, and research, and thought they have cost. It is, however, a labour that cannot be lightly passed by; for without a correct determination of the species the descriptions are useless or encumbering to science. Without such careful preliminary work no one can enter at all upon the subject of the geographical distribution of species. Yet that branch of ichthyology, no less than the habits of the species, is of vast importance to a maritime nation, desirous of extending her fisheries, and thereby increasing the supply of a most healthy and nourishing food for her teeming population, and raising new nurseries for seamen.

However desirous we may be of adding a few words on the geographical distribution of fish, the time has not yet arrived for enunciating many observed facts. There is as yet no general list of species comprising the whole class, and in local lists our conclusions are universally marred by the clashing of synonyms, and the superabundance of nominal species. A work, however, has been going on for some years, silently almost, and without attracting a title of the notice it deserves from scientific zoologists, but which, when completed, will supply exactly what is required. We mean the *Zoological Catalogues* of the British Museum, now in the course of publication in parts. The enlightened plan of this catalogue, as conceived by Dr John Gray, the keeper of the zoological department of the Museum, is to comprehend descriptions of all known species, of which specimens are to be found in any of the great European museums, with a comparison of the actual specimens in every instance in which that can be effected. In this way, not only are the species in the British Museum correctly named and pointed out, so as to relieve future inquirers of a load of labour; but the species not to be found in the Museum are also indicated. We know of no work on Natural History better planned, nor one that is likely to have

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more effect on the progress of Ichthyology. The Museum catalogues of the Serpentine Apodals, the Lemniscate Apodals, the *Mormyridæ* and *Balistide*, contain descriptions of a great many species, previously unknown to the world, and present comprehensive views of these groups nowhere else to be found. The generic and higher groups they characterize are embodied in our table. We cannot enter further on the bibliography of Ichthyology, and must refer the student to the *Bibliographia Zoologica*, published by the Ray Society, where he will find all that he wants in this respect.

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grations of the Swallows are no less extensive than those of the *Natatores*, and are as evidently designed to secure an appropriate succession of food. Every species has its proper range, that of some being of much greater extent both northwards and southwards than others. Of the Reptilian class, the algivorous Chelonians resort in numbers to certain solitary and sandy shores, for the purpose of depositing their eggs, but there is, as far as we know, no extensive migration of any member of that class in search of food. The *Pinnotheres*, a family of Crustaceans, also assemble annually in multitudes, descend from their usual places of abode in the interior, and travel in a straight line to the sea, to deposit their eggs in the sand of the shore. It is questionable whether any kind of fish makes long migrations either to seek for food or to deposit its eggs. Herrings have been said to do so, and to issue from their polar retreats to visit their proper spawning places on the coasts of Scotland; but as regards the length of their journey, this is probably a mistake, though there can be no doubt, that in common with many other fishes, they seek the shallow waters at spawning time; and it is true also, that the common Herring exists in the arctic seas, but it is precisely in the spawning months that it has been taken off the arctic shores of America, as well as in the British friths.

ON THE GEOGRAPHICAL DISTRIBUTION OF SPECIES.

This is a wide field for observation and discussion; but the way for entering upon it with much hope of success has not as yet been cleared. Systematic Ichthyology is but of recent date; our acquaintance with the species of fish is as yet limited; our knowledge of their habits and migrations very imperfect; and we should only lead to error, were we to attempt to deduce general laws from such scanty data. We can merely therefore glance at a few circumstances connected with this department of Ichthyology, which, little as it has hitherto been considered, will, when the science has advanced to the proper point, certainly meet with the attention it so fully merits. *Temperature* has an acknowledged influence, both directly and indirectly, on the distribution of organized beings over the globe. Vegetation ceases, or nearly so, when we reach the regions of perpetual frost, either by ascending lofty mountains, or sailing towards the poles; and even the *Protococcus nivalis*, that propagates and flourishes in the snow, must owe its growth to the action of the sun's rays, in liquefying a portion of the snow sufficient to furnish fluid for the extension of the simple cells of which it consists. The range of phytophagous animals depends, of course, on that of the plants which they can eat and assimilate; and their distribution again influences that of the predacious kinds which subsist solely or mostly on animalized matter. Migration, though not synonymous with distribution, yet inasmuch as it is an instinctive movement, having for its end proper supplies of food, must furnish many facts that bear on the dissemination of species. The extent and character of the migration varies with the species. Among Mammals it has been little noticed, except in the gregarious Ruminants and certain Rodents. The American bison roams over the prairies in quest of fresh grass. When the herbage has gone to seed in one locality, and the haulms are dried up, the vast herds travel onwards till they find a younger and greener vegetation in some district over which a fire has recently run. This movement, whatever may be the extent of the journey over these sea-like prairies, scarcely comes under the term migration. But the reindeer, pressed by some more recondite instinct, quits the interior where it has fed in winter, and in herds of greater or smaller size, but in numberless succession, and all actuated by a common impulse, hastens to the coasts and islands of Hudson's Bay, or of the Arctic Sea, passing rapidly over the intervening barren districts wherein pasture is scanty; but throughout the march regularly waited upon by bands of wolves. Birds, with their greatly superior locomotive powers, perform migrations much more remarkable for the length of way. Vast numbers of *Anatidæ*, natives of the extreme capes and islands of Arctic America, assemble in flocks on the approach of winter, and move southwards to pass that season on the table-lands of Mexico and of Central America, lingering on their way only in berry-producing or marshy districts and coasts, and passing over the others high in the air, and with great velocity. The annual mi-

