GUIDE TO THE CRUSTACEA

EXHIBITED IN

THE DEPARTMENT OF ZOOLOGY

BRITISH MUSEUM (NATURAL HISTORY)

CROMWELL ROAD, LONDON, S.W.7

WITH 53 ILLUSTRATIONS

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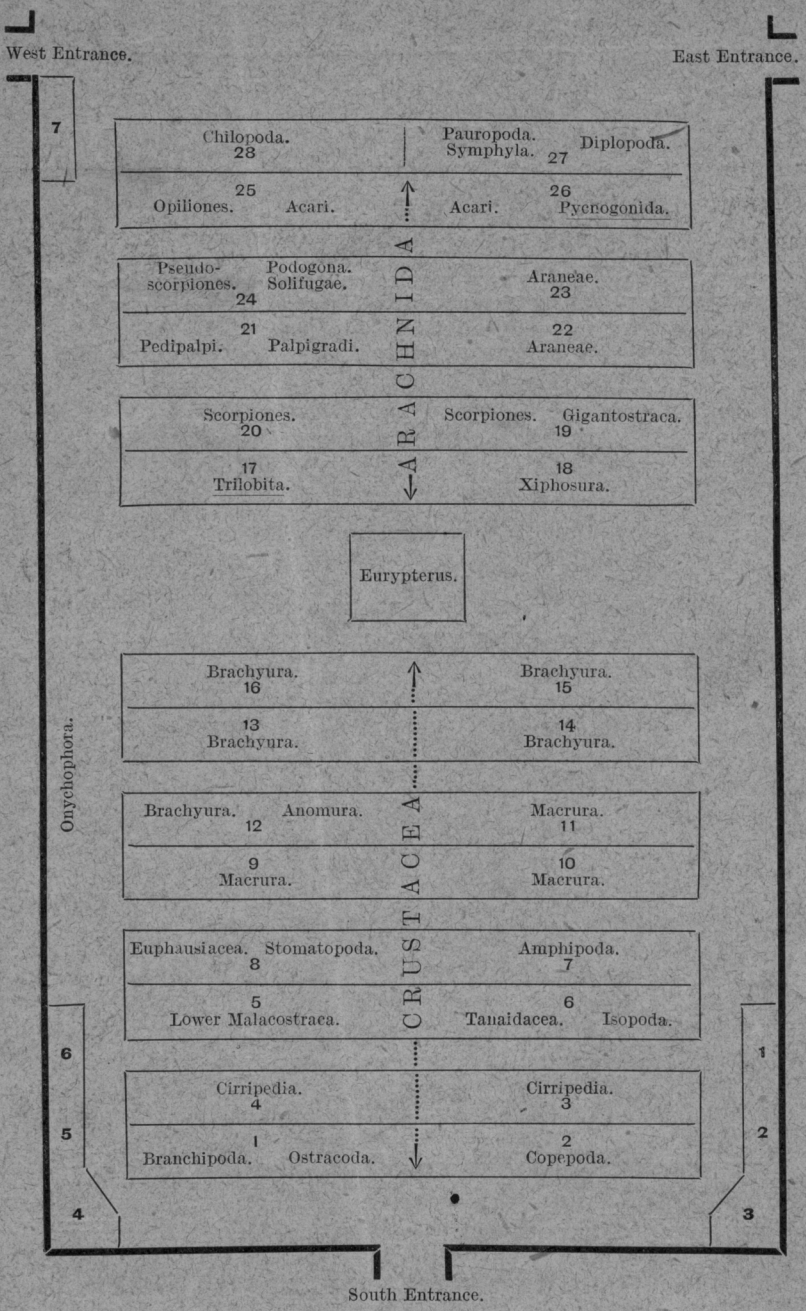

PLAN OF SOUTH HALF OF "INSECT GALLERY," SHOWING POSITION OF CASES OCCUPIED BY GROUPS DEALT WITH IN THIS GUIDE (CRUSTACEA, TABLE-CASES 1–16 AND WALL-CASES 1–6; TRILOBITA, TABLE-CASE 17; PYCNOGONIDA, TABLE-CASE 26).

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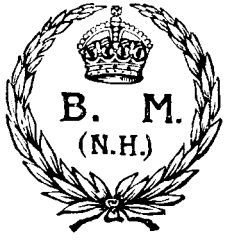

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PREFACE

THE comprehensive group Arthropoda includes animals that are more or less distinctly segmented, with jointed limbs, some of which are modified to serve as jaws, and generally with a hard external skeleton. It includes the Insects, the Arachnida (Scorpions, Spiders, Ticks, etc.), the Myriopoda (Centipedes and Millipedes), the Onychophora (*Peripatus*), the Crustacea (Shrimps, Lobsters, Crabs, etc.), the Trilobita, and the Pycnogonida. All these are exhibited in the narrow gallery between the Reptile and Fish Galleries.

The Insects are described in a separate guide.

This guide to the Crustacea has been written by Dr. W. T. Calman, F.R.S., and is in the main, although many additions and alterations have been made, his contribution to a former guide-book that included all the Arthropoda other than Insects, which was issued in 1910. In addition to the Crustacea a short account is given of the Trilobites, known only as fossils, and of the Pycnogonida, a small and isolated group of marine Arthropods.

The thanks of the Museum are due to Messrs. A. and C. Black for permission to use some of the blocks from Part VII (Dr. Calman's volume on Crustacea) of the "Treatise on Zoology," edited by Sir Ray Lankester, K.C.B., F.R.S.

C. TATE REGAN,
Keeper of Zoology.

BRITISH MUSEUM (NATURAL HISTORY).
January, 1927.

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Class I.—CRUSTACEA.

INTRODUCTORY.

The exhibited series of Crustacea occupies the southern part of the "Insect Gallery." The Table-cases Nos. 1–16 contain a series of typical representatives of the various Sub-classes and Orders composing the Class, arranged in systematic order. The Wall-Cases Nos. 1–6 contain exhibits illustrating the structure and life-history of the Lobster, forming an introduction to the study of the Crustacea, a number of specimens illustrating the habits and mode of life of various Crustacea, and sundry specimens which, by reason of their size, could not conveniently be exhibited in their proper places in the systematic series.

DEFINITION OF CRUSTACEA.

The Class Crustacea, as understood by modern zoologists, comprises the animals commonly known as Crabs, Lobsters, Crayfish, Prawns, Shrimps, Sandhoppers, Woodlice, Barnacles, and Water Fleas, besides a multitude of related forms undistinguished by any popular names. It does not include the King-Crabs (Xiphosura), formerly associated with it, but now regarded as more closely related to the Arachnida.

The Crustacea differ so widely among themselves that it is very difficult to give a definition of the group which will apply to all its members, and it is hardly possible to do so without entering into highly technical details of structure and development which would be out of place here.

It may be said, however, that they differ from Insects, Arachnida, and the other groups which, together with Crustacea, form the comprehensive group (Phylum or Sub-Phylum) Arthropoda, in having two pairs of antennae (feelers) in front of the

mouth and at least three pairs of jaw-like appendages behind the mouth, in being nearly always of aquatic habits, and in breathing by gills or by the general surface of the body.

A Crustacean can usually be distinguished from any other Arthropod by the fact that its "walking-legs" do not correspond in number or arrangement with those found in the other groups. Thus an Insect can usually be recognised at first sight by having three pairs of legs, an Arachnid by having four pairs, and a Centipede or a Millipede by having a great number of legs, all nearly alike. The Crustacea, on the other hand, show a great variety in the arrangement of their walking or swimming legs, but they very seldom exhibit any special resemblance, in respect of these appendages, to the other large groups of Arthropods.

THE LOBSTER AS A TYPE OF CRUSTACEA.

(Wall-cases Nos. 1–3.)

The plan of structure common to the whole Class will be best understood by beginning with the study of a typical form.

For this purpose the common Lobster has been selected as being easily accessible, of convenient size, and not so specialised as to prevent ready comparison with other Crustacea. The Crayfish, which is the type more usually described in text-books, differs only in minor details from the Lobster.

Like the other Arthropoda, the Crustacea have the body and limbs encased by a firm covering which gives support to the soft internal organs and in particular affords points of attachment for the muscles by means of which the animal moves. In other words, this covering plays the part of a skeleton; but since, unlike the bony skeleton of Vertebrate animals, it is outside instead of inside the soft parts, it is distinguished as an "exo-skeleton." In many Crustacea, the exoskeleton is sufficiently strong to serve the purpose of defensive armour, and to enable the limbs to act as efficient and powerful weapons.

Although the firm outer covering is continuous over the whole of the surface of the body and limbs, it becomes thinned away in places to form joints permitting movement between the various parts. Thus, the body and limbs are divided into "segments" * which, in the case of the body, are termed body-segments or "somites."

* The word "joint," often applied to these divisions of the body and limbs, ought properly to be restricted to the hinge or connection between two segments.

A study of the various modifications of structure presented by Crustacea and other Arthropoda has led to the conclusion that they are to be regarded as built up of a series of somites or body-segments, which may be distinct or soldered together, and each of which bears typically a single pair of limbs or appendages.

Thus, in the Lobster (Fig. 1), the hinder half of the body (or abdomen) is plainly made up of six somites (besides a tail-piece or "telson"), each of which carries on the under side a pair of "swimmerets." The front half of the body is not so divided,

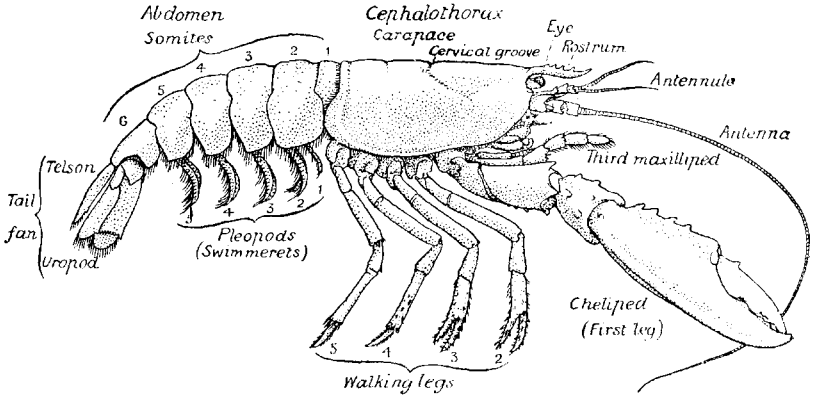


FIG. 1.

The Common Lobster (*Homarus gammarus*). Female, from the side.
[Wall-case No. 1.]

but is covered by a large shield or "carapace" which projects between the eyes as a toothed beak or "rostrum." Since, however, this part of the body also bears a number of appendages constructed on the same plan as the swimmerets of the abdomen, it is concluded that here also we have to do with a series of somites, although they are so completely fused together as to be indistinguishable except by their appendages. That this conclusion is correct is proved by comparison with some of the lower Crustacea, in which there is no carapace, and the fore part of the body has eight distinct somites each bearing a pair of walking legs. In front of these eight somites, which form what is called the "thorax," is the "head," a part of the body which is never, in any Crustacean, distinctly segmented, but which, since

it bears five pairs of appendages, must contain at least five somites. The part of the body covered by the carapace of the Lobster includes the head and the thorax and is known as the "cephalothorax." It is necessary to remark, however, that the regions of the body named head, thorax, and abdomen in the Crustacea are by no means exactly equivalent to those so named in the other Arthropoda, for instance in Insects, and still less to the parts bearing the same names among Vertebrate animals.

This "segmentation" of the body, or division into somites, is not only shown by the external covering, but affects some of the internal organs as well. Leaving these aside for the present, however, and considering only the exoskeleton, the structure of a typical somite will be best understood by examining one of the separated abdominal somites of the Lobster (Fig. 2). This consists of a ring of shelly substance, connected with the rings in front and behind by areas of thin membrane which permit movement in a vertical plane. For convenience of description the upper or dorsal part of this ring is called the "tergum," and the under or ventral part the "sternum." To the sternum are attached the appendages (or swimmerets); the tergum overhangs the base of the appendage on each side as a flap named the "pleuron." The terminal segment of the body or "telson" never bears typical limbs, and on this account and also because of its mode of development in the embryo, it is not regarded as a true somite.

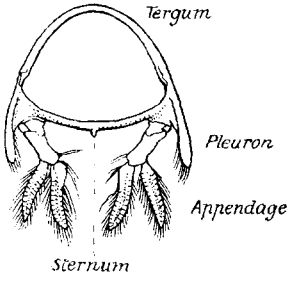


FIG. 2.

One of the abdominal somites of the lobster, with its appendages, separated and viewed from in front. [Wall-case No. 1.]

The carapace of the Lobster is not formed simply by the terga of several adjacent somites becoming soldered together. This is shown by a comparison with some of the lower shrimp-like Crustacea (Mysidacea, *see* Table-case No. 5), in which the carapace is seen to arise, as a fold of the skin, from the hinder edge of the head-region, and to envelop the distinctly segmented thorax like a loose jacket. In the Lobster, this fold has coalesced, down the middle of the back, with the terga of the thoracic somites,

but at the sides it hangs free, and between it and the side of the body is the " branchial cavity " in which the gills lie. The free part of the carapace which covers the branchial cavity is known as the " branchiostegite," and its front end is marked off on the outside of the carapace by an oblique " cervical groove " (Fig. 1), which has been supposed to indicate the limit between the head and the thorax.

Appendages.—Excluding the movable stalks on which the eyes are set and of which the nature will be discussed later, the body of the Lobster carries nineteen pairs of appendages. In front of the head are two pairs of feelers, the " antennules " and " antennae " respectively (sometimes called the first and second antennae); near the mouth are three pairs of jaw-appendages, the strong " mandibles " and the flattened leaf-like " maxillulae " and " maxillae "; following these, which belong to the head-region, are three pairs of thoracic appendages, the " maxillipeds," which form a transition between the true jaws and the legs. The large claws and the four pairs of walking-legs may simply be termed " legs," and together with the three pairs of maxillipeds, correspond with the eight somites of the thorax already referred to. The six somites of the abdomen have each a pair of appendages, those of the first five being known as swimmerets (" pleopods "); those of the last somite are known as the " uropods," and are large, flattened appendages spread out on each side of the telson to form the tail-fan. All these appendages can be shown to be constructed on a common plan, which is seen in a simple form in the case of the swimmerets. Each of these consists (Fig. 2) of a stalk, the " protopodite," with two branches known respectively as the " endopodite " (on the inner side) and the " exopodite " (on the outer side). The protopodite itself is composed of two segments; the first, very small, is the " coxa," and the second, much larger, is the " basis."

If the other limbs be compared with the swimmerets it will be found that they can be derived, without much difficulty, from the simple type. The *antennules* (Fig. 1), which appear most simple, are perhaps the least easy to interpret. Although they plainly consist, like the swimmerets, of a stalk and two branches, there are reasons for doubting whether these three parts correspond with the protopodite, exopodite, and endopodite respectively. In the *antenna*, on the other hand, there is little difficulty in recognising the two segments of the protopodite, the exopodite reduced to a small movable plate or scale, and the endopodite

drawn out into a long lash or flagellum of very numerous small segments.

The mouth-parts will be best understood by comparing them in order from behind forwards, beginning with the *third maxilliped* (Fig. 3). In this appendage it will be seen that the second segment of the protopodite carries an exopodite which ends in a lash or flagellum of numerous segments, and an endopodite of five segments which forms the main part of the limb. In addition to these divisions, however, there is another part not present in the swimmeret which we have taken as the type. This is the "epipodite," a membranous plate attached to the outer side of the first segment (coxa) of the protopodite, and bearing one of the gills (to be described later) attached to it.

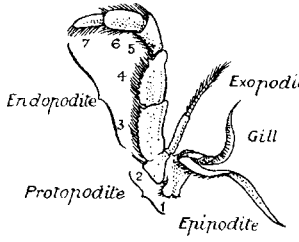


FIG. 3.
Third maxilliped of Lobster.
[Wall-case No. I.]

The *second maxilliped* is not dissimilar in structure, though much smaller than the third, but the *first maxilliped* differs considerably from both. The same parts can be recognised in it, but the endopodite is shorter than the exopodite and has only two segments; and the two segments of the protopodite grow out on their inner side into two large plates, fringed with bristles and serving as jaws. In the *maxilla* (*second maxilla*), these jaw-plates ("gnathobases") are still more developed, and each is slit into two. The endopodite is small and unsegmented, and on the outer side is a large plate which is probably the exopodite, although some have regarded it as the epipodite. Whatever its nature, this plate has an important function, since it lies in a channel leading forwards from the gill-chamber and serves by its continual movements to keep a current of water flowing over the gills. The *maxillula* (*first maxilla*) consists of little else than the two gnathobases, here undivided, and a small endopodite. The strong *mandibles* are clearly the chief instruments in the mastication of the food, to which the other mouth-parts are only accessory. Each consists of a massive "body" which seems to represent the first segment of the protopodite with its gnathobase, and a small "palp" of three segments representing the rest of the protopodite with the endopodite.

The rest of the appendages may be briefly disposed of. The

walking-legs (Fig. 1) can easily be seen to correspond, segment for segment, with the third maxillipeds, except that they have no exopodites. The large claws (*chelipeds*), like the two pairs of legs immediately succeeding them, are chelate or pincer-like. This modification, which is very frequent among Crustacea in limbs used for seizing food, is brought about by the penultimate segment of the limb growing out into a process, the "immovable finger," lying alongside the last segment, which can be brought into contact with it and is known as the "movable finger."

The movable *stalks*, upon which the eyes are set, are divided into two segments, and in a few Crustacea they are even composed of three. The view was long and widely held that these stalks were the equivalent of a pair of appendages like the legs or jaws. There are some reasons, however, for believing that this is not correct, and the eye-stalks are therefore omitted from the list of the Lobster's appendages given here.

Some of the gills (*branchiae*) of the Lobster are seen attached to the epipodites of the thoracic limbs. Their exact arrangement, however, is more clearly shown by the preparations in spirit exhibited alongside. In a transverse section through the thorax it is seen that the gill attached to the epipodite of the leg lies on the outer side of the branchial chamber. It is known as a "podobranchia." Next to it on the inner side are two gills which spring not from the leg itself, but from the membrane of the joint between the leg and the body. These are called "arthrobranchiae." Finally, next the inner wall of the chamber, is a gill attached to the wall of the body itself and known as a "pleurobranchia." The complete set of four gills is not present on every thoracic somite and the arrangement differs very much in different Crustacea.

Internal Anatomy.—The general arrangement of the internal organs of the Lobster is shown by a preparation in which the animal is dissected from the side (Fig. 4). The *alimentary canal* begins with a short gullet or "oesophagus" leading upwards from the mouth into the large "stomach," from which the "intestine" runs straight backwards to the vent on the under side of the telson. The stomach is not very suitably named, for it is probably not the place where the chief processes of digestion go on, but on the other hand it contains a complex apparatus known as the "gastric mill" which acts as a gizzard in grinding up the food. It is divided into two chambers, a larger one in front, the "cardiac chamber," which serves as a kind of crop,

and a smaller "pyloric chamber" behind. In the narrow opening between the two chambers are set three strong teeth which are connected with a system of plates and levers lying in the stomach-wall and moved by special muscles. This development of hard plates and teeth is associated with the fact that the whole stomach is lined by a membrane continuous at the mouth with that which covers the surface of the body and becomes thickened and hardened to form the shell. The external membrane also becomes turned in at the vent to line a considerable part of the intestine.

