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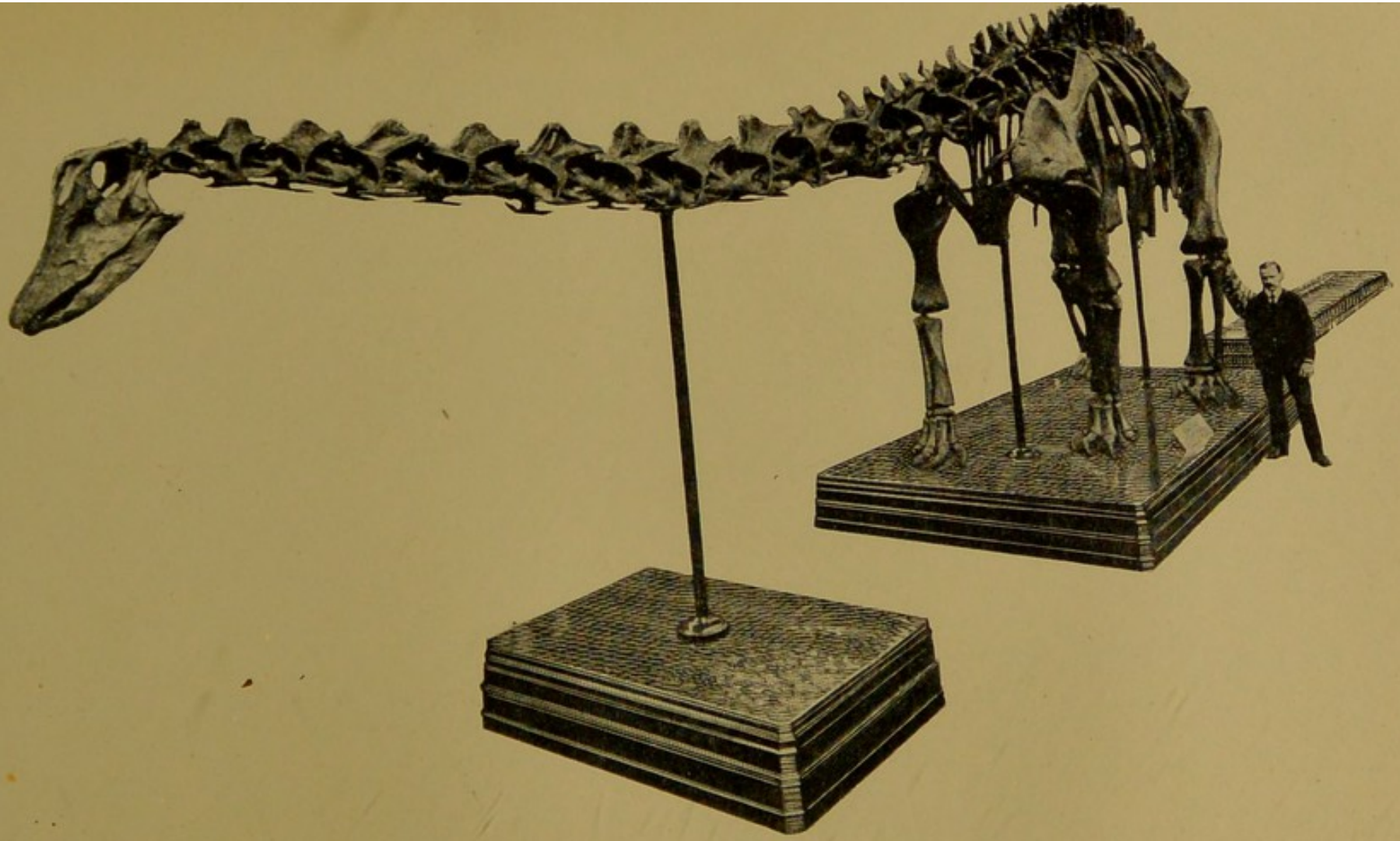
THE NATURAL HISTORY MUSEUM

THE TREASURE · HOUSE · SERIES ·

Wm. Peagre

THE NATURAL HISTORY MUSEUM



A Cast of Diplodocus Carnegii.