grations of the Swallows are no less extensive than those of the *Natatores*, and are as evidently designed to secure an appropriate succession of food. Every species has its proper range, that of some being of much greater extent both northwards and southwards than others. Of the Reptilian class, the algivorous Chelonians resort in numbers to certain solitary and sandy shores, for the purpose of depositing their eggs, but there is, as far as we know, no extensive migration of any member of that class in search of food. The *Pinnotheres*, a family of Crustaceans, also assemble annually in multitudes, descend from their usual places of abode in the interior, and travel in a straight line to the sea, to deposit their eggs in the sand of the shore. It is questionable whether any kind of fish makes long migrations either to seek for food or to deposit its eggs. Herrings have been said to do so, and to issue from their polar retreats to visit their proper spawning places on the coasts of Scotland; but as regards the length of their journey, this is probably a mistake, though there can be no doubt, that in common with many other fishes, they seek the shallow waters at spawning time; and it is true also, that the common Herring exists in the arctic seas, but it is precisely in the spawning months that it has been taken off the arctic shores of America, as well as in the British friths.

In respect of the power of making long journeys, many fishes are as favourably endowed as the swiftest bird,—their muscular powers are as great or greater, and the medium in which they move is more nearly equal to their bodies in gravity. Whoever has seen the Dolphin (*Coryphæna*) accompanying for days together a fast-sailing vessel running at speed before a fresh trade-wind, and occasionally shooting ahead, or playing round her as if she were at anchor, can have no doubts about the velocity with which a fish can travel. It has been calculated, indeed, that the Salmon can travel 20 miles an hour against the stream, and that the Tunny or *Coryphæna* would encircle the globe in a few weeks. This shows us, that unless the diffusion of a species be limited by other causes, mere distance is no obstacle to very many fishes. A bird in its migratory flight can soar high, and take advantage of the upper or lower currents of the air that may be favourable for its course, while at the same time it carries along with it the temperature of the colder regions it has left; the tenuity of the atmosphere being in fact the limit to its ascent. In the same way a northern fish might find at a distance from the surface the mean temperature of the sea (39°·5 Fahr.); its descent into the bosom of the ocean being limited by the pressure it can bear. This line of mean temperature varies in its depth with the latitude. Sir James C. Ross found it to be, in S. Lat. 45 degrees, 3600 feet below the surface; and in the equatorial and tropical regions 13,000 feet, the surface heat being in the latter districts 78°. In 70 degrees of south latitude, the surface heat is 30° Fahr., and the mean heat of 39°·5 has descended 4200 feet.

The obstacles that are likely to arise to a long journey by any fish, and also to the spread of the species, will vary with its habits. Ground fish, organized for swimming near the bottom only, and feeding there, will be stopped by great depths of the ocean as effectually as a land animal would be by a high mountain range rising far into the snowy regions,—they would neither be able to endure the pressure they would have to encounter at great depths, nor the privation of food to which they would be exposed in following the bottom to a depth to which they were not accustomed. James Forbes, whose early death has deprived Natural History of one of its most able and successful cultivators, has shown that marine life diminishes with the depth, and at length ceases, not perhaps at the limit he was inclined to assign to it, but still in a manner analogous to the ascent of a mountain. To favour the spread of ground-fish, then, a chain of sand banks, submerged to the proper

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depth, would be necessary. While the Scomberoids and other fishes that habitually swim near the surface would be more directly influenced by temperature, both as regulating the supplies of food, and as acting immediately on their own constitutions.