On each side of the thoracic region of the body is a large glandular mass, the "liver" or digestive gland, which opens into

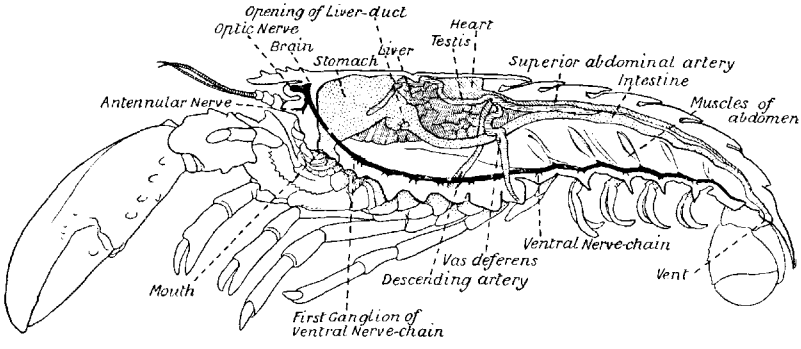


FIG. 4.

Dissection of male Lobster, from the side. [Wall-case No. 1.]

the alimentary canal by a short duct on each side just behind the stomach.

The *heart* lies near the back, just under the hinder part of the carapace. It gives off a number of large arteries in front and behind, as well as one ("descending artery") which runs downwards to the sternal surface of the thorax. As in other Arthropoda, there are no distinct veins, but the blood is discharged from the smaller arteries into the general cavity of the body and finds its way by ill-defined venous channels, first to the gills, and from these to the "pericardium" or space surrounding the heart. From the pericardium the blood returns through six valvular openings into the heart itself.

The *excretory system* (corresponding in function with the

kidneys of the Vertebrate animals) is represented by a pair of glands known as the "green glands" lying at the sides of the head and opening to the exterior each on a small tubercle on the first segment of the antenna.

The *central nervous system* consists of a "brain," lying in front of the head, connected by a pair of cords which pass on either side of the gullet with the "ventral nerve chain" in which may be distinguished twelve nerve centres or ganglia.

The *eyes*, as already mentioned, are set on movable stalks. The black, kidney-shaped area at the end of the stalk can be seen, under a magnifying lens, to be divided into numerous minute facets (some 13,500 in number), for the most part square in outline. It is not correct to state, as is sometimes done, that each facet corresponds to a separate eye, forming a separate image of the object looked at; the whole assemblage of facets and the structures underlying them co-operate to form a single image on the receptive nerve-endings in the interior of the eye.

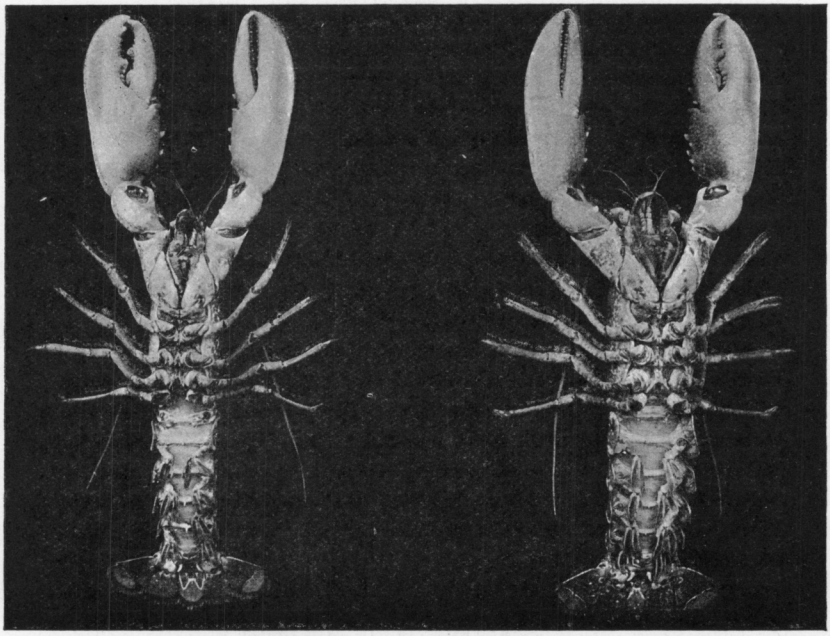
In the basal segment of the antennule is the so-called *auditory organ*, a small pouch open to the exterior and containing in its cavity a number of grains of sand. This pouch, which has on its inner surface numerous feathered hairs connected with a large nerve, was formerly regarded as the Lobster's ear. Although it is not impossible that it may have to do with the sense of hearing, investigations have shown that its principal function is connected with maintaining the equilibrium of the body in walking or swimming.

The dissection exhibited (see Fig. 4) is one of a male Lobster, and the *testis* can be seen lying below the heart and giving off a duct, the *vas deferens*, which opens to the exterior on the coxa of the last pair of legs.

Differences between the sexes.—Two preparations are exhibited in order to show the chief external differences between the sexes of the Lobster (Fig. 5). The most easily noticeable differences are the greater breadth of the abdomen and the larger size of its side-plates in the female than the male. The first pair of swimmerets (which, unlike the other pairs, have only one branch in both sexes) are very slender in the female, but are much larger and peculiarly shaped in the male. The second pair have an additional lobe on the inner side of the endopodite in the male. The openings of the genital ducts can be seen on the first segment (coxa) of the last pair of walking legs in the male,

and on that of the last pair but two in the female. Finally, the female has on the under surface of the thorax, between the last two pairs of legs, a curious three-lobed structure with a slit-like opening in the middle, known as the "sperm-receptacle."

As in most Crustacea, the eggs are carried, after spawning, by the parent Lobster, and, as in most of the higher Crustacea



Male. Female.

FIG. 5.

Male and Female Lobsters, showing the difference in the relative breadth of the abdomen in the two sexes. This figure also illustrates the dissimilarity of the large claws and the fact that the large "crushing-claw" may be on either the right or left side of the body. [Wall-case No. 1.]

(Decapoda), they are attached to the swimmerets on the under surface of the abdomen. The female Lobster carrying spawn in this way is said by fishermen to be "in berry." A specimen in this condition in shown in spirit, and a drawing, in natural colours, is hung in the upper part of the Case. The number of eggs carried by a single Lobster may vary from about 3,000 to nearly 100,000.

Development.—Like most other Crustacea, the Lobster when hatched from the egg differs considerably in form from the adult animal. Four larval stages are distinguished, of which the first and fourth are illustrated by enlarged drawings hung in Wall-case No. 2, and specimens of all the stages are exhibited in Wall-case No. 3. The most important differences from the adult in the first stage are the absence of all the abdominal appendages (pleopods and uropods) and the presence on each of the legs of an *exopodite*. These exopodites are fringed with hairs and are used as swimming organs, by means of which the larvae move rapidly about at the surface of the sea. In the fourth stage, the exopodites of the legs are lost, and the young animal, which has now assumed the essential structure of the adult, sinks to the sea-bottom. In many Crustacea the changes of form between the larval and the adult state are much greater than they are in the Lobster, but in some cases they are less marked, and the animal is hatched in what is practically the adult form.

Moulting.—As already mentioned, the outer covering of the Lobster is quite continuous over the whole surface of the body and limbs. It consists of a substance known as "chitin," which resembles horn and is hardened by lime-salts to form the shelly parts of the exoskeleton. At the joints the covering is thin and soft and contains no lime. As this covering will not stretch to any great extent, the Lobster, like all other Arthropoda, requires to cast its shell at intervals as it grows. In this process of *moulting* (or ecdysis) the integument of the back splits between the carapace and the first abdominal somite; and the body and limbs are gradually withdrawn through the opening, leaving the cast shell with all its appendages almost entire. The new shell, which had been formed underneath the old before moulting, is at first quite soft, and the animal rapidly increases in size by the absorption of water. The shell gradually becomes hardened by the deposition of lime-salts.

Several series of specimens illustrating the process of moulting are exhibited in Wall-case No. 3. These have been prepared and presented to the Museum by Mr. and Mrs. H. J. Waddington, of Bournemouth, who have been very successful in keeping marine animals alive for long periods in aquaria. Two cast shells, obtained successively from a single Lobster, and the Lobster itself preserved in the "soft" condition immediately after escaping from the second of these, show very clearly the

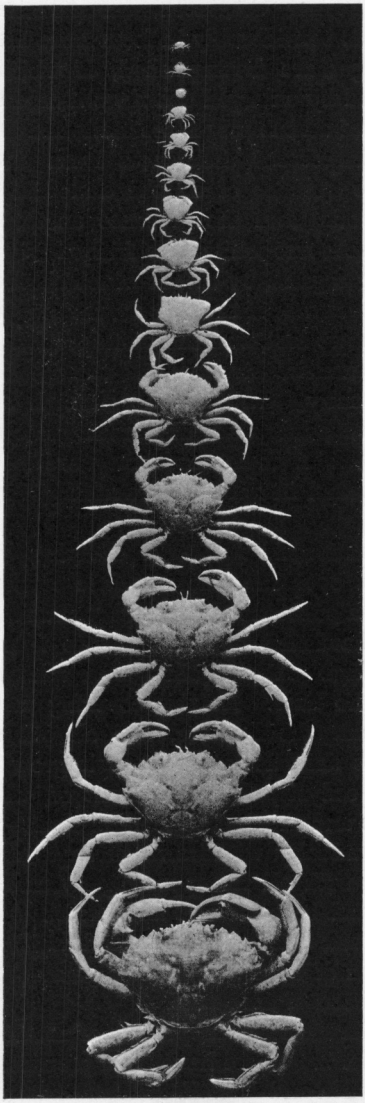


FIG. 6.

Series of cast shells obtained from a single individual of the Shore-Crab (*Carcinus maenas*) kept in an aquarium. The carapace of the largest is about 2½ inches wide. [Wall-Case No. 3.]

increase in size at each moult. The same point is illustrated in a different way by a drawing hung in this case, in which are superposed the outline of a Lobster before moulting and the outline of the same animal a few hours after the moult.

In a jar in the centre of the case are shown several specimens of the Edible Crab, of which one is in the act of moulting. The carapace has become separated from the abdomen and legs, and the body is beginning to be withdrawn from it.

On the right of the case is a series of cast shells obtained from a single individual of the Shore-Crab (Fig. 6). The crab was captured on 14th May, 1901. It was then in the second larval or Megalopa stage, and was found swimming at the surface of the sea. It lived in Mr. Waddington's aquarium till 20th July, 1904, and during that period it moulted seventeen times. All the cast shells, except two which were destroyed by accident, are exhibited.

In the lower part of the case two very beautiful series are exhibited, each obtained from a single Lobster in Mr. Waddington's aquaria, and together they give an almost complete picture of the

growth of the animal from an early post-larval stage until it reaches a marketable size. The younger series begins with a specimen of about $\frac{4}{5}$ths inch length of body, which moulted on

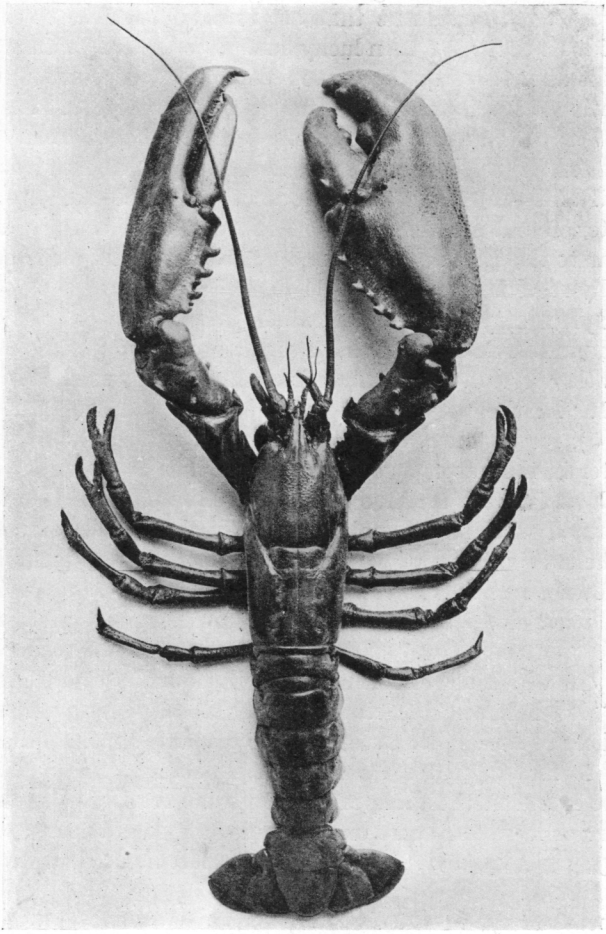


FIG. 7.

Common Lobster (*Homarus gammarus*). Length, from head to tail, 19 inches.

21st August, 1906; the latest of the fourteen moults exhibited was obtained on 8th June, 1909, when the animal was about $4\frac{1}{8}$ inches in length. The second series begins with a specimen about $4\frac{1}{2}$ inches long, obtained on 16th September, 1904.

Between that date and 31st July, 1909, when the lobster died, it moulted seven times and grew to a length of 9 inches.

Size.—It is probable that the Lobster goes on growing, although at a diminishing rate, for the whole of its life, and that the very large specimens that are found from time to time are individuals that have been lucky enough to live longer than usual.

It is difficult to get accurate records of the size and weight of exceptional specimens. The one exhibited in Wall-case No. 3 (Fig. 7) is the largest in the Museum and is believed to have been caught on the coast of Scotland. It measures 19 inches from head to tail and probably weighed more than 15 lb. The American Lobster, found on the Atlantic coast of North America, is very similar to the European species, but grows to a larger size, occasionally reaching as much as 34 lb. weight.

Asymmetry.—A point on which information is often asked, the unlikeness in size and shape of the great claws of the Lobster and other Crustacea, is illustrated by specimens in Wall-case No. 1. In the preparations of the male and female Lobster (Fig. 5), for instance, or in the pair of claws from a very large Lobster in the lower part of the case, it will be seen that one of the claws is more massive than the other and that the fingers are armed with blunt knobs. It is, in fact, used for crushing the shells of animals on which the Lobster may be feeding, and is known as the "crushing-claw." The other is more lightly built, with sharp saw-like edges to the fingers, and is known as the "cutting-claw." There is no rule as to the side of the body on which either form of claw is found, "right-handed" and "left-handed" specimens being about equally common. In others of the higher Crustacea the disparity in size of the two claws is much greater than in the Lobster; many examples will be found in the table-cases. In some crabs the larger claw is more or less constantly on the same side of the body; that is to say, right-handed (or, more rarely, left-handed) individuals predominate.

Occasionally, in the Lobster, specimens with similar claws occur. Most commonly, in these, both claws are of the cutting type, but, very rarely, specimens like that shown in the lower part of Wall-case No. 1 are found, in which both claws are of the crushing type. The mode of production of such abnormalities is not fully understood, but it seems probable that in most cases it is associated with the regeneration of limbs removed by accident or thrown off after injury.

MODIFICATIONS CAUSED BY PARASITES.

A series of specimens, exhibited in Wall-case No. 2, illustrate the changes of structure produced in certain crabs which are infested by the degenerate Crustacean parasite *Sacculina*. It is a curious and significant fact that these changes affect almost exclusively the secondary sexual characters of the crabs. The details of the modifications are explained at length in the labels accompanying the specimens, and need not be recapitulated here ; but it may be said in general that the characters distinctive of either sex, *e.g.* the large chelipeds of the male, or the egg-carrying appendages of the abdomen in the female, become reduced in infected specimens, and that the male may even assume the characters of the female, although it would appear that females never take on distinctively male characters.

SYSTEMATIC SERIES.

The following table gives the system of classification which has been adopted in arranging the collection :—

Class *CRUSTACEA*.

Sub-class BRANCHIOPODA.
,, OSTRACODA.
,, COPEPODA.
,, CIRRIPEDIA.
,, MALACOSTRACA.

Division *Phyllocarida* .	Order Nebaliacea.	
,, *Syncarida* .	,, Anaspidacea.	
,, *Peracarida* .	,, Mysidacea.	
	,, Cumacea.	
	,, Tanaidacea.	
	,, Isopoda.	
	,, Amphipoda.	
,, *Hoplocarida* .	,, Stomatopoda.	
,, *Eucarida* . .	,, Euphausiacea.	
	,, Decapoda.	

Sub-class I.—BRANCHIOPODA.

(Table-case No. 1.)

This Sub-class includes a number of very primitive Crustacea that differ widely from one another in many points of structure, but agree in having the appendages of the trunk, for the most part, flattened and leaf-like. It is divided into four Orders, of which the first three are specially interesting on account of their primitive characters. In the large number of the somites

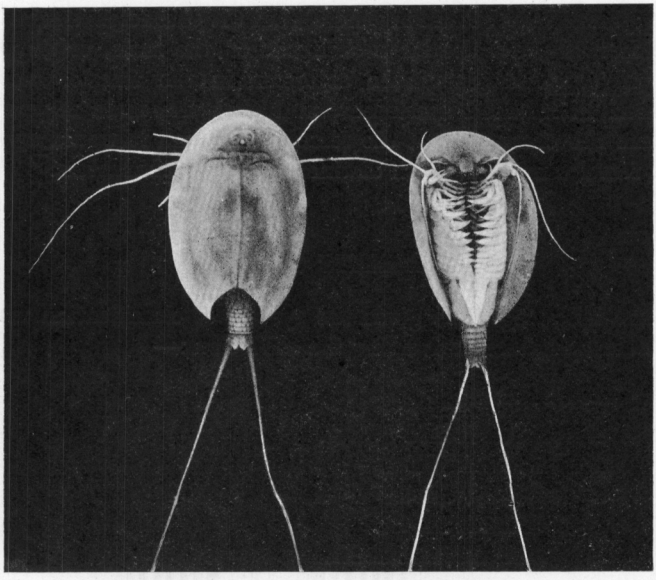


FIG. 8.
Apus cancriformis, from Kirkcudbrightshire, slightly enlarged.
[Table-case No. 1.]

(up to 40) and the uniformity of the limbs, as well as in some points of internal structure (heart, nervous system), they approach more closely than any other living Crustacea to the hypothetical ancestral type of the Class. In some respects, however, such as the reduction of the mouth-parts, they are considerably specialised.

In the Order ANOSTRACA there is no carapace, and the animals have a more worm-like appearance than is usual in Crustacea. The eyes are set on movable stalks. The males are distinguished

by the remarkable development of the antennae, which form complicated clasping organs for seizing the females. The "Fairy Shrimp" (*Chirocephalus diaphanus*), of which specimens are shown together with a coloured drawing from the living animal, occurs in the South of England in ponds and rain-puddles.

In the Order NOTOSTRACA the carapace forms a broad dorsal shield, resembling, at first sight, that of the Arachnidan King-crabs. *Apus cancriformis* (Fig. 8) is found in fresh-water pools and ditches in many parts of Europe, but it is very uncertain in its occurrence, and it may suddenly reappear in numbers after an absence of many years. Males are rarely seen. It was formerly found in several localities in the south of England, but no British specimens were seen for upwards of forty years, and the species was supposed to be extinct in this country. In 1907, however, it was discovered by Professor Balfour Browne, in Kirkcudbrightshire, and some specimens obtained by him are exhibited. The eggs of *Apus*, and indeed of most Branchiopoda, can survive being dried, and they may be carried from place to place in mud adhering to the feet of wading birds or in other ways. There can be little doubt that the appearance of the species in Scotland was due to introduction of the eggs in some such way from the Continent.