(Presented by A. Carnegie, Esq.)

Frontispiece.

THE TREASURE-HOUSE SERIES

THE BRITISH MUSEUM OF NATURAL HISTORY

(SOUTH KENSINGTON)

BY

W. P. PYCRAFT, F.Z.S., A.L.S.

OF THE BRITISH MUSEUM, NATURAL HISTORY

AUTHOR OF "A HISTORY OF BIRDS," "THE ANIMAL WHY BOOK," "THE STORY OF REPTILE LIFE," ETC. ETC.

ILLUSTRATED BY

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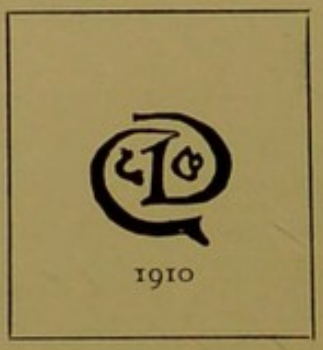


THIS BOOK

IS

DEDICATED TO

ROWLAND WARD

WHOSE WORK HAS DONE SO MUCH TO MAKE

THIS MUSEUM BEAUTIFUL

CONTENTS

ILLUSTRATIONS

THE NATURAL HISTORY MUSEUM

CHAPTER I

THE GREAT HALL AND THE NORTH HALL

"Behold a cabinet for sages built
Which kings might envy."

THE part which the Great Hall plays in relation to the rest of the Natural History Museum is by no means generally realised; and this is to be regretted, because it contains the key to the wonderful array of specimens which fill the galleries on either side. If only the broad outlines of the facts here illustrated are fairly well grasped, a new and deeper meaning will be found in the specimens set out in the various departments which are described, in as many chapters, in this book.

In the series of bays which run round this hall there will be found all the salient features of the great science of Comparative Anatomy. Usually, of course, exhibits of this kind are regarded merely as dissecting-room details. Yet a very little while spent here would yield a rich reward, for a wonderful

insight would be gained into the architecture, so to speak, of animals and plants, which would help, far more than is generally supposed, towards understanding the "why and the wherefore" of the peculiarities of their external shapes, and of the mysteries of classification.

The large cases which stand in the centre of this hall are designed to serve another purpose. Their function is to bring home, in as graphic a way as possible, the leading facts of that great theory of evolution formulated by our most illustrious countryman, Charles Darwin—the greatest interpreter of Nature whom the world has yet seen. The cases containing the pigeons and fowls, for example, recall to us most vividly his masterly work on "Animals under Domestication," and the way in which the breeder, by careful selection, has in process of time brought into being many and very diverse types from a common ancestral form. To appreciate fully the lesson this case is intended to teach, the several varieties of domesticated fowls should be compared, one with another, and with the jungle-fowl, the stock from which all these most unlike varieties have been raised. Contrast, for example, the "rumpless" fowl with the long-tailed Japanese race; the long-legged game-cock (Fig. 1) with the bulky Cochin; the Dorking with the Polish fowl; and what was before a case of stuffed birds becomes a casket of wonders! And the same lesson is conveyed in the array of the different breeds of canaries and pigeons. The huge runts, the enormously wattled carriers, the

pouters (Fig 2), fantails (Fig. 3), and short-faced tumblers are so unlike one another that it seems impossible they can all have descended from the wild rock-dove; yet such is the fact!