There can be no doubt that species have been framed to endure certain degrees of temperature only; that some which thrive in water, just above the point of congelation, would perish in the tepid ponds of intertropical regions, and *vice versa*. Dr Davy has shown that a continued heat of 80° will addle the egg, and destroy the embryo of the common Salmon; the fact of that species being limited to the countries lying northwards of the 41st parallel of latitude being most probably dependent on the small power the species has of resisting heat. On the other hand, the experiments of Broussonnet show that by using much caution, and elevating the temperature gradually, fish of temperate regions may be brought to endure a heat of 97° Fahr. The *Ambassis thermalis* is reported in the *Histoire des Poissons*, on the authority of M. Renaud, as capable of inhabiting the hot springs of Cannea, near Trincomalee, in a temperature of 115°·25 Fahr.; but there is reason to suspect some inaccuracy of observation here. Dr Davy visited these springs in 1817, when of seven wells, then existing, the hottest and principal one, and the one which he thought supplied the others, had a temperature of 105°·75° Fahr.; but the heat was said to vary, and he was told that it occasionally rose to 110°. The coolest of the seven wells had a heat only of 86° Fahr.; and in one only, whose temperature was 91°, did he see any fishes. Many small fishes, such as the *Antennarii*, and others of the less active swimmers, dwell in the floating islands of Sargasso, and most probably spawn among its stems. Though they find shelter in its mimic groves from the predacious birds and fishes, yet they must be exposed to a pretty high temperature under the direct rays of a tropical sun, against which, however, nature has furnished them with a protection, in the copious secretion of mucus which envelops their skins. The *Anabas*, again, ascends the palm trees of Bengal, and endures the heat of an atmosphere rising to 97° in the shade; while the *Callichthys* of tropical America must be exposed to at least an equal heat in its overland journeys. Fish constituted to brave such heats would speedily perish, there is every reason to believe, in colder regions; and a review of the whole class leads irresistibly to the conclusion that many species have been created solely to meet the conditions of existence which certain limited localities afford, such as the *Amblyopsis* of the Mammoth Cave of Kentucky, and the Siluroids of the mud volcanoes of the Andes.

The creation of a single pair of each species in certain spots, and the diffusion of their progeny from thence, has been of late a favourite subject of speculation; but this implies the subsequent calling into existence of the more predacious kinds, when the others had multiplied, so as to need a check; and the simpler supposition, and the one that is most consistent with the facts that are known, is that when the ocean was in a condition to support ichthyic life it was peopled by the Great Creator, each species being placed in sufficient numbers in the district best suited to its structure and habits, and the purpose it was designed to serve, while at the same time the balance between reproduction and supplies of food was provided for by a sufficient number of the rapacious kinds. And, moreover, that new species were created when a change in the condition of the ocean and its boundaries led to the extinction of the older races, and rendered such an exercise of creative power necessary.

Our limits will not permit us to stray into further speculation, and we shall conclude this article by hastily glancing at a few general facts. The northern seas, which are for