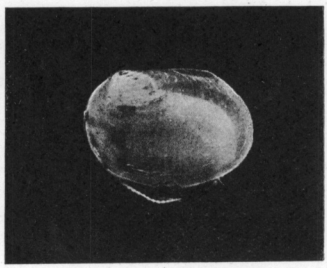


FIG. 9.

Estheria melitensis (slightly enlarged). [Table-case No. 1.]

The species of the Order CONCHOSTRACA have the body enclosed in a bivalved shell, which resembles very closely the shells of some Molluscs. The genus *Estheria* (Fig. 9), of which specimens are exhibited, is of interest on account of its geological antiquity; fossils referred to the genus occur in rocks of the Devonian period.

In the Order CLADOCERA the number of somites is small. There are from four to six pairs of trunk-limbs. The carapace generally forms a bivalve shell, enclosing the body and limbs but leaving the head free. The antennae are large and two-branched, and are used in swimming.

The Cladocera are generally very small animals, and from their jerky mode of swimming have received the name of "Water

Fleas." They are abundant everywhere in ponds and ditches, and a few species are found in the sea.

One of the commonest species in fresh water is *Daphnia pulex*, of which specimens are exhibited together with an enlarged drawing of the animal as seen under a low power of the microscope

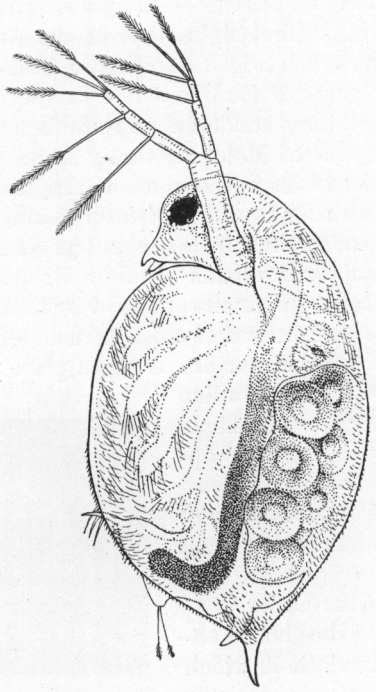


FIG. 10.

Daphnia pulex. Female carrying eggs in the brood-chamber. Enlarged. [Table-case No. 1.]

(Fig. 10). *Leptodora kindtii* is the largest species of the Order. It is found chiefly in lakes, and its glassy transparency makes it a very beautiful object when alive. It is exceptional in the small size of the carapace, which does not enclose the body and serves only as a brood-pouch.

Sub-class II.—OSTRACODA.

(Table-case No. 1.)

The number of somites, as indicated by the appendages, is smaller than in any other Crustacea, there being, at most, only two pairs of trunk-limbs behind those belonging to the head-region. The carapace forms a bivalved shell completely enclosing the body and limbs. There is a large, and often leg-like, palp on the mandible. The antennules and antennae are used for creeping or swimming.

The Ostracoda (Fig. 10) are for the most part extremely minute animals, and only one or two of the larger species can be exhibited. They occur abundantly in fresh water and in

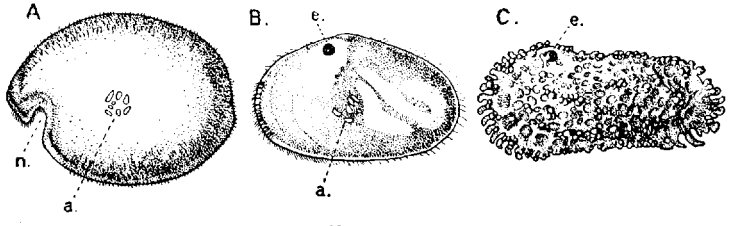


FIG. 11.

Shells of Ostracoda, seen from the side. A. *Philomedes brenda* (Myodocopa); B. *Cypris fuscata* (Podocopa); C. *Cythereis ornata* (Podocopa): all much enlarged. *n.*, Notch characteristic of the Myodocopa; *e.*, the median eye; *a.*, mark of attachment of the muscle connecting the two valves of the shell. A. and C. are marine species, B. is from fresh water. (From Lankester's "Treatise on Zoology," after Brady and Norman, and Müller.)

the sea, and their fossil remains are found in all geological formations from the oldest to the most recent. The giant of the group is the deep-sea *Gigantocypris* which may measure nearly an inch in length. Nearly all the Ostracoda belong to two Orders, the *Myodocopa* and the *Podocopa*, of which the former may generally be distinguished by a notch (Fig. 11, *n.*) in the front of the shell.

A series of enlarged drawings gives some idea of the diversity of form and ornamentation in the shells of these minute Crustacea.

Sub-class III.—COPEPODA.

(Table-case No. 2.)

There are, at most, ten free somites behind the head. The carapace is reduced or absent. The first thoracic limbs form maxillipeds, and are followed by four or five pairs of two-branched swimming feet. The posterior region of the body (the so-called "abdomen") is generally narrowed and is without limbs, but the terminal segment carried a pair of appendages, forming the "caudal fork."

Many Copepoda are found in fresh water, but the majority inhabit the sea, where they are often extremely abundant.

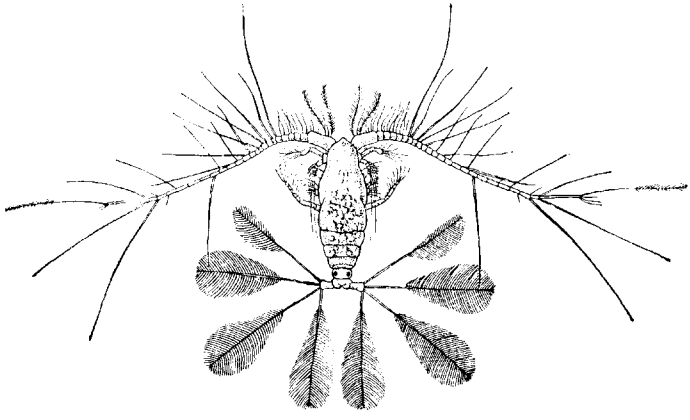


FIG. 12.

Calocalanus pavo, one of the free-swimming Copepoda of the "plankton." Enlarged. (From Lankester's "Treatise on Zoology," after Giesbrecht.)

They form one of the most important constituents of the "plankton," the assemblage of floating organisms in the waters of the open ocean. Since it is chiefly on the plankton that the other inhabitants of the sea ultimately depend for food, it may be said that the Copepoda, notwithstanding their small size, play a more important part in the economy of nature than any other Crustacea.

Many Copepoda live as parasites on fishes and other aquatic animals, and as a result of this parasitic life their structure becomes greatly modified and degenerate.

The Order EUCOPEPODA (Fig. 12) includes the great majority

of the Copepoda, both free-living and parasitic. True paired compound eyes are never present, but the median unpaired eye is often well developed. Most of the free-swimming species are extremely minute, few attaining the size of *Euchaeta norvegica*, of which specimens are exhibited. The enlarged drawings show the brilliant colours of some pelagic species.

The parasitic species are usually much larger than those which live a free life, and a number of species taken from common fishes are exhibited. *Pennella*, which is found on whales and fishes, is the giant of the sub-class, some specimens being even larger than that exhibited here.

The order BRANCHIURA includes a small number of fish-parasites whose exact relations to the other Copepods are obscure. They possess a pair of compound eyes, and a piercing stylet, connected with a poison-gland, in front of the mouth. *Argulus foliaceus* is common on fresh-water fishes in this country. The large *Argulus scutiformis* is taken from marine fishes in Japan.

Sub-class IV.—CIRRIPEDIA.

(Table-cases Nos. 3 and 4.)

The members of this group are sedentary animals, attached by the anterior part of the head-region, and having the body generally enclosed by a fleshy mantle, representing the carapace, strengthened externally by shelly plates. There are typically six pairs of trunk-limbs, each two-branched and many-jointed.

On account of their shelly covering the Cirripedia were classed by the older naturalists with the Mollusca, and it was only when their larval stages were discovered in 1829 by J. Vaughan Thompson that their affinities with other Crustacea were recognised. Nearly all the Cirripedia are hermaphrodite, having both sexes combined in each individual, a condition very rare among the Arthropoda. In some cases, however, there are dwarf male individuals which pair either with females or with hermaphrodites of normal structure.

The Sub-class may be divided into five Orders, but three of these comprise only a few imperfectly-known forms which cannot be exhibited here.

The Order THORACICA includes the typical Cirripedes, in which the six pairs of feathery trunk-limbs are well developed. Two sub-orders are recognised.

In the sub-order *Pedunculata* (the Stalked Barnacles) there is a fleshy peduncle, or stalk of attachment, at the free end of which is the " capitulum " formed by the mantle enclosing the body and limbs.

Specimens of the common Goose-Barnacle, *Lepas anatifera* (Fig. 13), are exhibited showing the external appearance with the feathery " cirri " extended from the opening of the shell; in another specimen half of the shell is removed to show the form

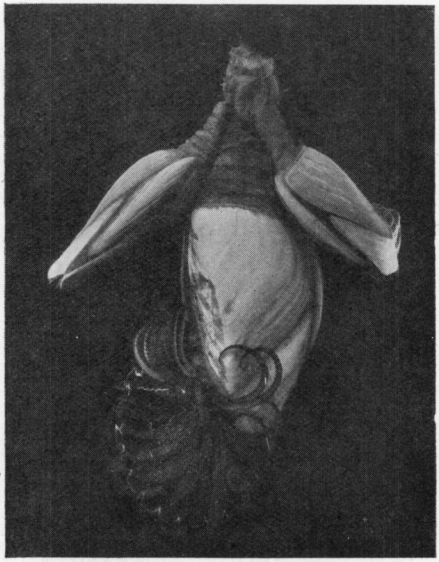


FIG. 13.

Group of specimens of a stalked Barnacle (*Lepas anatifera*). One showing the cirri extended as in life. [Table-case No. 3.]

of the body and limbs within it; and a third preparation shows the five valves of the shell (Fig. 14A) separated from each other. Like many other barnacles, the species of *Lepas* are commonly attached to floating objects, drift-wood, ships' bottoms, and the like; most of the species have an extremely wide distribution in all the oceans. The great length sometimes reached by the peduncle of the common goose-barnacle is shown by a fine group of specimens mounted in a jar by the doorway at the south end of the gallery.

Among the other genera of stalked barnacles exhibited, *Polli-*

cipes may be noted as having rows of valves on the capitulum which pass gradually into the small scales covering the peduncle. This shelly armour of the peduncle was more fully developed in certain extinct genera, as is shown in the cast of the fossil *Loricula* exhibited in this case. A species of *Pollicipes* is used for food on the coasts of Brittany and Spain. The genus *Scalpellum* is of interest not only on account of the deep-sea habitat of many species and the great size of some (*Scalpellum giganteum*), but also and more especially because of the dwarf male individuals already alluded to, which are found in this genus and in the

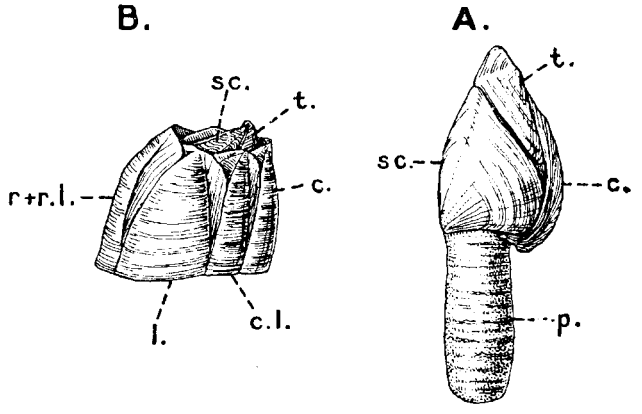


FIG. 14.

A. A stalked Barnacle (*Lepas anatifera*). B. A sessile Barnacle (*Balanus hameri*). *p.*, The peduncle. The other letters relate to the "valves" or parts of the shell; *c.*, carina; *c.l.*, carino-lateral; *l.*, lateral; *r.* + *r.l.*, rostrum and rostro-lateral fused together; *sc.*, scutum; *t.*, tergum. (From Lankester's "Treatise on Zoology," after Darwin.)

related *Ibla*. In the different species of *Scalpellum* three conditions are represented. In some, all the individuals of a species are similar and hermaphrodite as in ordinary barnacles; in others, as in *Scalpellum peronii*, of which a specimen is shown, the large hermaphrodite individuals have small males attached to them like parasites; in others, again, the separation of the sexes is complete and the larger individuals are purely female.

Most barnacles are hatched from the egg as actively swimming larvae of a type which is found in many other Crustacea, and is known as the *Nauplius*. They have three pairs of appendages, an unsegmented body, and a conspicuous median eye. Like many other "pelagic" animals, the Nauplii of barnacles living

at the surface of the ocean often have long spines and outgrowths from the surface of the body, which are probably of service in keeping the animals afloat. A coloured drawing of one of these spiny larvae is exhibited. In its later development the young barnacle passes into a stage in which the body and limbs are enclosed in a bivalved shell like an Ostracod. On account of this resemblance the stage is known as the "*Cypris*" stage, after one of the genera of Ostracoda. After swimming about for some time longer it attaches itself by means of its antennules, casts off its bivalved shell, and gradually assumes the structure of the adult.

The Sessile Barnacles or Acorn-shells, forming the sub-order *Operculata* (Fig. 14B), agree in most points of structure and development with the stalked barnacles, but they have no peduncle. The shelly plates of the mantle are, for the most part, soldered together to form a cylindrical or conical case, the opening of which is protected by four movable "opercular" plates. In a preparation of *Catophragmus polymerus* here exhibited, names are attached to those parts of the shell which are found (though often reduced in number by coalescence) in all the typical Operculata, the "scutum" and "tergum" forming the movable lid or "operculum," while the others form the outer "wall." In the genus *Catophragmus*, however, there are numerous additional plates outside those which usually form the wall. These outer plates correspond to the additional capitular plates found, among the Pedunculata, in *Pollicipes*, of which a specimen is placed alongside for comparison.

One of the commonest British Barnacles is the little *Balanus balanoides* which is familiar at the seaside, coating rocks and stones as if with "rough cast." At the other extreme of size is another species of the same genus, *Balanus psittacus*, the largest member of the sub-class, of which some fine specimens are exhibited in Wall-case No. 4. It is found on the coasts of Chile, where it is "universally esteemed as a delicious article of food."

Several species of sessile Barnacles are commonly found attached to large marine animals such as whales and turtles. The curious *Tubicinella* which burrows into the skin of whales is exhibited here, and a large cluster of *Coronula diadema*, growing on the skin of a whale, is mounted at the side of the doorway at the south end of the gallery.

Darwin's Monograph of the Cirripedia, published 1851–1854, is still the chief work of reference on this group of animals; it is

of special interest to the historian of biological theory, because, in the course of its preparation, Darwin had to deal with the problems of specific and individual variation as they present themselves to the systematic zoologist. Like other groups of sedentary organisms, plants and corals for example, the Cirripedia are particularly subject to great variation dependent on differences of environment, and Darwin often found considerable difficulty in deciding as to the limits of species. In Table-case No. 4 is exhibited a small series of specimens selected by Darwin himself to illustrate the variations of *Balanus amphitrite*, and accom-

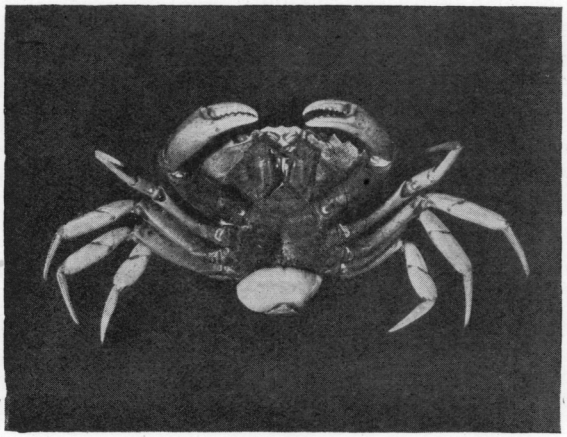


FIG. 15.

Sacculina carcini attached under the abdomen of a common Shore-crab. [Table-case No. 4.]

panied by a list in his handwriting. Of this species Darwin wrote in his Monograph :—

" In order to show that it has not been from indolence that I have put so many forms together, I may state that I had already named and fully described in detail eight of the following forms as species, when I became finally convinced that they were only varieties. . . . After studying such varying forms as *B. tintinnabulum* and *amphitrite*, it is difficult to avoid, in utter despair, doubting whether there be such a thing as a distinct species, or at least more than half a dozen distinct species in the whole genus *Balanus*."

The members of the Order RHIZOCEPHALA are parasites living on other Crustacea, and they offer one of the most striking

examples of the degradation in structure associated with the parasitic habit of life. In the adult they lose every trace, not only of Crustaccan, but even of Arthropodous structure, although the very close resemblance of their larval stages to those of the normal Cirripedes shows that they have been derived from forms similar to the latter. The body is enclosed in a fleshy mantle, which has a small opening to the exterior. From the short stalk by which the animal is attached, fine root-like filaments branch in all directions throughout the body of the host (generally a Crab), and serve for the absorption of nourishment. The parasite has no mouth or food-canal, no limbs, and only a feebly developed nervous system.

Sacculina carcini, of which a specimen is exhibited (Fig. 15), is found on the common shore-crab (*Carcinus maenas*) and other Crabs.

The remarkable changes which the presence of *Sacculina* induces in its hosts are illustrated by a series of specimens in Wall-case No 2 already referred to.

In their larval development the Rhizocephala pass through Nauplius and Cypris stages closely similar to those of ordinary barnacles. Drawings of the larval stages of Sacculina are exhibited.

Sub-class V.—MALACOSTRACA.

The body consists of nineteen limb-bearing somites (or twenty, if the eye-stalks be reckoned as appendages). A *thorax* of eight and an *abdomen* usually of six somites are sharply distinguished by the character of the appendages.

This sub-class is much larger and more varied than any of the others. It may be divided into five divisions as follows :—

Division 1. *Phyllocarida.*
,, 2. *Syncarida.*
,, 3. *Peracarida.*
,, 4. *Hoplocarida.*
,, 5. *Eucarida.*

Division 1.—PHYLLOCARIDA.

(Table-case No. 5.)

The carapace is bivalved, enveloping but not coalescing with the thoracic somites, and bearing in front a movably articulated rostral plate. The eyes are stalked. The last somite of the

abdomen has no limbs, but the telson carries a pair of appendages forming the "caudal fork." The thoracic limbs are flattened and leaf-like.

The existing species belonging to this division are few in number but are very widely distributed in all seas. *Nebalia bipes* (Fig. 16), of which a specimen is exhibited, occurs on the British coasts and ranges from Greenland to Chile and Japan. A coloured drawing of a living *Nebalia* is hung in Wall-case No. 4.