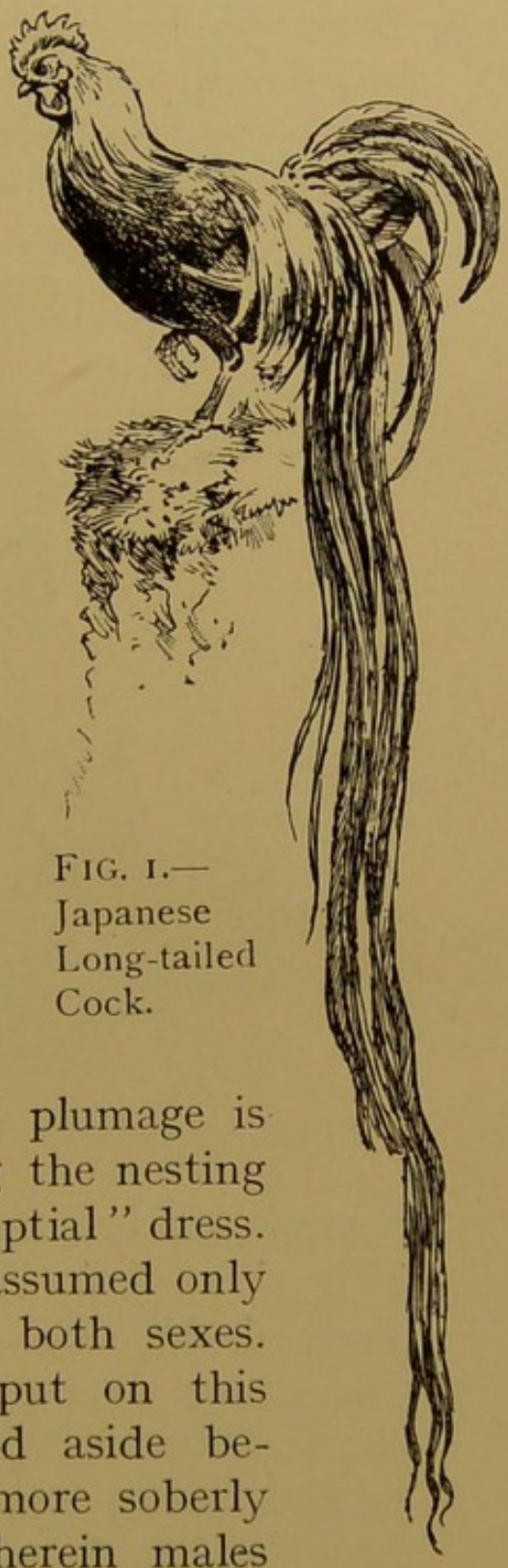


FIG. 1.—Japanese Long-tailed Cock.

In the case standing north of that containing the races of domesticated fowls will be found a wonderful series of birds once common in our fen-lands, but now, alas, practically extinct, owing to drainage on the one hand, and the raids of "collectors" on the other. These are the ruffs; birds allied to the sandpipers and snipe—they are of the plover tribe, in short. They have been brought together to illustrate the fact that in many species of birds a special and more or less highly ornamental plumage is assumed just before and during the nesting period. It is the courting, or "nuptial" dress. In some instances this dress is assumed only by the males, and in some by both sexes. In the ruffs only the males put on this resplendent livery, which is laid aside before the summer is over for a more soberly coloured "winter plumage," wherein males and females are almost indistinguishable. The ruff, however, is furthermore peculiar on account

of the marvellous range of variety which a series presents, in the coloration and markings of the great frills or " ruffs " and " bars " which adorn the head. No two are ever found quite alike ! Every stage of plumage from the downy nestling upwards, in every season of the year, is here illustrated.