the most part comparatively shallow, nourish many of the *Sclerogenidae*, which feed at the bottom and frequent shelving, sandy shores or sandbanks. The majority of these have barbels or portions of the pectoral fins detached or otherwise organized as fingers or organs of touch. An allied group, the *Uranoscopidae* or *Trachinidae*, have often the tips of the anal rays similarly constituted. The *Gadidae*, also, which have barbels under the chin, are ground feeders; and these, with the *Cotti* and *Scorpenæ* among the Sclerogenids, and the fresh-water *Trutta*, and anadromous *Salmones*, are the most characteristic groups of fishes in the northern seas. The same generic forms of sea-fish, but not the same species, reappear in corresponding southern latitudes; the *Cotti*, *Scorpenæ*, and *Gadidae* being also conspicuous among the South Australian fishes. The Sclerogenids are not unknown in the middle tropical districts of the ocean, but they are different generically; the *Cotti* and *Scorpenæ* being replaced by *Pelors*, *Synanceia*, and others of a different aspect. There is a general resemblance between the fishes of the northern and southern extra-tropical seas, so that emigrants to Australia have very generally bestowed familiar European names on the sea-fish they found in the country of their adoption. In like manner there is a similarity of general aspect, but an almost total difference of species between the fish of Behring's Sea and the Sea of Ochotsk, and those of the German Ocean—though there are some facts which lead us to infer that in a higher parallel still there is a zone in which the same species form a circumpolar ichthyic fauna. This is different, both generically and specifically, from the fragments of the antarctic circumpolar groups of fish, which have reached us through Sir James Ross, the only navigator who has made collections in the high southern latitudes. Some genera, of few species, are the more remarkable from their occurrence both in the northern and southern seas, though in form of distinct yet closely resembling species. *Macrourus* has two representatives in the seas of Greenland and Norway; two in the Mediterranean; and two in the Australian seas. *Lophius* has one species in the European seas and another in the sea of China, so much alike that very close comparison is required to distinguish them. *Zeus*, also, and the allied genus of *Capros*, have each a species in the Mediterranean and temperate parts of the North Atlantic, as well as in the seas of Australia. The Greenland and Iceland *Notacanthus*, also, or *Campilodon* of Fabricius, reappears in the seas of South Australia with exactly the same generic aspect, but some subordinate difference of details, showing the species to be distinct, and without having been detected in the intervening districts of the ocean. No example of the genus, *M. Valenciennes* remarks, has ever reached the Paris Museum from the Indian Ocean. The true *Salmonidae* or *Trutta* of some authors are confined, as we have already more than once remarked, to the northern hemisphere. They do not pass the great Himalayan range. We have seen none from Africa, nor a figure of any species among the drawings made at Canton of all the fish brought to that market, though the *Salmonidae* are both various and plentiful in the Kamtschadale seas. The *Characinidae*, once included in the Salmon family, because they possess the characteristic Linnæan mark, an adipose fin, are chiefly South American; while the *Scopelinidae*, another family having also an adipose fin, are oceanic, being found in all seas from the German Ocean to the Chinese, Australian, and Polynesian waters, the only large district from which specimens have not hitherto been brought being the North Pacific and Behring's Sea. They are small fish, mostly nocturnal in their habits, and though many of them carry phosphorescent lamps, they have until lately escaped the observation of mariners; but when the practice of keeping a trawl overboard becomes more frequent, it is likely that they

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Geographical Distribution.

will be discovered to be inhabitants of the North Pacific also. *Chirus* has been found only in the North Pacific, but as low down as California, and more abundantly in Behring's Sea.

One large portion of the ocean, including the Sandwich Islands and the more southern Chinese seas, the Indian Ocean, Red Sea, and Polynesia, down to the northern and eastern coasts of Australia, forms an almost uniform ichthyic district, from the general diffusion throughout it of a great majority of the species that exist within its limits—though there are many local littoral species within its bounds. The Scomberoid skimmers of the surface are nearly the same in all parts of this wide sea. As we approach its confines, N. and S., there is a gradual intermingling of the forms belonging to the higher latitudes on each side; and on removing still farther from the equator, we find the seas of Kerguelen's Land, South Shetland, and Cape Horn showing as much identity of species as those of Norway, Spitzbergen, and Greenland; the *Notothenia*, however, and other predominant forms in the Antarctic seas being dissimilar to the Arctic ones. In fact, there is a greater generic dissimilarity between the extreme Arctic and Antarctic fish than we observe between the fish of the British Channel and the antipodal species. A *Notothenia*, we may add, is one of the most southern fish, having been found to the amount of 28 lbs. in the stomach of a seal, in S. Lat. 66., on Sir James C. Ross's voyage; and an *Ophidium* was found by the same distinguished navigator to the N. of Spitzbergen. Both seek shelter from the seals in crevices of the ice.

With respect to fresh-water fish, the common Salmon, as we have more than once mentioned, is identical on both sides of the North Atlantic down to the 41st parallel, but does not occur in Behring's Sea; and we are not aware of any other species of *Salmo* or *Trutta* being common to the Old and New Worlds, although the family is even more abundant both in individual numbers and in variety of specific forms than in Europe or Asia. Sturgeons, another family of fresh-water fishes, containing anadromous mem-

bers, have a less high northern range than the Salmon, not being found in rivers that fall into the Icy or Arctic American seas, but existing abundantly in most of the great rivers of Siberia and North America that flow southwards, or laterally, into the Black Sea, North Atlantic, or Northern Pacific. The genus exists in China, but we have seen none from the southern hemisphere. This leads us to observe, that no living Ganoid fish has as yet been detected in the southern hemisphere. The *Pharyngobranchii* are confined as natives to India and the Cape of Good Hope, though one or two species have been transported to Cayenne, and thrive there. Some of the remarkable genera that occur in the Nile exist also in the Gambia and Niger, though, as far as we know, not the same species; and there is a similar likeness between the marine fish of Western Africa and those of the Red Sea, extending in one or two instances even to species. The Siluroids have their headquarters in India and the southern seas, the species being comparatively few in Europe and North America. There are many in South America; and the Goniodonts are exclusively natives of that country.