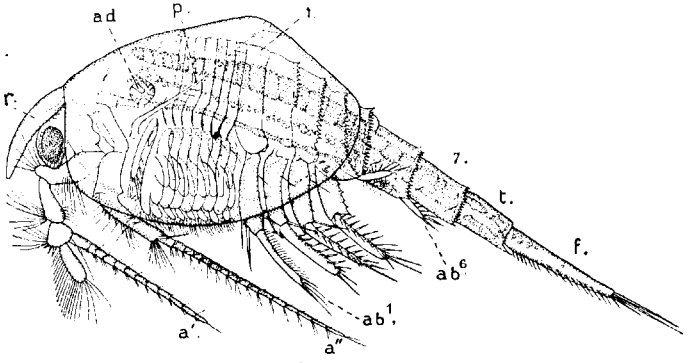


FIG. 16.

Nebalia bipes, female, from the side (enlarged). *a.'*, Antennule; *a.''*, antenna; *ab.*^{1}–*ab.*^{6}, the abdominal limbs; *ad.*, the adductor muscle joining the two valves of the shell; *f.*, the caudal fork; *p.*, palp of maxillula; *r.*, rostral plate; *t.*, telson; 1–7, the seven somites of the abdomen. (From Lankester's "Treatise on Zoology," after Claus.)

It is probable that the fossil forms known as the *Ceratiocaridae*, which are abundant in many rocks of Palaeozoic age, should be referred to this division.

Division 2.—SYNCARIDA.

(Table-case No. 5.)

There is no carapace, and all the thoracic somites, or all except the first, are distinct. The eyes may be stalked or sessile. The thoracic limbs carry exopodites and a double series of plate-like gills.

This division includes, among living Crustacea, a small number of very peculiar forms nearly all found in the fresh waters of Tasmania and Victoria (Fig. 17). They are of special interest on account of the fact that they appear to be survivors of an

ancient group of Crustacea of which the remains are found fossil in Carboniferous and Permian rocks. The drawing of the fossil *Palaeocaris praecursor* (Fig. 18), exhibited in the case, shows the

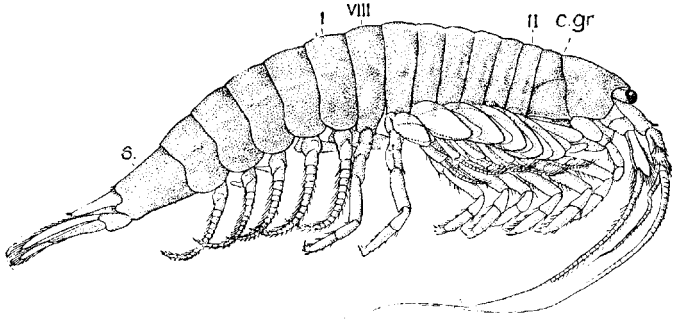


FIG. 17.

Anapides tasmaniae, male, from the side (slightly enlarged). *c.gr.*, "Mandibular groove"; II–VIII, the thoracic somites; 1–6, the abdominal somites. [Table-case No. 5.]

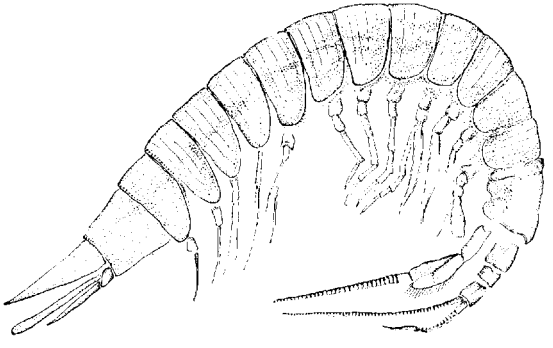


FIG. 18.

Palaeocaris praecursor, from the Coal Measures of Derbyshire.

great resemblance in general form between that species and the recent *Anaspides* (Fig. 17).

Division 3.—PERACARIDA.

(Table-case Nos. 5–7.)

The carapace, when present, does not coalesce dorsally with more than four of the thoracic somites. The eggs and young are

carried in a brood-pouch formed by overlapping plates attached to the bases of the thoracic limbs.

The following Orders are included in this division :—

Order 1. *Mysidacea.*
,, 2. *Cumacea.*
,, 3. *Tanaidacea.*
,, 4. *Isopoda.*
,, 5. *Amphipoda.*

Order 1.—Mysidacea.

(Table-case No. 5.)

The general form is shrimp-like (Fig. 19). A carapace is present, but it leaves free at least five of the thoracic somites. The eyes, when present, are stalked and movable. There are swimming branches (exopodites) on the thoracic legs.

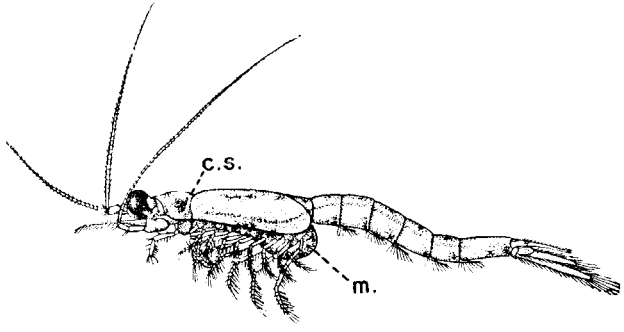


Fig. 19.

Mysis relicta, female, from the side. *c.s.*, "Mandibular groove"; *m.*, Brood-pouch. (From Lankester's "Treatise on Zoology," after Sars.)

Most of the Mysidacea live in the sea and many species are found on the British coasts. *Macromysis flexuosus* is one of the commonest species. A coloured drawing of the closely allied *Leptomysis* is hung in Wall-case No. 5. A drawing of *Arachnomysis leuckartii* in the Table-case gives an example of the remarkable forms assumed by some deep-sea members of the Orde . The family *Lophogastridae*, all of which are inhabitants of the deep sea, reach a much greater size than do the members of the other families. A specimen of *Gnathophausia ingens* from the *Challenger* Expedition is exhibited, and alongside of it is placed a copy of a coloured drawing from a living specimen of *G. zoëa*

(Fig. 20), showing the vivid red coloration characteristic of many deep-sea Crustacea.

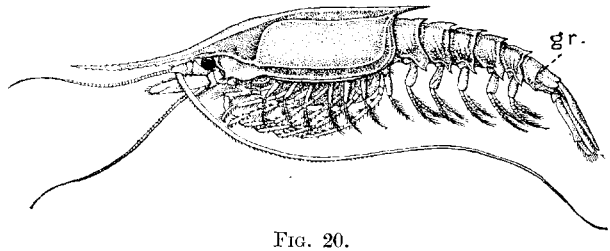


FIG. 20.

Gnathophausia zoëa, female, from the side, one-half natural size. *gr.*, a groove dividing the last abdominal somite. (From Lankester's "Treatise on Zoology," after Sars.)

Order 2.—Cumacea.

(Table-case No. 5.)

A carapace is present, but it leaves four or five of the posterior thoracic somites free. The eyes are not stalked, and are usually coalesced into one. Swimming branches (exopodites) are usually present on some of the thoracic limbs. The abdomen is generally very slender, and the last pair of appendages (uropods) are

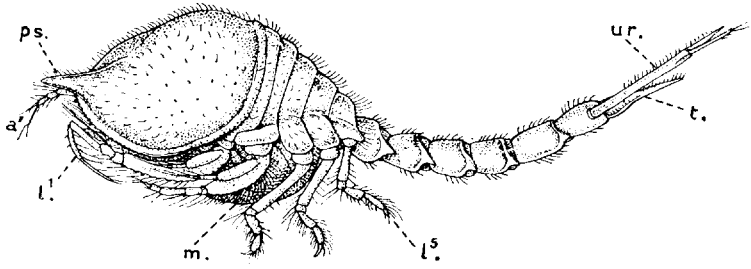


FIG. 21.

Diastylis goodsiri, female, from the side, enlarged. *a.'*, antennule; *l.*^{1}–*l.*^{5}, the five pairs of walking-legs; *m.*, brood-pouch; *ps.*, "pseudo-rostrum," formed by lateral plates of the carapace; *t.*, telson; *ur.*, uropods. (From Lankester's "Treatise on Zoology," after Sars.)

elongated. The other abdominal appendages are absent, at least in the female.

The Cumacea are all marine, burrowing in sand and mud, and being occasionally taken in great numbers swimming at the surface of inshore waters. As a rule, they are very small, the specimens of the common British species *Iphinoë trispinosa* here

shown being perhaps larger than the average, but in Arctic seas, where they are especially abundant, they often attain a much greater size, as is shown by the specimen of *Diastylis goodsiri* (Fig. 21) from the Kara Sea.

Order 3.—Tanaidacea.

(Table-case No. 6.)

Six of the thoracic somites are always distinct, the reduced carapace involving only the first and second (Fig. 22). On each side the overhanging carapace encloses a cavity within which lies (as in the Cumacea) a branchial appendage attached to the first thoracic limb. The second thoracic limb is chelate or pincer-like, and the second and third may carry minute vestiges of swimming-

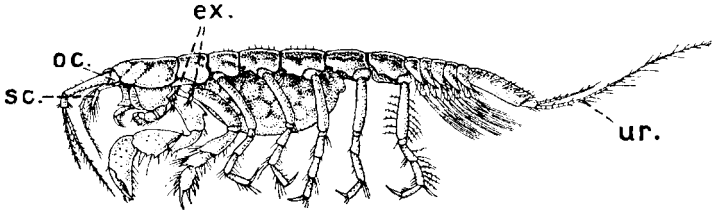


Fig. 22.

Apseudes spinosus, female, from the side, enlarged. *ex.*, vestiges of exopodites on second and third thoracic limbs; *oc.*, the small and immovable eye-stalks; *sc.*, scale or exopodite of antenna; *ur.*, uropod. (From Lankester's "Treatise on Zoology," after Sars.)

branches (exopodites) (Fig. 22, *ex.*). The eyes, when present, are set on small and immovable stalks (Fig. 22, *oc.*).

The Tanaidacea, which are all marine, and generally of very small size, are of great interest as preserving, along with the Cumacea, links of connection between the stalk-eyed or "podophthalmate" type of the Mysidacea and the sessile-eyed or "edriophthalmate" Isopoda and Amphipoda.

Order 4.—Isopoda.

(Table-case No. 6.)

There is no distinct carapace. As a rule, only the first thoracic somite is fused with the head, and the other seven are free. There are no exopodites on the thoracic limbs. The eyes, when present, are sessile. The body is usually flattened from above downwards. The abdominal appendages are lamellar and respiratory.

This is a very large and varied group, comprising numerous families which are grouped under six Sub-orders.

In the Sub-order ASELLOTA the uropods are slender ; the basal segments of the legs are not coalesced with the body as in most other Isopoda ; the first pair of abdominal limbs are generally fused, in the female, to form an operculum, or cover for the remaining pairs. This group includes *Asellus aquaticus*, which is

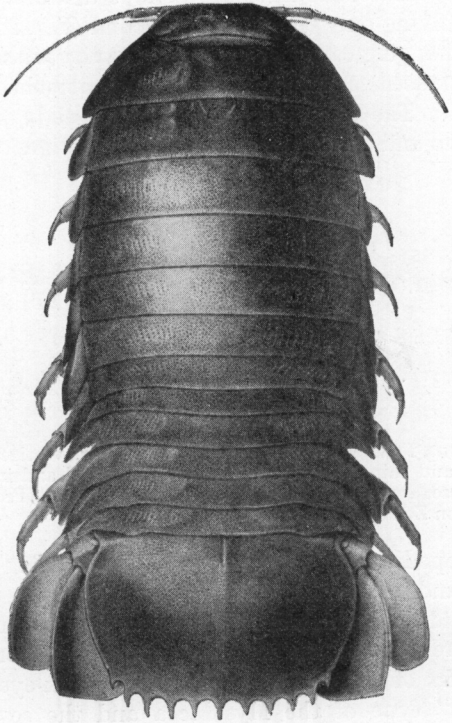


FIG. 23.

Bathynomus giganteus, about one-half natural size. (From Lankester's "Treatise on Zoology," after Milne-Edwards and Bouvier.) [Table-case No. 6.]

common everywhere in ponds and ditches in this country, and a very large number of marine species, mostly of small size.

The Sub-order PHREATOICIDEA includes a small number of very peculiar species found in fresh water in Australia and New Zealand. In these the body is flattened from side to side, and

the animals in other respects have a superficial resemblance to Amphipoda.

In the Sub-order FLABELLIFERA the terminal limbs of the abdomen (uropods) are spread out in a fan-like manner on each side of the telson. Many species of this group, belonging to the family *Cymothoidae*, are blood-sucking parasites of fish, and some of them are remarkable for being hermaphrodite (like the Cirripedia), each animal being at first a male and afterwards a female. Most of these parasites are found adhering to the surface of the body, behind the fins or under the gill-covers of the fish. A few, however, become internal parasites like the *Artystone trysibia* exhibited in this case, which has burrowed into the body of a Brazilian freshwater fish. This family includes the giant of the Order, the deep-sea *Bathynomus giganteus* (Fig. 23), which sometimes reaches an even greater size than the specimen exhibited.

A contrast in point of size is provided by the minute *Limnoria lignorum* belonging to the family *Sphaeromidae*, which, in company with certain other Crustacea, burrows in wood and is the cause of great damage to submerged structures of timber. An account of these boring Crustacea will be found in the Museum pamphlet "Marine Boring Animals" (Economic Series, No. 10).

The Sub-order VALVIFERA is characterised by the fact that the uropods form a pair of plate-like "valves" closing over the remaining five pairs of abdominal appendages. This Sub-order includes the species of *Idotea* common on the British coasts, one of which is shown in a coloured drawing hung in Wall-case No. 6. The family *Arcturidae* is remarkable for the long and sub-cylindrical body, very unlike that of the ordinary Isopods, and also for the great size of the antennae, on which the young cluster as in the specimen of *Arcturus baffini* (Fig. 24) exhibited here.

The Sub-order ONISCOIDEA comprises the familiar "Wood Lice" or "Slaters" so common in gardens. They are terrestrial animals adapted for breathing air, and sometimes having, in the abdominal limbs, tufted air-tubes like the "tracheae" of insects, which serve as respiratory organs. The terminal limbs of the abdomen are slender or minute, and the antennules are always small. The large "Sea Slater," *Ligia oceanica*, which is always found near the sea and sometimes actually in rock pools, is intermediate in many points of structure, as it is in habits, between the exclusively terrestrial species and their marine relatives. *Porcellio scaber* (Fig. 25) is one of the very common garden species.

The Isopods belonging to the Sub-order EPICARIDEA are all parasitic on other Crustacea, and their structure presents, in the

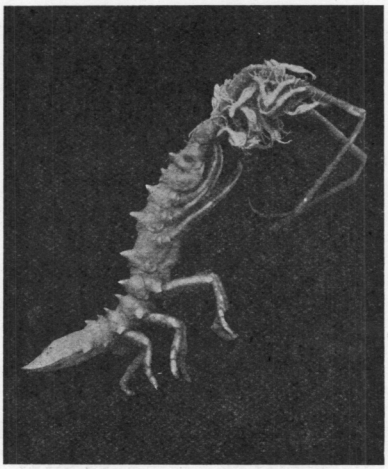


FIG. 24.

Arcturus baffini, female, carrying a cluster of young ones on its antennae. [Table-case No. 6.]

adult state, a great variety of modifications. The two sexes are often very dissimilar in size and shape, and some species are hermaphrodite. A specimen of the common Prawn (*Leander serratus*) is exhibited which has, on one side of the carapace, a swelling due to the presence in the gill-chamber of the parasite *Bopyrus squillarum*. The female of the parasite, taken out of the gill-chamber, is shown alongside. The male, in this species, is almost microscopic in size, and is commonly found clinging to the under side of the female.

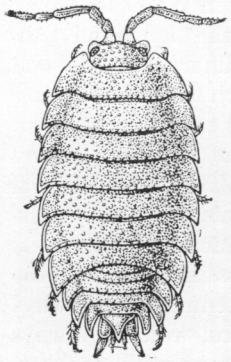


FIG. 25.

Porcellio scaber, female, dorsal view, enlarged. (From Lankester's "Treatise on Zoology," after Sars.)

A still more remarkable form is shown in the drawings of *Portunion maenadis*, a parasite of the Common Shore Crab, *Carcinus maenas*. The figure on the right shows the parasite *in situ* in the shell of the crab. The yellow mass is

the greatly developed brood-pouch, which is distended with eggs. The figure on the left represents a younger specimen removed from the crab and further enlarged. The flaps of the empty brood-pouch have been turned back.

Order 5.—Amphipoda.

(Table-case No. 7.)

As regards the segmentation of the body, the sessile eyes, and some other characters, the members of this Order agree with the Isopoda, but the body is usually compressed from side to side, the abdominal appendages are not respiratory, and there are gill-

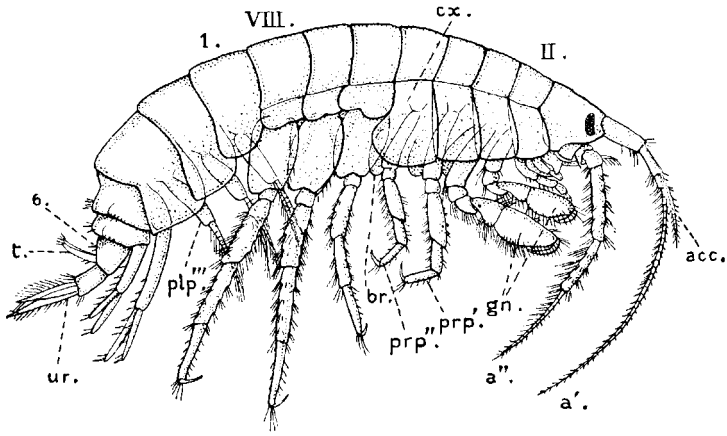


FIG. 26.

Gammarus locusta, male, from the side, enlarged. *a'*, antennule; *a''*, antenna; *acc*, accessory (inner) flagellum of antennule; *br*, gill-plate; *cx*, coxal plate (the expanded first segment of the leg); *gn*, the two pairs of "gnathopods" (prehensile legs); *plp'''*, abdominal appendage of third pair; *prp'*, *prp''*, first and second peracopods or walking-legs; *t*, telson; *ur*, uropod; II., VIII., second and eighth thoracic somites; 1, 6, first and sixth abdominal somites. (From Lankester's "Treatise on Zoology," after Sars.)

plates attached on the inner side of the bases of some of the thoracic limbs.

The Amphipoda are grouped under three Sub-orders.

In the Sub-order GAMMARIDEA are included the typical Amphipoda, in which the body is more or less stout, the abdomen well developed, and the eyes generally small. The most familiar members of this Sub-order are perhaps the Sandhopper, *Talitrus saltator*, and the Shorehopper, *Orchestia gammarellus*. These

two species are exceedingly common all round our coasts. They are almost terrestrial in their habits, burrowing in the sand above high-water mark, and sometimes at a little distance from the sea. The two are often found together, and it is perhaps incorrect to imply that they are distinguished in popular speech, but *Talitrus* is stated to be more common on sandy beaches, while *Orchestia* is often found among rocks.