Next in order stands a case displaying another

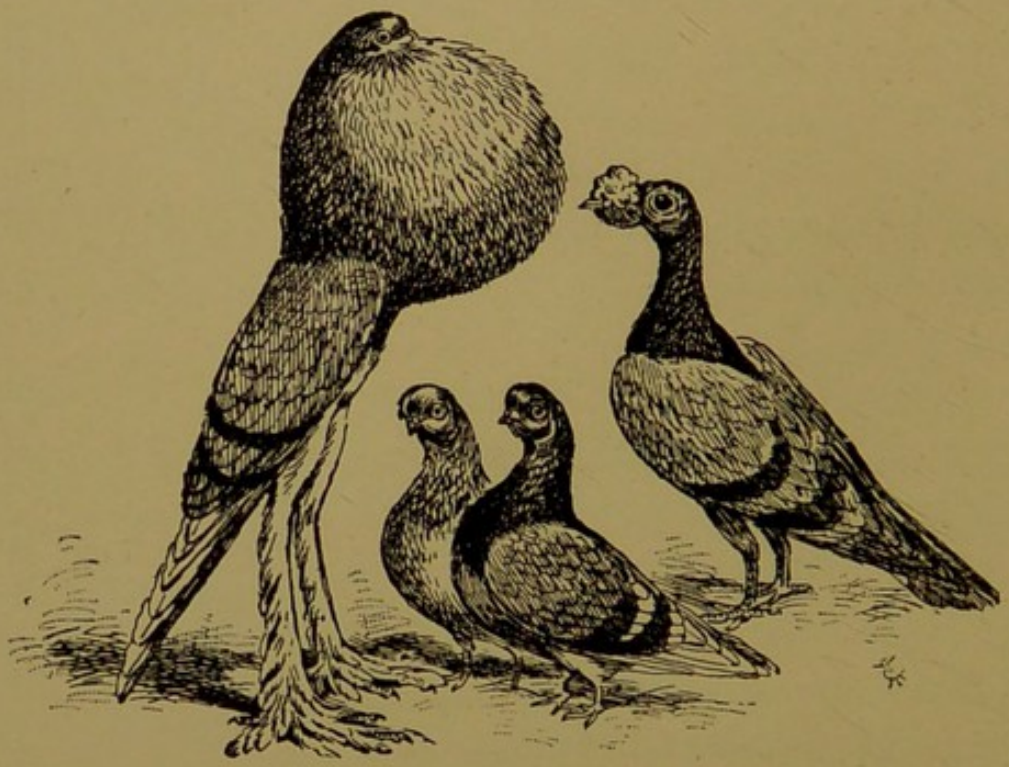


FIG. 2.—Pouter Pigeon, Carrier, and Short-faced Tumbler.

remarkable series of plumage sequences—those exhibited by the wild duck or " mallard." Here the male, during the summer, puts off the resplendent dress worn during the greater part of the year and dons a livery hardly to be distinguished from that of the female. He goes, as it has been aptly said, into " eclipse," and this for the sake of the protection the more sombre dress affords him against enemies, during the time that he is flightless—for

ducks, and some other aquatic birds, moult all their flight feathers at once, and so have unusual difficulty in escaping danger. Being flightless, they must hide; and for hiding, the more closely the plumage harmonises with the bird's surroundings the better the chance of escaping discovery. The bright-coloured feathers worn during the greater part of the year would never afford this mantle of invisibility: and hence, the nearly lost "winter" plumage is retained to serve this very useful purpose. Some birds, like the capercailzie, for instance, have quite got rid of this winter dress, and wear what was once a wedding garment all the year round. The kindred blackcock has nearly, but not quite, succeeded in following suit, for each year his head and neck lose the light steel-blue feathers, and become clothed in dull brown; the jungle-fowl also presents the same features.

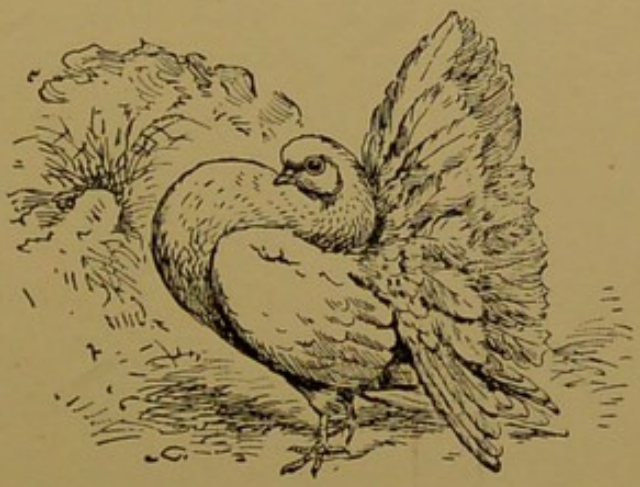


FIG. 3.—Fantail Pigeon.