There are other facts connected with this subject, some of which we shall simply mention without dwelling on, such as the influence of the Gulf Stream and other oceanic currents, in bringing fish that are natives of the warmer districts of the ocean into the higher latitudes. A drift tree or a spar is seldom met with at sea without its attendant fish, especially if it has been long enough afloat to be covered with fuci and barnacles. It would appear as if these fish stuck by it in all its wanderings, from their unwillingness to quit it, even when approached by a boat. And all mariners are familiar with the fact of certain fish following a ship for weeks together, until it has entered the colder latitudes. The beautiful *Naucrates*, or Pilot-fish, has in this way been brought to the Cornish shores, and we have known the *Echeneis* to attach itself in considerable numbers to a ship's bottom in the Bight of Benin, and to continue there until the Azores were passed on the homeward voyage. (J. R.—N.*)

* The accomplished naturalist and excellent man, James Wilson, by whom the first edition of this article was penned in 1835, was preparing to revise his work when death put an end to all his labours, and the task which he would have accomplished so well was entrusted to another. During the last twenty years Ichthyology has gained so many new facts that it became necessary to write the whole over again; but such passages of the original treatise as were suitable have been interpolated in the text.

NOTE.—At page 236 we have mentioned the *Meletta venenosa* as being occasionally a poisonous fish; and at page 312 the Tetraodons are noticed as having generally a bad reputation on the same account. Not without reason, indeed, since the small liver of a single Tetraodon was the cause of two deaths at the Cape of Good Hope. The subject is one of much interest both to seafaring men and to physiologists; and we gladly avail ourselves of a little spare room on this page to insert a few of the details given by Dr Julius Hellmuth, surgeon of the Dutch brig of war, and Mr Hugh Jameson, surgeon of the royal navy, who witnessed the fatal occurrence.

"J. Kleinhaus, boatswain's mate, thirty-two years of age, and J. Hausen, purser's steward, forty-three years of age, had partaken at dinner-time (noon), in addition to the usual ship's fare, of the liver of a fish. Within ten minutes I was called to render assistance to both, and observed the following symptoms:—J. Kleinhaus could not raise himself without the greatest exertion, his face was somewhat flushed, his eyes glistening, and pupils rather contracted; the mouth was open, the muscles of the pharynx spasmodically contracted; the lips tumid and somewhat blue; the forehead covered with perspiration, and the pulse quick, small, and intermittent. The patient was in great distress but still conscious. He complained, but with great difficulty, of pain from constriction of the fauces and gullet, together with great uneasiness in the region of the stomach, and had an inclination to vomit. An emetic was administered, but he could scarcely swallow it, and he almost immediately became paralytic; his eyes were fixed in one direction, his lips became livid, and his pulse failing, he expired scarcely seventeen minutes after eating of the liver of the fish. There was no full vomiting during the rapid action of the poison, the emetic having produced no effect. The other patient vomited thrice, the first time before taking an emetic which was given to him, followed by abundance of warm water, which caused a repetition of the vomiting, after which he said that he was easier, but in a few moments a single convulsive movement in the arms ensued, the livid tongue was protruded from the mouth, and he expired about one minute later than his messmate. Mr Jameson did not reach the Dutch vessel till forty-five minutes after twelve, before which time both men had expired. He found their faces collapsed, pallid, and covered with cold moisture, the lips livid, pupils of the eyes moderately dilated, the joints still flexible, and the limbs relaxed. On examining the bodies next day the stomachs were observed to be moderately distended with pulaceous food, nearly wholly reduced to the state of chyme, some of which had passed the pylorus. None of the poisonous fish could be distinguished among this comminuted mass. The inside of the stomach round the cardiac orifice was of a deep purple colour, and minute ramifications of the vessels extended along the smaller arch, and to the eminence at the beginning of the greater arch. The vascularity was not perhaps greater than it would have been in a healthy stomach during the first process of digestion, but it was rendered more conspicuous by the dark colour of the blood. In the right ventricle of the heart there was a fibrinous clot and a small quantity of fluid blood; the left ventricle was moderately distended with dark fluid blood; the muscular tissue of the heart was natural, and the muscles of the body generally were florid and healthy in appearance. The spotted Tetraodon measured from 6 to 8 inches, and it was the liver only, not exceeding 4 drams in weight, that was eaten by the men."



1856. "Ichthyology." *Ichthyology* 8, 204–331.

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