More typical representatives of the Gammaridea, however, are

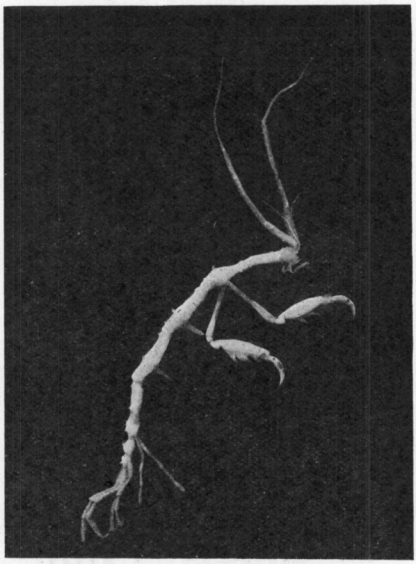


FIG. 27.

Aegina spinosissima, one of the Caprellidae, slightly reduced.
[Table-case No. 7.]

the numerous species of *Gammarus*, of which some live in the sea, and others, like the very common *Gammarus pulex* of this country, in fresh water. Specimens and a drawing of *Gammarus locusta* (Fig. 26) are shown in this case, and a coloured drawing of the same species, from life, is hung in Wall-case No. 6.

Of the other Gammaridea exhibited, it need only be said that some, like *Eurythenes gryllus* and *Stegocephalus ampulla*, show the large size reached by some species in Arctic Seas, where they swarm in extraordinary profusion ; that *Acanthogammarus godlewskii* is one of a host of remarkable species, all closely related

to the common *Gammarus*, found in Lake Baikal; and that the little *Chelura terebrans* is, of all Amphipoda, perhaps the most directly important to man on account of its destructiveness to marine timber.

The members of the Sub-order HYPERIIDEA can generally be recognised by the very large eyes, which may cover almost the whole surface of the head. The first thoracic limbs (maxillipeds) are reduced. Most of the species are pelagic in habit, living at the surface of the open sea. One of the most remarkable is *Phronima sedentaria* which lives on various pelagic organisms, like jelly-fishes and salps, and often carries about with it as a kind of cloak the remains of its prey. One of the two specimens here shown is enclosed in a barrel-shaped case, the remains of a swimming-bell of one of the Siphonophoran jelly-fishes.

In the Sub-order CAPRELLIDEA the body is either slender and thread-like (Caprellidae), or broad and flattened (Cyamidae). The abdomen and its limbs are vestigial.

The *Caprellidae* (Fig. 27) are generally found among Zoophytes or seaweeds. A group of specimens mounted in natural surroundings is shown in Wall-case No. 4.

The *Cyamidae*, or "Whale Lice," are parasitic on Whales, and are sometimes found in large numbers clinging to their skin.

Division 4.—HOPLOCARIDA.

(Table-case No. 8.)

Four or five of the posterior thoracic somites are free from the carapace. There is no brood-pouch. Two movable segments are separated from the anterior part of the head, bearing respectively the pedunculate eyes and the antennules, and there is a movable rostral plate in front of the carapace. The first five pairs of thoracic limbs are subchelate, and the second pair very large. The last three pairs carry exopodites. There are tufted gills borne by the first five pairs of abdominal appendages.

This division includes the single order STOMATOPODA, the members of which are abundant in the warmer seas. They are generally easily recognised by the characteristic form of the large claws, which are not pincer-shaped, like those of Lobsters and Crabs, but have the last segment shutting down, like a knife-blade, on the segment before it.

One species of *Squilla* (*S. desmarestii*) occurs occasionally

on the South Coast of England, and the much larger *S. mantis* (Fig. 28), of which specimens are exhibited from the Mediterranean, is said to have been found off the coast of Cornwall. Both species are used for food in Mediterranean countries.

The Stomatopoda have a prolonged larval development, in the course of which the larvae assume very striking forms, and often

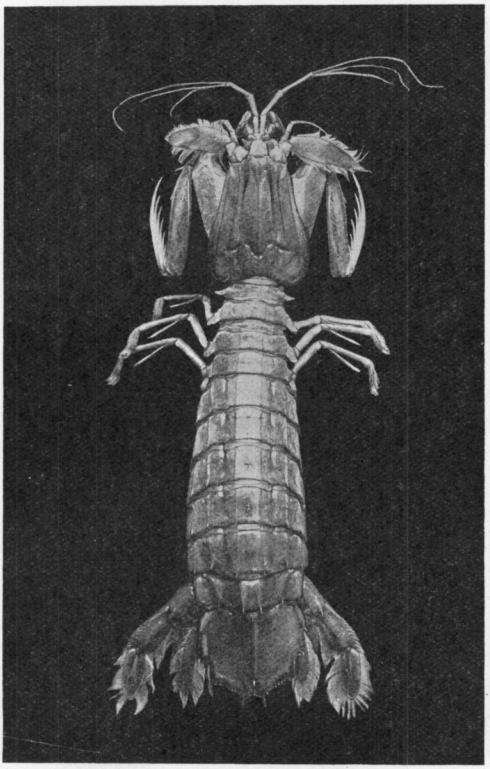


FIG. 28.

Squilla mantis, about one-half natural size. [Table-case No. 8.]

attain a large size. They were formerly supposed to be independent species of Crustacea, and received the generic names of *Erichthus*, *Alima*, etc. The " species " *Lysioerichthus edwardsii*, of which a specimen is exhibited, has been found to be the larval state of *Lysiosquilla glabriuscula*.

Division 5.—EUCARIDA.

The carapace is coalesced dorsally with all the somites of the thorax. There is no brood-pouch.

Two Orders of very unequal size are included in this Division :—

Order 1.—*Euphausiacea.*
„ 2.—*Decapoda.*

Order 1.—Euphausiacea.

(Table-case No. 8.)

The members of this Order were formerly included with the Mysidacea in the Order "SCHIZOPODA." They are, however, very closely allied to the Decapoda, and are distinguished from

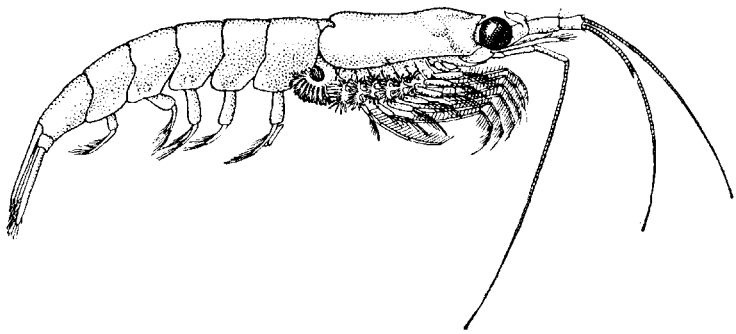


FIG. 29.

Meganyctiphanes norvegica, male, from the side, about twice natural size. (From Lankester's "Treatise on Zoology.")

the more primitive types of that Order chiefly by the fact that they possess only a single series of gills (podobranchiae), and that none of the thoracic limbs is distinctly modified as a maxilliped.

Most of these animals, like some of the lower Decapods, are phosphorescent. The light-producing organs, situated on various parts of the body and limbs, were formerly described as "accessory eyes;" they are seen as little red spots along the sides of the body in the coloured drawing of *Nematoscelis microps* exhibited in this case.

Meganyctiphanes norvegica (Fig. 29), one of the larger species of the Order, occurs in deep water off the British coast. In Loch Fyne, where the specimens here exhibited were obtained, the species forms an important food of the herring.

Order 2.—Decapoda.

(Table-cases Nos. 9–16.)

The gills are arranged typically in three series—podobranchiae, arthrobranchiae, and pleurobranchiae. Only in the aberrant genus *Leucifer* are the gills entirely absent. The first three pairs of thoracic limbs are more or less completely modified to act as jaws (maxillipeds), while the last five form the legs.

This very extensive and varied Order includes all the larger and more familiar Crustacea, such as Crabs, Lobsters, Crayfish,

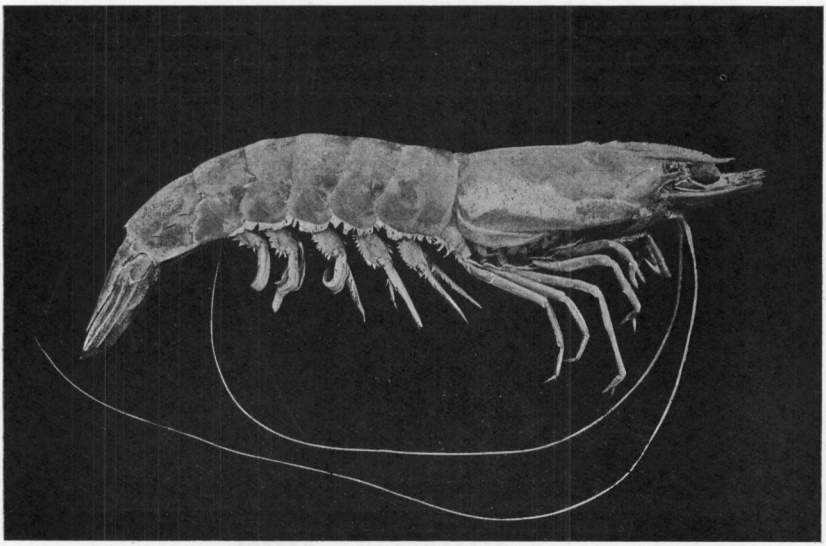


Fig. 30.

Penaeus caramote, from the side, about half natural size.
[Table-case No. 9.]

Prawns, and Shrimps. From their greater size and more general interest, it is both possible and desirable to exhibit a much larger series than in the other groups of Crustacea, and in Table-cases Nos. 9 to 16 will be found representatives of all the Tribes and of the more important families composing the Order. On the system of classification adopted here, these tribes are grouped under three Sub-orders :—

Sub-order 1.—Macrura.
,, 2.—Anomura.
,, 3.—Brachyura.

Sub-order I.—MACRURA.

(Table-cases Nos. 9–11.)

The Macrura are generally distinguished by the large size of the abdomen, which is symmetrical and not folded under the body. The front, or rostrum, is not united with the "epistome." The sixth pair of abdominal appendages (uropods) are always present, generally broad and flattened, forming with the telson, a "tail-fan."

The first Tribe of the Macrura, the Penaeidea, consists of prawn-like animals having the first three pairs of legs usually chelate or pincer-like, and not differing greatly in size. The side-plates of the second abdominal somite do not overlap those of the first. Members of this Tribe are the commonest Prawns in tropical seas, and often reach a great size. *Penaeus caramote* (Fig. 30) is highly esteemed for the table in Mediterranean countries, and many other species are used for food in various parts of the world. *P. caramote* is stated to have occurred on the Welsh coast. *Leucifer*, a delicate, transparent, pelagic form, belonging to this tribe, differs from all other Decapoda in having no gills.

The small Tribe of the Stenopidea includes a few forms which resemble the Penaeidea and the Astacidea in having the first three pairs of legs chelate, but differ from them, among other characters, in the fact that the third pair is much the largest. *Stenopus*, a common tropical genus, is remarkable for the brilliant coloration of the living animals. The specimen of *S. hispidus* exhibited here has been painted so as to convey some impression of this.

The Tribe Caridea includes the true Prawns and Shrimps. The first two pairs of legs are generally chelate or pincer-like, and the first is seldom larger than the second. The second somite of the abdomen has the side-plates broadened, so as to overlap those of the somites in front and behind.

Only a few of the numerous families composing this tribe are illustrated by the specimens exhibited.

The members of the family *Acanthephyridae* are deep-sea animals, and possess many primitive characters. Like some of the related families, they have swimming branches (exopodites) on the legs. Some of them are phosphorescent.

The *Nematocarcinidae* are also inhabitants of the deep sea, and are remarkable for the extreme length and slenderness of

the legs, well shown by the specimen of *N. undulatipes* (Fig. 31) from the *Challenger* Expedition, which is exhibited here.

The *Pandalidae* have the first pair of legs slender and ending in pincers so minute that, to the naked eye, the limbs appear simply pointed. The second legs have the carpus, or " wrist," divided into small segments. To this family belong the British *Pandalus montagui* (the " Pink Shrimp " of the fishmonger) and

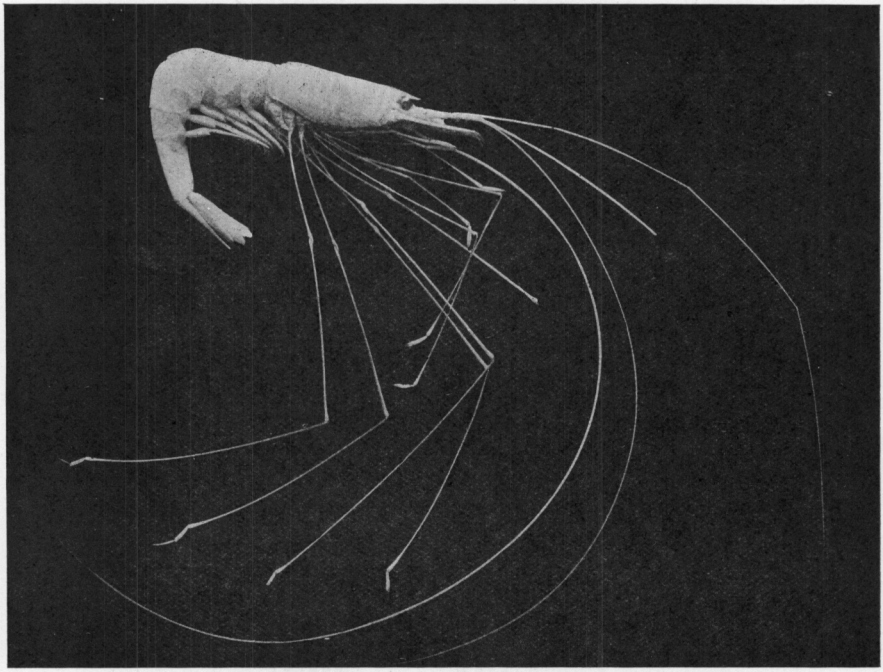


FIG. 31.

Nematocarcinus undulatipes. [Table-case No. 9.]

the much larger *P. borealis.* The latter inhabits the deeper waters of some of the Norwegian fjords, ranging from 60 to 400 fathoms depth. In recent years, as a direct result of investigations carried out by the zoologists of the Norwegian Fishery Department, an important fishery of this species has been established, and large quantities are now exported from Norway to the English and other markets.

In the family *Alpheidae* the pincers of the first pair of legs are

usually greatly enlarged and very dissimilar in shape. The second legs are slender, and have the carpus, or "wrist," divided into many small segments. The members of this family are very abundant in tropical seas, especially on coral reefs. Some of them produce a clicking noise by snapping the fingers of one of the chelae.

In the family *Palaemonidae* the first two pairs of legs end in chelae, or pincers; the second pair is larger than the first, and has the carpus, or "wrist," undivided. The antennules bear each three terminal filaments. To this family belong the common marine "Prawns" of British coasts and the "River Prawns" that are abundant everywhere in fresh waters within the tropics. The great size reached by some of the latter is shown by the

FIG. 32.

The common Prawn, *Leander serratus*, slightly reduced. [Table-case No. 9.]

specimens of *Palaemon carcinus* from the East Indies and *P. jamaicensis* from the West Indies. Attention may also be directed to a specimen of the common Prawn (*Leander serratus*) (Fig. 32) prepared by a special process so as to retain the translucency of the living animal.

In the family *Crangonidae* the pincers of the first pair of legs are imperfectly formed (sub-chelate) and much stronger than those of the second pair, which are very slender. The rostrum is usually short and flattened. To this family belong the common Shrimp (*Crangon vulgaris*) and the large Arctic Shrimp (*Sclerocrangon boreas*).

The Tribe ASTACIDEA (or NEPHROPSIDEA) includes the true Lobsters and Crayfishes. They may be recognised by having the first three pairs of legs chelate or pincer-like, and the first pair very large.

The Lobsters constitute the family *Homaridae*, all the

members of which inhabit the sea. The last thoracic sternum is firmly fixed to the preceding, and the male has sexual appendages on the abdomen.

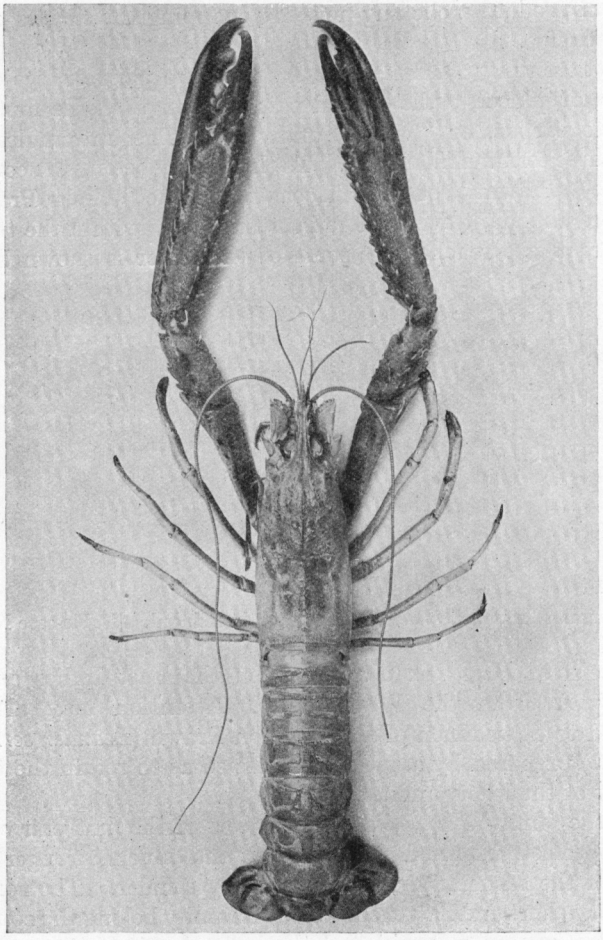


FIG. 33.

The "Norway Lobster," *Nephrops norvegicus*. Length, from head to tail, 7½ inches. [Table-case No. 10.]

The common Lobster of Europe, *Homarus gammarus*, is represented on the American coasts of the North Atlantic by a closely allied species, *H. americanus*. A third species, *H. capensis*, is

found at the Cape of Good Hope, but it is of small size and of no economic importance. A series of specimens and drawings in Wall-cases Nos. 1 to 3, illustrating the structure and life-history of the Common Lobster, have already been described. The "Norway Lobster," *Nephrops norvegicus* (Fig. 33), is found abundantly in certain localities in deeper water than that frequented by the Common Lobster. It is generally sold in London shops under the name of "Dublin Prawn," although the chief supplies now come from Scotland and the North-East of England, not, as formerly, from the Irish Sea. In connection with the name "Norway Lobster" used for this species, it should be remembered that the common Lobster is abundant on the coasts of Norway, and that large quantities are exported thence to England.

In the true Crayfishes, which belong to two families inhabiting respectively the fresh waters of the Northern and Southern Hemispheres, the last thoracic sternum is movable. In the Northern Crayfishes, belonging to the family *Astacidae*, the male has sexual appendages on the abdomen.

The largest of the Crayfishes found in Western Europe, and the most highly esteemed for food, is the "Red-clawed Crayfish," *Astacus fluviatilis* (French, "Écrevisse à pattes rouges," German, "Edelkrebs"), found in France, Germany, Austria, N.W. Russia, S. Sweden, Denmark, &c. Although the name *A. fluviatilis* is sometimes applied to the English Crayfish, it is more correctly restricted to the Red-clawed species, which does *not* occur in the British Islands.

