

1927

Calman, W.T.
Calman

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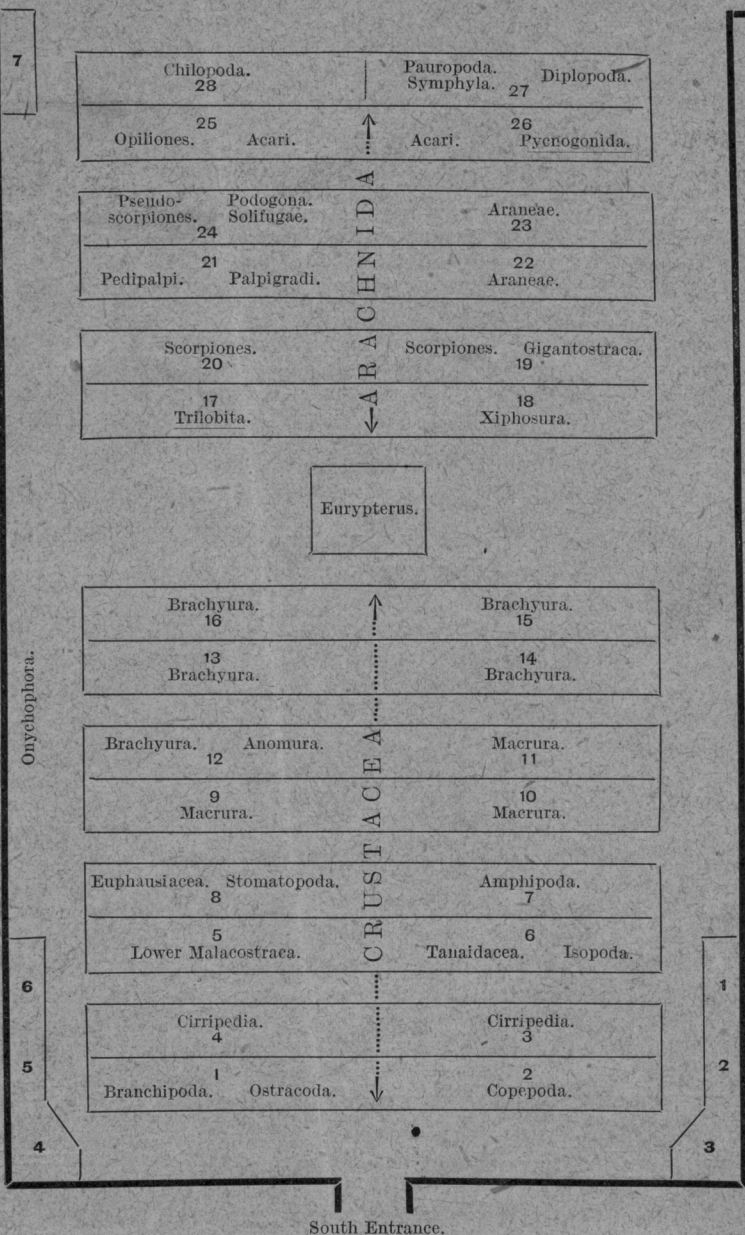
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PLAN OF SOUTH HALF OF "INSECT GALLERY," SHOWING POSITION OF CASES
OCCUPIED BY GROUPS DEALT WITH IN THIS GUIDE (CRUSTACEA, TABLE-
CASES 1-16 AND WALL-CASES 1-6; TRILOBITA, TABLE-CASE 17; PYCNO-
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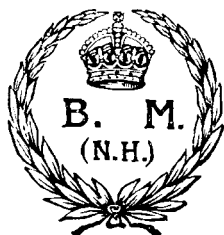
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PREFACE

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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GUIDE TO THE CRUSTACEA.

Class 1.—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, Cray-fish, 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 "exoskeleton." 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,

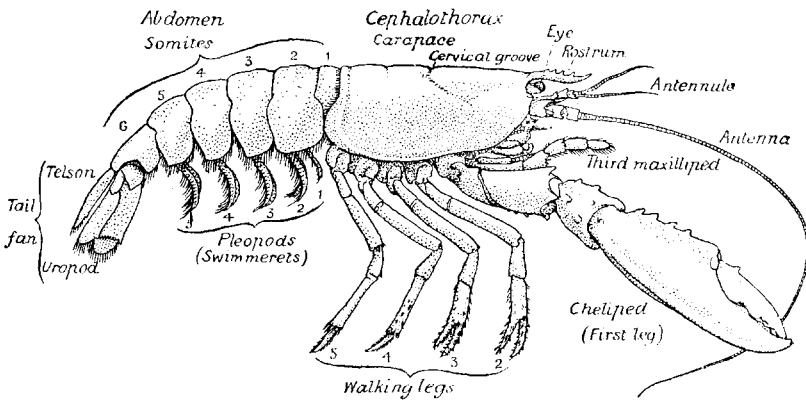


FIG. 1.

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

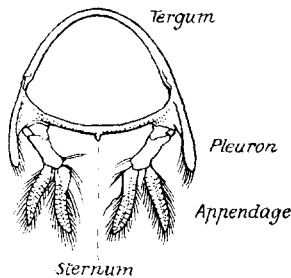


FIG. 2.

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

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.

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.

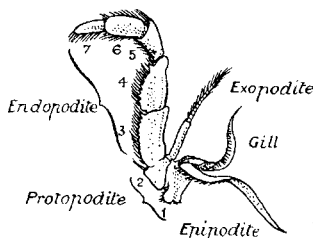


FIG. 3.
Third maxilliped of Lobster.
[Wall-case No. 1.]

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

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

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

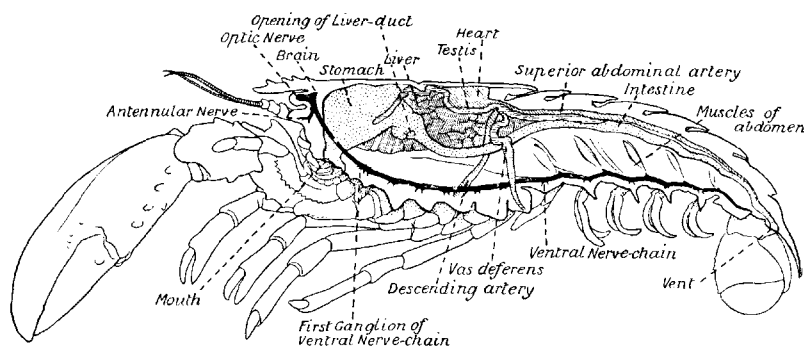


FIG. 4.

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.

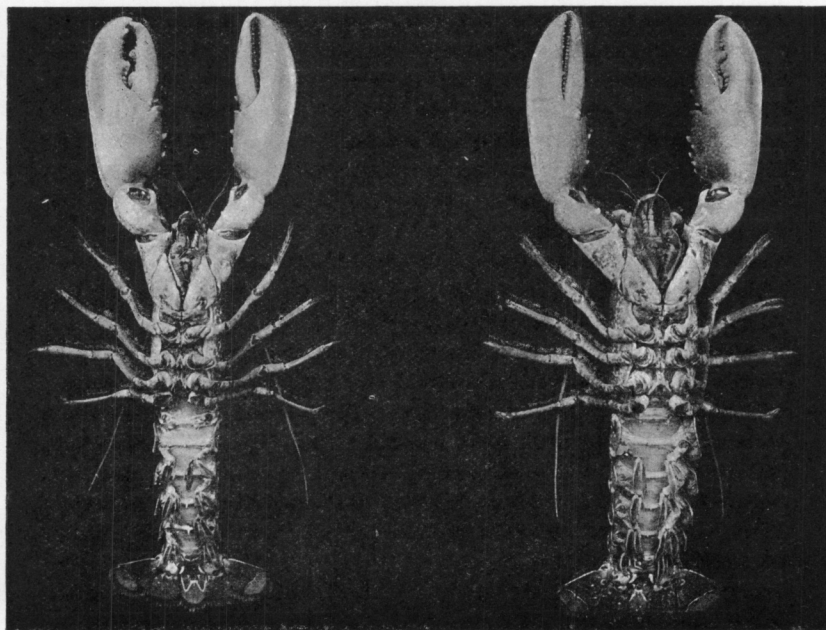
In the basal segment of the antennule is the so-called *auditory organ*, a small pouch open to the exterior and containing in its cavity a number of grains of sand. This pouch, which has on its inner surface numerous feathered hairs connected with a large nerve, was formerly regarded as the Lobster's 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.

FIG. 5.

Female.

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 is 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