The "White-clawed Crayfish," *Astacus pallipes* (French, "Écrevisse à pattes blanches," German, "Steinkrebs"), is found in England and Ireland, France, South Germany, Italy, &c. It is little used for food, being regarded as much inferior to *A. fluviatilis*.

Astacus leptodactylus is a large species found in the Lower Danube and its tributaries, and in Russia, especially in those rivers that flow into the Black Sea and the Caspian. It is occasionally used for the table, but is regarded as inferior in quality.

In North America, east of the Rocky Mountains, numerous species of crayfish of the genus *Cambarus* are found. A few of these live in the subterranean waters of caves, and, like many other subterranean animals, are blind. The best known species is *Cambarus pellucidus*, from the Mammoth Cave in Kentucky, of which a specimen is exhibited.

In the Southern Crayfishes, forming the family *Parastacidae*, there are no sexual appendages in the male. Numerous species of this family occur in Australia, and *Astacopsis spinifera*, known as the "Murray River Lobster," is used for food. Like the closely allied *A. franklinii* (Fig. 34) of Tasmania (of which a specimen is exhibited in Wall-case No. 5), it sometimes grows to a great size. The occurrence of *Astacoides madagascariensis* on the island of Madagascar is remarkable, since no Crayfishes are found anywhere on the African continent.

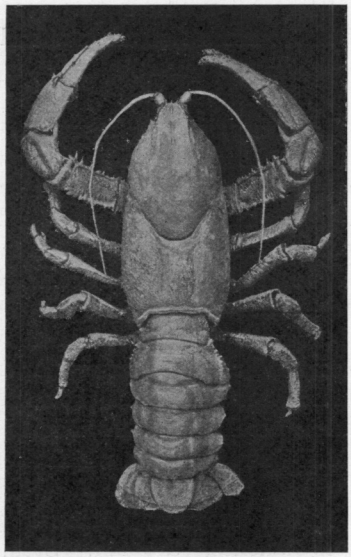


FIG. 34.

Astacopsis franklinii, about $\frac{1}{7}$th natural size. [Wall-case No. 5.]

The members of the tribe LORICATA (or SCYLLARIDEA) are large, lobster-like Crustacea. They may be distinguished from the true lobsters by having no chelae (the last pair of legs only are imperfectly chelate in the female). In the family *Palinuridae* the body is more or less cylindrical, and the antennae are long, cylindrical and jointed, while in the *Scyllaridae* the body is more or less flattened, and the antennae are expanded into broad plates, which are said to be used as shovels in burrowing. To the former family belongs the Spiny Lobster or Sea Crawfish (French, "Langouste"), *Palinurus vulgaris* (Fig. 35), which is

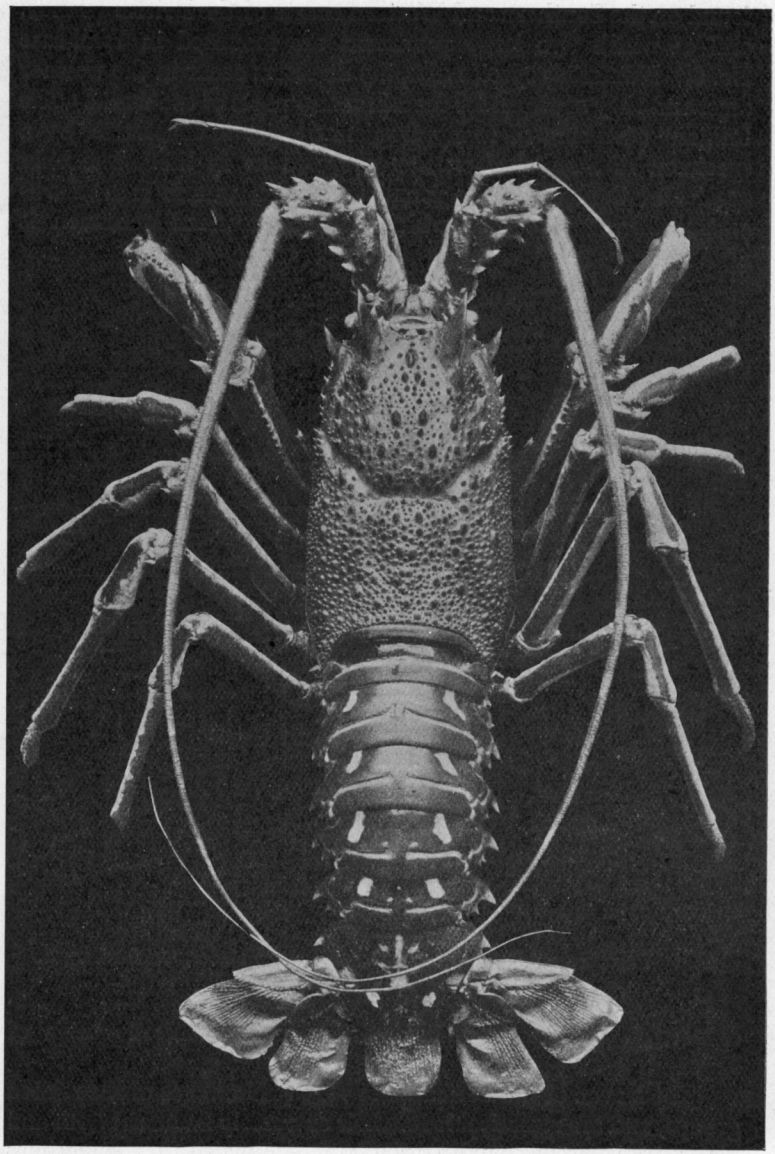


FIG. 35.

The common Spiny Lobster, *Palinurus vulgaris*, much reduced.
[Wall-case No. 6.]

found on the Southern and Western coasts of the British Islands, and of which two large specimens are mounted in Wall-case No. 6. Numerous species of Spiny Lobsters occur in the warmer seas, and they are used for food in many parts of the world. The brilliant colouring of many tropical species is illustrated by a specimen of *Panilurus ornatus* coloured as in life. The only species of the Scyllaridae found in British waters is *Scyllarus arctus* (*Arctus ursus*) of which a Mediterranean specimen is

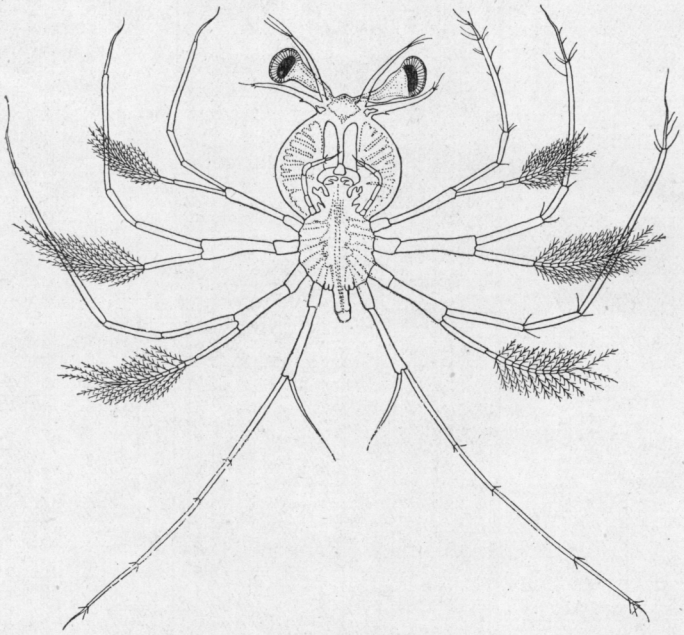


FIG. 36.

The "*Phyllosoma*" larva of the common Spiny Lobster, much enlarged. (After J. T. Cunningham.)

exhibited. It occurs, rarely, off the south-western coasts of England.

The larvae of the Loricata are very unlike those of the related groups, and are remarkable for their extremely flattened form and glassy transparency, and for the large size which they sometimes attain. They were formerly regarded as adult and independent species of Crustacea, and received the generic name of *Phyllosoma* (Fig. 36).

Representatives of the extinct family *Glyphaeidae* are found fossil in rocks of Mesozoic age, from the Trias onwards. In some characters, such as the possession of a scale or exopodite on the antenna, and sometimes in having true chelae, they are much more primitive than the existing Loricata. A drawing of *Glyphaea regleyana* from the Jurassic of France is exhibited.

In the Tribe ERYONIDEA the first four, and sometimes all five, pairs of legs are provided with chelae. Special interest attaches to this tribe on account of its geological antiquity. Fossil forms, not very different from those now living, are found in rocks of Mesozoic age, from the Trias onward.

The existing species are confined to the deep sea, and, like many other deep sea animals, are blind. Some, at least, are phosphorescent, and a living example of *Stereomastis phosphorus* (of which a specimen is exhibited) (Fig. 37) was observed by Dr. Alcock to be "luminous at two points between the last pair of thoracic legs where there is a triangular glandular patch." A copy of a drawing made from a living specimen of another species, *Stereomastis sculpta*, dredged at a depth of 695 fathoms in the Gulf of Panama, shows the red coloration that is very characteristic of deep-sea Crustacea.

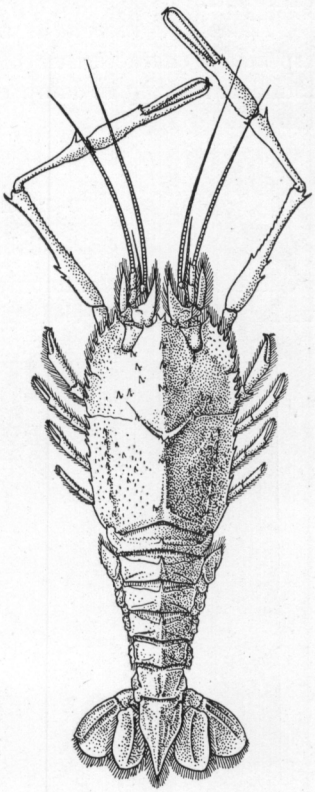


FIG. 37.

Stereomastis phosphorus, female. (After Alcock.) [Table-case No. 11.]

The fossil species are represented by a cast of *Eryon arctiformis*, from the Lithographic limestone (Jurassic) of Solenhofen in Bavaria.

The members of the tribe THALASSINIDEA are burrowing forms, with a soft, loosely built body. They form, in some respects, a transition to the Anomura, in which, in some systems of classification, they are included.

In the genus *Callianassa*, of which two species occur on the south coast of England, one of the chelae of the first pair of legs is much larger than the other and is of peculiar form. A specimen of the large *C. armata* from the Fiji Islands is exhibited.

Thalassina anomala is a widely distributed tropical species, especially characteristic of mangrove swamps, but sometimes found burrowing in damp earth at a considerable distance from the sea.

Sub-order 2.—ANOMURA.

(Table-case No. 12.)

The Anomura commonly have the abdomen more or less bent under the body, or else spirally coiled and asymmetrical. The

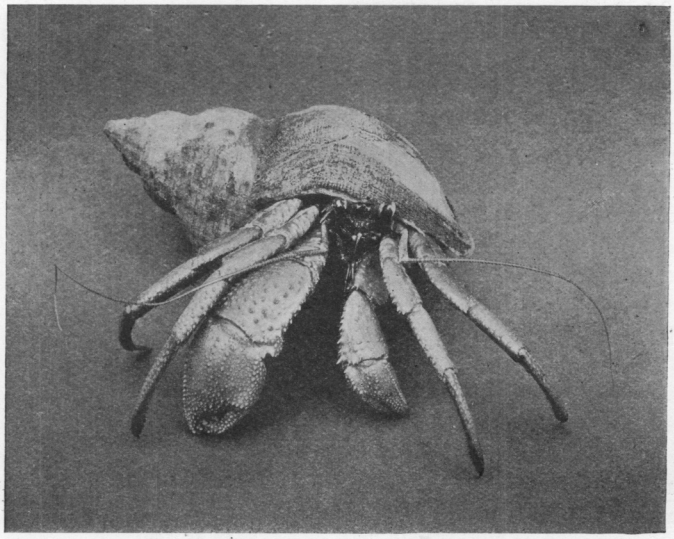


Fig. 38.

The common Hermit Crab, *Eupagurus bernhardus*, in the shell of a whelk, reduced. [Table-case No. 12.]

front, or rostrum, is not united with the epistome. The sixth pair of abdominal appendages (uropods) are rarely absent. The last pair of legs are reduced in size and the last thoracic sternum is movable.

The Sub-order is divided into three tribes, of which the first, PAGURIDEA, includes the Hermit Crabs and their allies. With few exceptions, the most important of which are the Coco-nut Crab, *Birgus*, and the family Lithodidae, the members of this tribe have the abdomen soft, not distinctly segmented, and spirally twisted in adaptation to the habit of living in the empty shells of Gasteropod Molluscs.

The marine Hermit Crabs, forming the family *Paguridae*, nearly all live in shells, and very often the outside of the shell gives attachment to Sponges, Hydroid Zoophytes, or Sea Anemones, between which and the Hermit there may exist more or less definite relations of "commensalism." In Wall-case No. 4 is shown a specimen of the common British species *Eupagurus bernhardus* lodged in a shell of *Buccinum undatum* the outside of which bears a specimen of the Anemone *Sagartia parasitica*. In addition, the cavity of the shell gives lodging to an Annelid worm, *Nereis fucata*, which protrudes its head from the opening of the shell and shares the hermit's meals. In the case of *Paguropsis typica*, exhibited in Table-case No. 12, no shell is carried, but the abdomen is protected by a cloak of living sea anemones held in position by the hinder legs of the crab. One of the largest representatives of the family, *Pagurus punctulatus*, is also placed in this case.

The members of the family *Coenobitidae* are Land Crabs, though their early stages are passed in the sea, and the adults visit the sea periodically. The species of *Coenobita* carry shells about with them like the marine Paguridae, but the "Robber Crab" or "Coco-nut Crab," *Birgus latro* (Fig. 39), of which a specimen is shown in Wall-case No. 6. has given up the habit of carrying a portable dwelling, and the dorsal plates of the abdomen, which in the other hermit-crabs are soft and membranous, have again become hard and shelly.

The stories told of the tree-climbing habits of *Birgus* have often been doubted, but the matter is set at rest by a photograph exhibited in Wall-case No. 6. This photograph was taken on Christmas Island, in the Indian Ocean, by the late Dr. C. W. Andrews, F.R.S., of the Geological Department of the Museum, and it shows a specimen of *Birgus* in the act of descending the trunk of a sago-palm.

The members of the family *Lithodidae* have become completely crab-like in shape, and were formerly classified with the Brachyura, with which, however, they have no direct affinity.

They may be at once distinguished from the true Crabs by having only three pairs of walking-legs visible behind the chelipeds, the last pair being carried folded up within the branchial chambers. Their relationship to the Hermit Crabs is shown by the fact that the abdomen is frequently asymmetrical, and has appen-

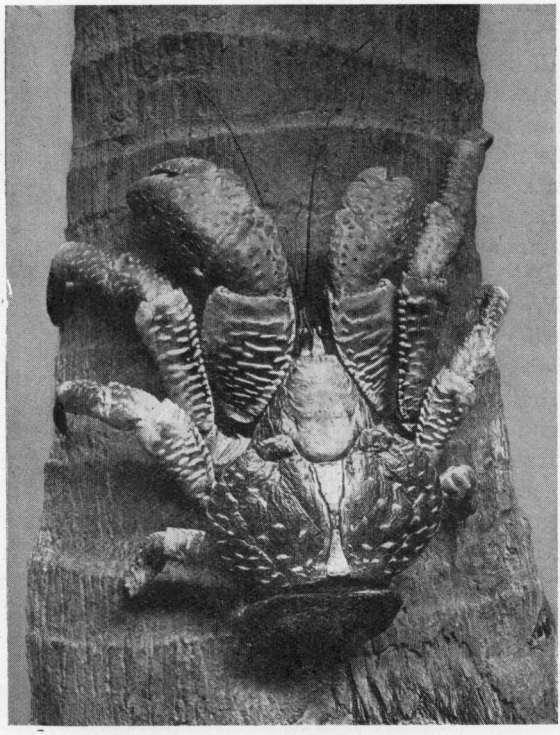


FIG. 39.

The Coco-nut Crab, *Birgus latro*, much reduced. [Wall-case No. 6.]

dages only on one side. The last pair of abdominal appendages (uropods) are wanting.

The " Northern Stone Crab," *Lithodes maia* (Fig. 40), found on the more northerly coasts of the British Islands, belongs to this family. The large *Lithodes antarctica* from the Straits of Magellan exhibited in Wall-case No. 5 is very closely related to a species (*L. camtschatica*) which is the object of an extensive fishery and canning industry in Japan. Another large species

of the same family, *Echidnocerus cibarius*, from the Pacific coast of North America, is shown in the same case. *Cryptolithodes* is an allied genus in which the carapace is expanded at the sides so as to cover the limbs completely.

In the Tribe GALATHEIDEA the body is symmetrical and more or less lobster-like, but the abdomen is bent upon itself, and sometimes folded under the body. The last pair of legs are slender and are carried folded up within the branchial chambers. The

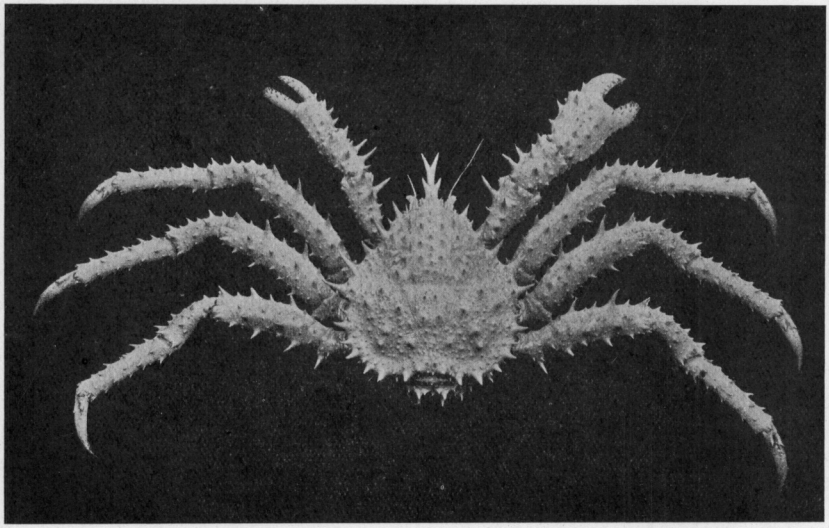


FIG. 40.

The "Northern Stone Crab," *Lithodes maia*, much reduced. The last pair of legs are folded out of sight in the gill chambers. [Table-case No. 12.]

last pair of abdominal appendages (uropods) are large, forming a well-developed tail-fan.

Several species of *Galathea* occur on the British coasts, *G. strigosa* being the largest. *Munida rugosa* (Fig. 41) is found in rather deep water in British seas. The family *Uroptychidae* includes only deep-sea species and is represented by the brilliantly coloured *Eumunida picta*. The family *Aegleidae* comprises only a single species, *Aeglea laevis*, which is interesting as being the only Anomuran inhabiting fresh water. It is found in South America, especially in mountain streams. In the family *Porcellanidae*, the short and broad carapace, without a prominent

rostrum, and the fact that the abdomen is folded under the body, give the animals quite a crab-like appearance. They are, however, very closely allied to the Galatheidae. All the species are found in shallow water. The little "Porcelain Crabs" (*Porcellana*) of British coasts are represented in tropical seas by

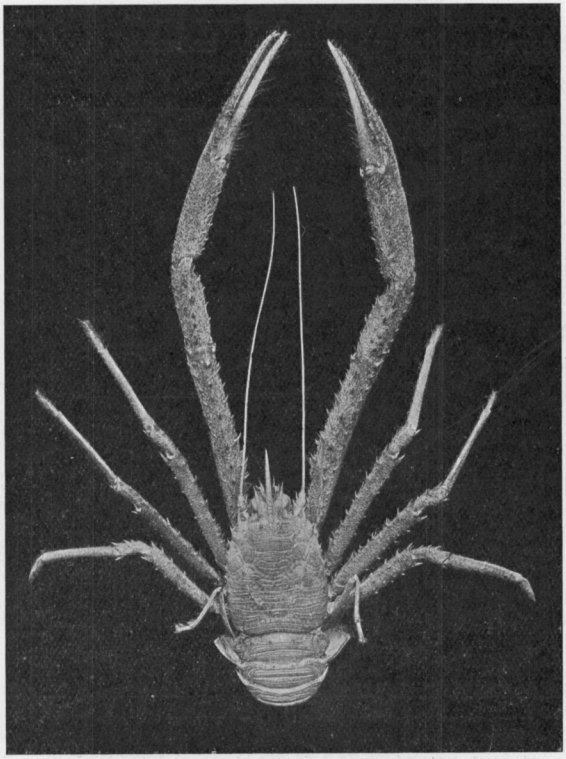


FIG. 41.

Munida rugosa (reduced). [Table-case No. 12.]

numerous species, some of which, like those exhibited, are of considerable size and striking colours.

The small tribe HIPPIDEA includes small, crab-like, burrowing forms, living in sand and having the feet flattened for digging. They are only found in the warmer seas. In one of the families of this tribe, the *Albuneidae* (Fig. 42), when the animals are buried in sand, respiration is carried on by means

of a tube formed by the long antennules, each of which bears a double row of stiff hairs. It is noteworthy that in the Brachyuran Corystidae (*see* Table-case No. 15), which have a very

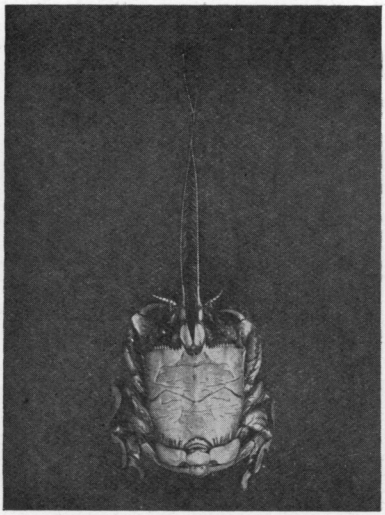


FIG. 42.

Albunea symnista (reduced). [Table-case No. 12.]

similar respiratory siphon, it is formed, not, as in this case, by the antennules, but by the antennae.

SUB-ORDER 3.—BRACHYURA.

(Table-cases Nos. 13–16.)

The BRACHYURA, or true Crabs, are distinguished from the other Decapoda by having the abdomen short and bent up under the body. The "front" sends down a process to meet the epistome, and thus forms a septum between the antennules. The sixth pair of abdominal appendages (uropods) are generally absent, rarely present as rudiments. The third pair of maxillipeds are generally broad and flattened, forming a pair of "folding doors" which cover the other mouth-parts.

The Brachyura are usually divided into five Tribes, which, however, are not all of equal value :—

Tribe 1—Dromiacea. Tribe 3—Oxyrhyncha.
,, 2—Oxystomata. ,, 4—Cyclometopa.
Tribe 5—Catometopa.

The DROMIACEA or Sponge Crabs are the most primitive of the existing Brachyura. The last pair, or the last two pairs, of

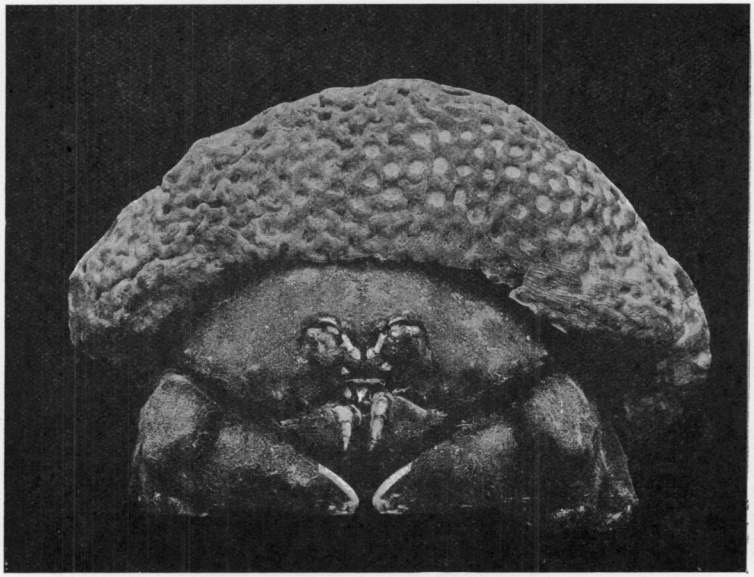


FIG. 43.

Dromia vulgaris. Front view of a specimen carrying on its back a mass of the sponge *Clione celata* (reduced). [Table-case No. 12.]

legs are dorsal in position, with hooked or prehensile claws, and are used for holding a piece of sponge, an Ascidian, or half of a bivalve shell, under which the animal is completely hidden. The mouth-frame is square. The primitive character of the group is shown especially by the retention of a vestigial pair of limbs on the first abdominal somite of the female, and often on the sixth abdominal somite in both sexes (*see* the exhibited specimen of *Dromia lator*). The basal segment of the antenna is large and unusually free, the pits into which the antennules fold are not separated from the orbits, and the gills are, in most

cases, more numerous than in the other Brachyura. The oviducts of the female open on the first segment of the third pair of legs.

Many of the Dromiacea, especially the more primitive forms, inhabit the deep sea. *Dromia vulgaris* (Fig. 43), which occurs off the South of England, belongs to the family *Dromiidae*, in which the last two pairs of legs are generally reduced in size, and are elevated on the back. One of the specimens exhibited, taken in the Bristol Channel, carries as a cloak a specimen of the sponge *Clione celata*. In the family *Dynomenidae*, represented by the little *Dynomene hispida*, only the last pair of legs are reduced and elevated on the back.

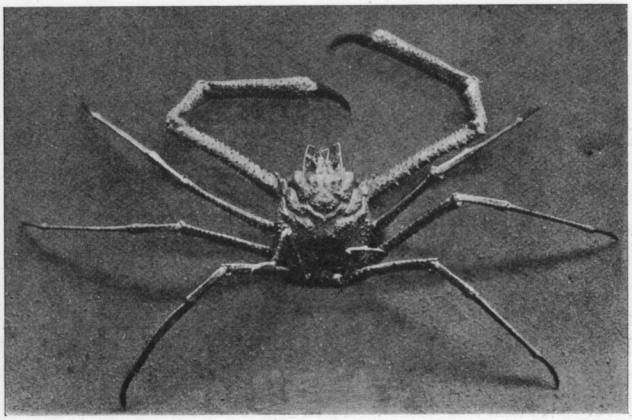


FIG. 44.

Homola cuvieri. The carapace of this specimen is about 7 inches long. [Wall-case No. 5.]

Latreillia elegans belongs to the aberrant family *Latreilliidae*. In the triangular shape of the carapace and the length and slenderness of the legs, the members of this family show a certain similarity to the Spider Crabs of the Tribe Oxyrhyncha.

To this group also belongs the family *Homolidae*, a typical example of which is the large *Homola* (*Paromola*) *cuvieri* (Fig. 44), exhibited in Wall-case No. 5. This species occurs in deep water off the south-west of Ireland.

The members of the family *Prosoponidae* are only known as fossils, but it has recently been shown that they are closely allied to the living *Dromiacea*, especially to the deep sea *Homolodromiidae*. They range from the lower Oolite to the Upper

Cretaceous. A cast of the carapace of *Prosopon mammillatum* illustrates this family.

The members of the tribe OXYSTOMATA, sometimes known as "Sand Crabs," may be recognised by the triangular shape of the mouth-frame, which is narrowed in front and extends forward between the eyes. The channels which carry the outward stream of water from the gills, and in most other crabs open at the front corners of the mouth-frame, are produced forwards to the front of the head and are closed in below by plate-like processes from the endopodites of the first maxillipeds. This arrangement is correlated with the characteristic habits of the tribe, nearly all the members of which conceal themselves in the sand, where they lie buried with only the eyes exposed.

In the family *Calappidae* the openings by which the water enters the gill-chambers are situated, as in most Brachyura, in front of the bases of the chelipeds. The legs are normal in position.

A specimen of *Calappa hepatica* is exhibited which has been prepared to illustrate the distinctive characters of the tribe. The second and third maxillipeds have been removed on one side to show the triangular mouth-frame (coloured red) and the process from the endopodite (coloured blue) of the first maxilliped. The arrow indicates the course of the respiratory current. A broad space (marked X), free from hair, is seen on each side of the mouth-frame leading down to the entrance of the gill-chamber. When the chelipeds are closed up against the under surface of the body, as in one of the specimens of *Calappa flammea* exhibited, this space is converted into a tubular channel, through which a supply of pure water can reach the gills when the crab is buried in the sand.

The species of the genus *Matuta* swim well by means of their flattened, paddle-shaped feet, which are also used for digging in sand. The animals are said to bury themselves with wonderful rapidity. The channel leading to the entrance of the gill-chamber, seen in the preparation of *Calappa*, is here much deepened in its front portion, where the overarching hairs convert it into a tubular passage opening into the orbit.

In the family *Leucosiidae* the channels leading to the gills are completely covered in by the expanded exopodites of the third pair of maxillipeds. This character is illustrated by a preparation of *Parilia alcocki* (the largest species of the family), in which the second and third maxillipeds have been removed on one side.

The mouth-frame is coloured red and the endopodite of the first maxilliped blue. X marks the inhalent respiratory channel. One of the third pair of maxillipeds is mounted separately to show the greatly expanded exopodite which, in the natural position, covers the inhalent channel.

The only Oxystomata found in British seas are several species of the genus *Ebalia*. They are small Crabs, resembling the pebbles among which they are found. Specimens of *Ebalia tuberosa* are shown in their natural surroundings in Wall-case No. 4.

In the family *Dorippidae* the afferent branchial openings are in front of the bases of the chelipeds. The abdomen is not completely concealed under the cephalothorax. The last two pairs of legs are elevated on the dorsal surface of the body, and have the terminal segments more or less distinctly modified to form a prehensile claw. The Dorippidae appear to have given up the sand-burrowing habits characteristic of other Oxystomata, and they conceal themselves by holding a piece of sponge or some other object over the back by means of the hinder legs. Many of the species inhabit the deep sea.

In the *Raninidae* the water seems to enter the branchial chamber from behind, between the edge of the carapace and the bases of the last pair of legs. As in Dorippidae, some of the abdominal somites are visible from above, and the last pairs of legs are elevated on the dorsal surface. The legs, however, are flattened and paddle-like, and appear to be used for swimming and digging, as in *Matuta*. The "Frog Crab," *Ranina scabra*, is, in general appearance, one of the most striking and aberrant of the Brachyura.

In the Tribe OXYRHYNCHA the carapace is usually triangular in shape, narrowed in front, and produced to form a rostrum. The mouth-frame is square. The genital ducts of the male open on the bases of the last pair of legs. As a rule, the legs are long and slender.

The Crabs of this tribe are generally sluggish and inactive animals, and many of them, as already mentioned, have the habit of masking themselves with seaweed, sponges, etc. Evidences of this habit will be noticed on many of the specimens in this case.

The members of the family *Maiidae* are known as "Spider Crabs." In these, the chelipeds are very mobile, and are usually not much stronger than the other legs. The orbits are more or

less incomplete. Among the specimens exhibited may be mentioned *Macropodia longirostris*, a common British species which has the long and slender legs that are typical in the group.

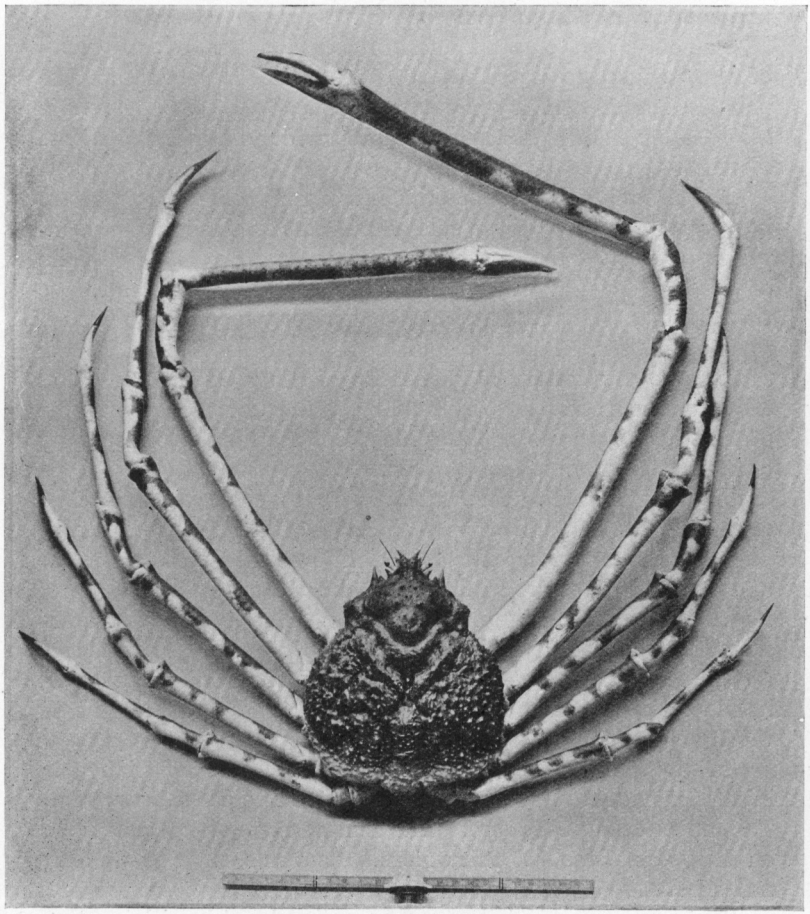


FIG. 45.

The Giant Japanese Crab, *Macrocheira kaempferi*, male. The scale of the figure is given by a two-foot rule placed below the specimen. [Specimens of the male are mounted above Wall-cases 3 and 4, and one of the female above Wall-cases 1 and 2.]

Huenia proteus is noteworthy for the leaf-like expansions of the carapace ; in life it is of an olive-green colour and is difficult to detect among the foliaceous sea-weeds which it frequents. To

this family belongs the large Spider Crab of the South and West coasts of England, *Maia squinado*, a large specimen of which is exhibited in Wall-case No. 4.

Another noteworthy member of the family is the Giant Japanese Crab, *Macrocheira* (or *Kaempferia*) *kaempferi* (Fig. 45), the largest of existing Arthropoda, of which two male specimens and a female are mounted above the Wall-cases at the south end of the Gallery. They were coloured after a drawing of a live specimen by a Japanese artist.

In the family *Parthenopidae*, the chelipeds are usually much more massive than the other legs, and the orbits are well formed. The typical members of this family have taken to the same habitat as the Oxystomata, burying themselves in sand or shingle, and they show many superficial resemblances in the shape of the chelipeds, the lateral extensions of the carapace, and the disposition of the breathing channels, to such Oxystomes as *Calappa*. In many species, as in the *Parthenope horrida* exhibited, the carapace and limbs are remarkably rugged and uneven.

The crabs belonging to the Tribe CYCLOMETOPA have the carapace, as a rule, broader than long, with the anterolateral borders strongly curved, and the postero-lateral borders convergent; the front is not produced into a rostrum; the mouth-frame is square; the genital ducts of the male open on the bases of the last pair of legs. With the exception of the River Crabs, all the members of this tribe inhabit the sea.

In the large and very varied family *Xanthidae*, the carapace, as a rule, is transversely oval, and its surface is often lobulated. The species of this family are very abundant, especially in the tropics, in the littoral region. Three species of *Xantho* are British, one of which, *X. incisus*, is exhibited. The vivid colours of some tropical species are exemplified by the painted specimens of *Carpilius maculatus* and *Zozymus aeneus*. To this family also belongs the large Tasmanian Crab, *Pseudocarcinus gigas* (Fig. 46), a specimen of which is mounted above Wall-cases Nos. 5 and 6.

A specimen of *Zozymus aeneus* is exhibited which has been prepared to illustrate the disposition of the branchial passages in Cyclometopa, for comparison with similar preparations of the Oxystomata in Table-case No. 13. The third maxilliped has been removed on one side to show the quadrilateral shape of the mouth-frame (coloured red), characteristic of most Brachyura.

The arrow indicates the course of the respiratory current, which, however, may sometimes be temporarily reversed, especially in burrowing species.

The typical members of the family *Portunidae* (Swimming

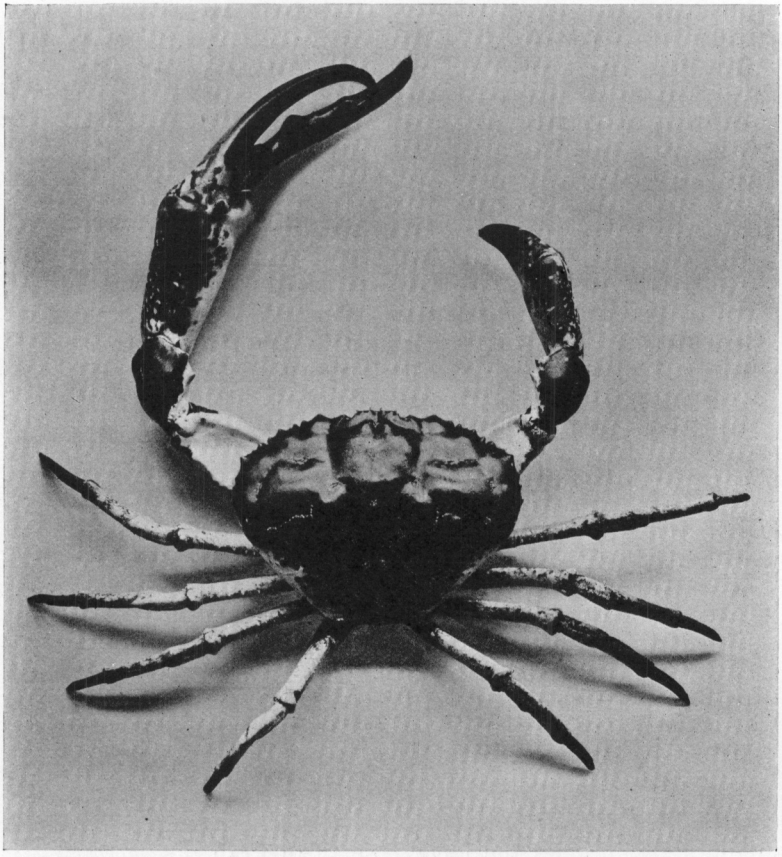


FIG. 46.

Pseudocarcinus gigas, from Tasmania. The carapace of this specimen is just over a foot in width. [Above Wall-cases Nos. 5 and 6.]

Crabs) may be recognised by the flattened, paddle-shaped, last pair of legs. Two British species of the genus *Portunus* are exhibited : the colours of *P. depurator* have been carefully copied from a living individual, and the specimen is mounted on a sample

of the shell-gravel on which it was actually caught. The large *Neptunus pelagicus* is the commonest edible Crab in many parts of the East. The Common Shore Crab, *Carcinus maenas*, is also referred to this family, although the paddle-shape of the last legs is not so marked as in the more typical Portunidae.

Podophthalmus vigil (Fig. 47) is remarkable for the great length of the eye-stalks, which is quite unusual among the Cyclometopa, and gives this Crab a curious likeness to the genus *Macrophthalmus* among the Ocypodidae (*see* Table-case No. 16). The resemblance, however, is quite superficial, for in this case

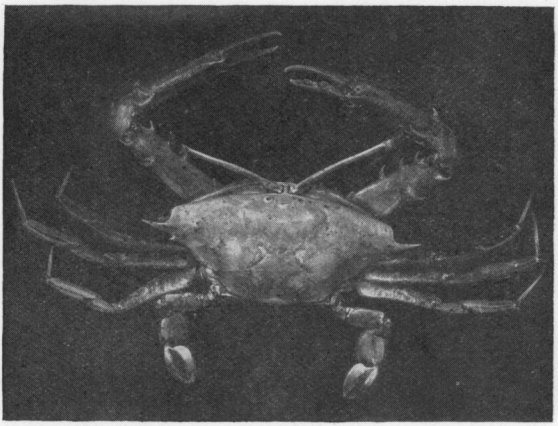


FIG. 47.

Podophthalmus vigil (reduced). [Table-case No. 15.]

it is the first of the two segments of the eye-stalk which is elongated, while in *Macrophthalmus* it is the second.

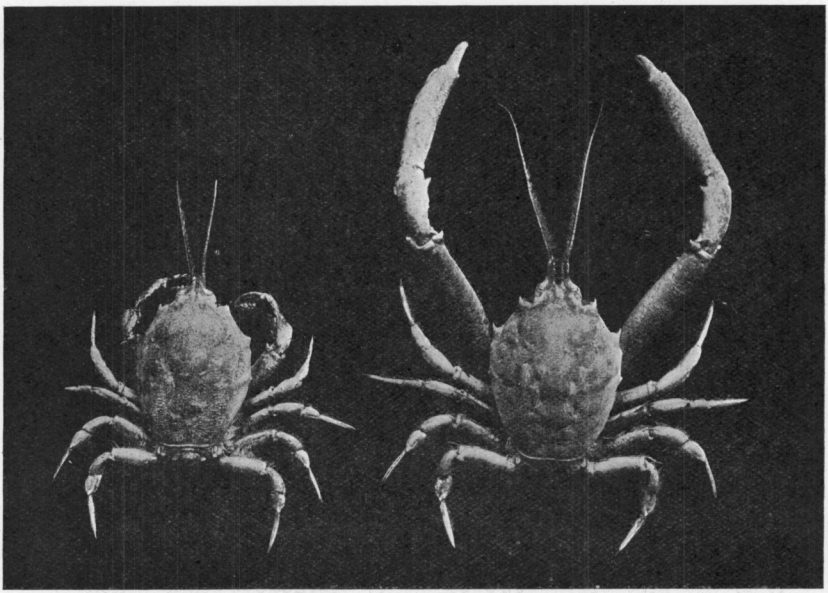
The genus *Platyonychus*, of which a group of specimens is mounted in Wall-case No. 5, also belongs to this family.

The *Cancridae* are distinguished from the preceding families by having the antennules folded longitudinally instead of transversely. To the typical genus *Cancer* belongs to the Edible Crab of British coasts, of which a large specimen is exhibited in Wall-case No. 5. The wide distribution of the genus is illustrated by species from the Azores and from New Zealand.

The family *Potamonidae* (*Thelphusidae*) comprises the River Crabs. In the shape of the carapace, which is generally more or less square, and in having the front bent downwards, these

Crabs show some resemblance to the next Tribe, Catometopa. They are widely distributed in fresh waters throughout the Tropics. *Potamon edule* (better known as *Thelphusa fluviatilis*) occurs in Italy and other parts of Southern Europe.

The family *Corystidae* includes Crabs which are allied to the Cancridae, but have long antennae, and the third maxillipeds are elongated, extending over the front edge of the mouth-frame. The latter character recalls the Oxystomata, which the members of this family also resemble in their sand-burrowing habits.



Female. Male.

FIG. 48.

Corystes cassivelaunus (slightly reduced). [Table-case No. 15.]

Corystes cassivelaunus (Fig. 48) is a common British species. The claws or chelipeds are much elongated in the male. The antennae are much longer than is usual in the Brachyura, and each bears a double row of bristles so arranged that when the antennae are brought together they form a tube, through which respiration can be carried on while the animal is buried in sand.

In the tribe CATOMETOPA the carapace is typically more or

less quadrate, with the front strongly bent downwards; the mouth-frame is square; the genital ducts of the male open on the sternum. A large proportion of the Crabs belonging to this tribe live on land, in fresh water, or between tide-marks on tropical shores. Only the chief families are illustrated in this Case.

The family *Geocarcinidae* (or *Gecarcinidae*) comprises the true Land Crabs, although some members of the other families also are almost entirely terrestrial in habits. The carapace is more or less transversely oval, and the front is of moderate breadth. The branchial regions of the carapace are generally swollen, and the lining membrane of the gill-chamber is richly supplied with blood-vessels, and acts as a lung. Typical genera are *Geocarcinus*, *Cardisoma*, and *Uca*.

The Crabs of the family *Grapsidae* are the most typical Catometopa. The carapace is nearly quadrilateral, with the front very broad and the orbits near the antero-lateral corners. Many species are estuarine or fluviatile in habitat. The species of *Grapsus* and allied genera are common shore Crabs in all the warmer seas.

The genus *Sesarma* and its allies include, for the most part, amphibious fresh-water Crabs, abundant in the tropical regions of the Old and New Worlds.

Varuna litterata is widely distributed throughout the Indo-Pacific region, and seems to be equally at home in fresh water and in the sea. It is often found clinging to drift-wood at the surface of the sea.

The little *Planes minutus* also lives at the surface of the open sea, clinging to floating weed or drift-wood, or to the bodies of large marine animals such as turtles. It is especially abundant in the Sargasso Sea, but is widely distributed in the warmer regions of all the oceans, and is occasionally carried to the South and West coasts of the British Islands. It is related of this species that "Columbus, finding this alive on the Sargasso floating in the sea, conceived himself not far from some land, on the first voyage he made on the discovery of the West Indies" (Sloane, Nat. Hist. Jamaica, ii. p. 2).

In the family *Ocypodidae* the front is generally narrow and the eye-stalks are often very long. Most of the species are amphibious shore Crabs, burrowing and often gregarious in their habits. Several species of the typical genus *Ocypoda* are exhibited.

The species of *Gelasimus*, often called "Fiddler Crabs" or "Calling Crabs" (Fig. 49), are common on most tropical shores, living in vast numbers in salt marshes or between tide-marks, where they make burrows in the sand or mud. A group of specimens of two species is mounted in Wall-case No. 5. The genus is of interest as exhibiting in an extreme degree two characters which are more or less marked in nearly all Crabs —the unequal development of the chelae or pincers on the two sides of the body, and their greater size in the male sex.

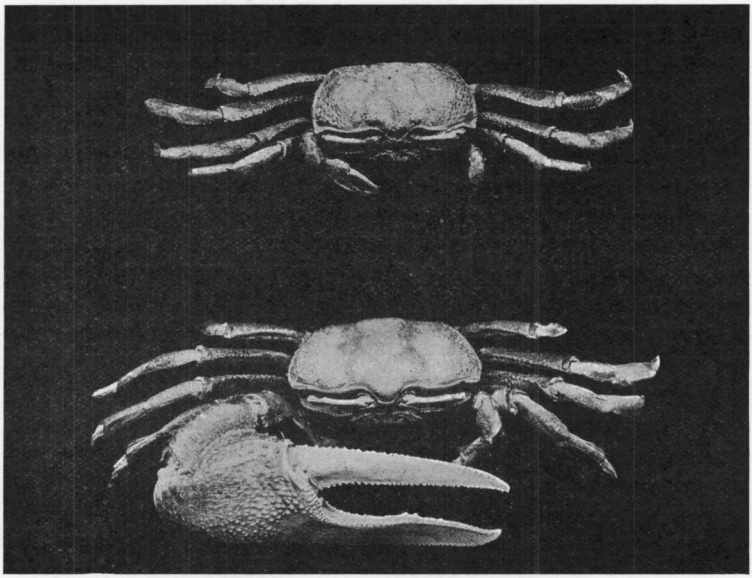


FIG. 49.

Gelasimus tangeri, male (below) and female (above). [Table-case No. 16.]

The large, brightly coloured claws are used by the males in fighting with each other, and are also believed to serve to attract the females.

Gelasimus tangeri occurs on the Spanish coast near Cadiz, where there is a regular "fishery" for these Crabs. Only the large claws of the males are taken, and are prepared for the market by cooking and then drying. After the claw has been torn away, the Crab grows a new one in its place, but these regenerated claws are smaller, and are regarded as of inferior quality.

The genus *Macrophthalmus* (Fig. 50) has already been mentioned (p. 69) as having a superficial resemblance to the Portunid *Podophthalmus*.

The members of the family *Pinnotheridae* are small parasitic or commensal Crabs, living in the mantle-cavity of bivalve Mollusca, in Ascidians or Echinoderms, or in coral-stocks. The shell is usually soft, and the eyes, antennules, and antennae much reduced. A preparation is exhibited of a Sea-Urchin, *Strongylocentrotus gibbosus*, found on the coast of Chile. One half of the shell has been cut away to show the Crab *Pinnaxodes*

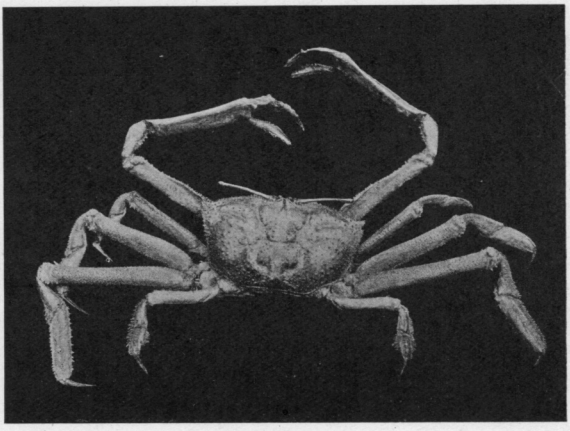


FIG. 50.

Macrophthalmus pectinipes, reduced. [Table-case No. 16.]

chilensis lying in a large pouch which is formed by enlargement of the terminal part of the Sea-Urchin's intestine.

The family *Gonoplacidae* includes Crabs that in many respects approach the tribe Cyclometopa. The only British species is *Gonoplax rhomboides*.

The small Crabs included in the family *Hymenosomidae* have a more or less triangular front, and in other respects show some resemblance to the Oxyrhyncha. *Halicarcinus planatus*, of which specimens obtained by the *Discovery* Expedition at the Auckland Islands are exhibited, is found throughout the whole of the " Sub-Antarctic " region, occurring at such distant points as the Falkland Islands, the Cape, Kerguelen Island, and New Zealand.

Class 2.—TRILOBITA.

(Table-case No. 17.)

The members of this class are known only in the fossil state, and are characteristic of the strata of the Palaeozoic era. They are expecially abundant in the Silurian and pre-Silurian rocks. On the whole, they seem to be most closely related to the Crustacea, although they have been supposed to have affinities also with the Arachnida and especially with the Xiphosura or King Crabs. The somites of the body are variable in number, each, so far as is known, being provided with a pair of append-

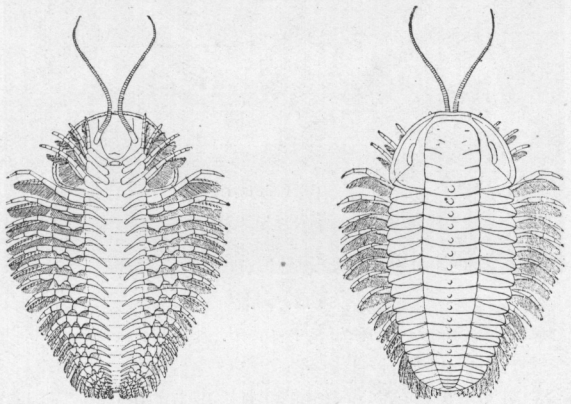


FIG. 51.

Reconstruction of a Trilobite, *Triarthrus becki*. Slightly enlarged (after Beecher).

ages which, with the exception of the pre-oral pair, are substantially similar in structure and function.

The dorsal plates of the five somites composing the anterior region of the animal (the "head" or prosoma) are fused to form a carapace or "cephalic shield"; its median area is vaulted, and each of the lateral areas is expanded, laminate, and divided by a groove into an inner and an outer portion; upon the latter a large compound eye is present.

The somites of the middle portion of the body (thorax or

mesosoma), which vary in number from two to as many as twenty-nine, were movably jointed together in the living animal. Each consists of a vaulted dorsal area (the tergum), and a flat membranous ventral area (the sternum), and, on each side, a laminate expansion overlapping the greater part or the whole of the legs. The convexity of the terga and of the upper surface of the lateral laminae gives to the body a three-lobed appearance, from which the name Trilobita is derived. The dorsal and lateral plates of the somites of the posterior region of the body (pygidium or metasoma) are immovably united, although generally defined by transverse grooves.

The appendages of the first pair, where known, are long, unbranched, antenniform limbs. Those of the remaining pairs consist of two branches rising from a common basal segment The external branch is slender, many-jointed, and furnished with a series of flattened filaments; the internal branch, constituting the locomotor portion of the limb, consists of six or, including the basal segment, seven segments. The post-oral appendages of the prosoma resemble those of the rest of the body, except that the inner extremities of the basal segments are toothed to act as jaws.

The Trilobites probably resembled the existing King Crabs in habits, and crept about the bottom of the sea, feeding upon worms and other soft animal organisms, which were crushed between the basal segments of the anterior appendages. On account of the softness and membranous nature of the sternal region they were able to double up the body or roll it up in a sphere, like wood lice (as shown by two of the specimens of *Calymene blumenbachii* in Table-case 17); and this habit, coupled with the strong spines with which the dorsal area was frequently armed, suggests that the Trilobites themselves were in need of protection from more powerful inhabitants of the seas.

About 2,000 species have been described from Cambrian and later beds of the Palaeozoic period, at the close of which the group became extinct.

A restoration and drawings of *Triarthrus becki* and a few specimens and casts of other Trilobites are exhibited in Table-case 17. The attention of those who are interested in these Arthropods is directed to the account of them which appears in the "Guide to the Fossil Invertebrate Animals," and to the series of specimens displayed in the Geological Department (Gallery 8, Table-case 25, Wall-case 14 b).

Class 3.—PYCNOGONIDA.

(Table-case No. 26.)

The Pycnogonida, Pantopoda, or Podosomata, are a small group of marine animals, here treated as a separate class. They may be related to the Crustacea, although their affinity with that group of animals is by no means close, and they show many points of resemblance to the Arachnida.

The body (Fig. 52) consists, as a rule, of a head-segment, followed by three free somites and a small terminal lobe repre-

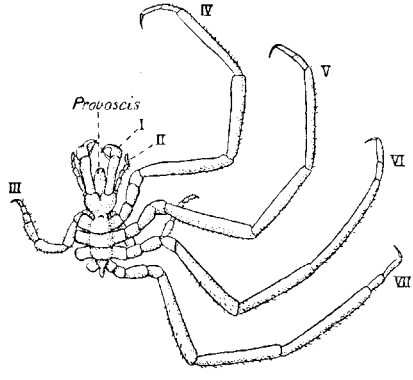


FIG. 52.

Diagram of a Pycnogonid, *Nymphon* (*Boreonymphon*) *robustum*. Enlarged. [Table-case No. 26.]

senting the abdomen. Four pairs of very long legs (IV.–VII.) are attached, the first to the head-segment, and the others to the three free somites. In addition the head-segment may bear three pairs of appendages; the first pair (I.) are chelate (or pincer-like), and overhang a tubular proboscis on which is the opening of the mouth; the second pair (II.) are sensory palps, placed at the sides of the proboscis; the third pair (III.), placed just behind the last, are used, in the male sex, for carrying the eggs, and are known as "ovigers." One or other of the first three pairs, or (in the female sex) all of them, may be absent in certain genera.

The apparent resemblance of a Pycnogonid to an Arachnid is due chiefly to the four pairs of long and slender legs, and to the chelate form of the first pair of appendages. The comparison, however, is complicated by the fact that the Arachnida possess but one pair of appendages, the pedipalps, between the chelicerae and the first legs, whereas the Pycnogonida have two pairs, the palps and the ovigers, in the same position. A further serious difficulty in the way of comparison is raised by the existence of three genera, *Decolopoda* (Fig. 53), *Pentanymphon* and *Pentapycnon*, which have five, instead of four, pairs of legs, and four free somites behind the head.

The internal structure presents many exceptional features,

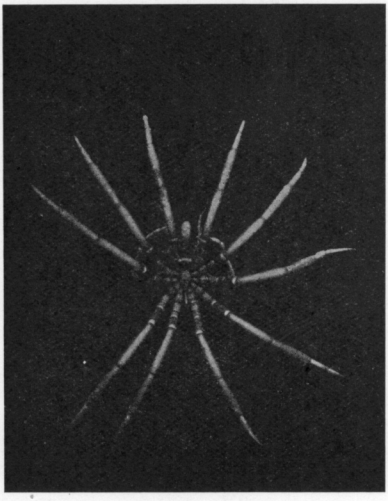


FIG. 53.

Decolopoda australis, a ten-legged Pycnogonid from the Antarctic Seas. Slightly reduced. [Table-case No. 26.]

which are illustrated by the drawings exhibited above the Table-case. The food-canal sends long diverticula into the appendages, and the generative glands also are partly situated in the legs and open to the exterior by pores on the second segments of some or all the pairs. A remarkable fact in the breeding habits of these animals is that the eggs are carried, after deposition, not by the female, but by the male, attached in clusters to the third pair of appendages.

The Pycnogonida are all marine animals, ranging from shallow water to depths of at least 2,000 fathoms. They are especially abundant in the Arctic and Antarctic regions. The specimens exhibited include *Pycnogonum littorale*, which is common between tide-marks on the British coasts; *Nymphon* (*Boreonymphon*) *robustum* (Fig. 52), a characteristic Arctic species; two species of the deep-sea genus *Colossendeis*, which includes the largest of the Pycnogonida; and the ten-legged *Pentanymphon* and *Decolopoda* already alluded to.

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