Near this case will be found another, illustrating plumage of yet another character—plumage which, by reason of its coloration, serves the purpose of an invisible mantle, and thus very considerably aids the wearer to escape its enemies. But this form of coloration is by no means confined to birds, a fact which this case is designed to show. Here, for example, are willow-grouse and

ptarmigan crouching amid rock and lichen, and plants of various kinds natural to the environment : and also the mountain hare, a stoat, a weasel, and an Arctic fox—all creatures which are to be met with in the same area. All show a very remarkable likeness to their surroundings. With the approach of winter, and the arrival of the snow, these animals don a new livery, this time of white, so as to render them hardly visible against the mantle of white which so long covers the earth in the places where these creatures live. The prey, and their preyer, in a word, adopt the same tactics ; the one that they may not be eaten, the other that they may eat ! This is not so contradictory as appears at first. If the victims did not thus change they would be conspicuous to their enemies at great distances, and so be speedily captured ; but by assimilation with their surroundings—that is, by growing like their surroundings—they can be discovered only by accident. If, on the other hand, the prowling carnivore did not change, it would starve, for it would never be able to approach its intended victims unawares. Such complete changes as these occur, of course, only where snow lies long on the ground. Our ptarmigan turns white in winter ; the red-grouse never does, because, as it is a dweller in the lowlands, the snow does not lie long enough to render such a change either possible or necessary. The cousin of the grouse, the " willow-grouse " of the Continent, on the other hand, always changes after this fashion, because it lives where the snow covers the ground for long periods.

Animals which live in deserts similarly wear a livery which harmonises, often with an extraordinary completeness, with the inanimate environment. This fact is illustrated in a case on the east side of the hall near the great staircase, by birds, mammals, and reptiles, all of which wear a dress completely harmonising with the buff-coloured earth and rocks amid which they live. Yet other and very wonderful illustrations of this protective coloration will be found in one of the bays on the east side of the hall. Here will be found some amazingly exact cases of blending coloration, accompanied, furthermore, by profound changes of shape, to make the deception more complete – changes which cause these animals to resemble dead leaves and dead twigs, green leaves and flowers, patches of lichen, and bits of bark, and so on. This kind of transformation is known as "mimicry." Instances of each of these forms of transformation will be found here.

The curious phenomena of "albinism" and "melanism" are illustrated in another case. Albinism is due to an abnormal condition of the body, wherein the pigment or colouring matter, which gives the normal, characteristic hues to the body, is wanting. In some cases this albinism is only partial, when the eyes retain their normal colour: such are merely white varieties. But where the colouring matter is totally suppressed even the eyes change, becoming pink, owing to the exposure of the bloodvessels; such animals are said to be albinos. Melanism represents the oppo-

site condition, wherein the formation of pigment or colouring matter has become intensified, and hence blackness follows.

But besides these various aspects of Nature there will be found here some wonderful object-lessons illustrating the life-histories of animals which cause or spread some of the greatest scourges that flesh is heir to—malaria and sleeping sickness. Mosquitoes are the agents which spread the first named, tsetze flies the last, and beautiful enlarged models of these insects are here exhibited.

Behind the staircase is the North Hall, wherein will be found the finest collection of domesticated animals to be seen in this country; and this is well worth very careful study, not only because it affords a ready and easy grasp of what man has achieved in the matter of animal breeding, but also because it forms a concrete illustration of Darwin's celebrated work, "Animals and Plants under Domestication," wherein he sought to establish a parallel between the result of selection on the part of man, and selection in Nature; in both many and often extremely unlike forms can be traced back to a common ancestor. Comparison may here be made, for instance, between the various breeds of horses, illustrated by a number of most beautiful models, and skeletons, and the mounted heads of typical breeds, among which will be found those of some notable Derby winners. But this is not all. From the prominent place which this animal has taken, and happily still takes, in the service of mankind, it has been

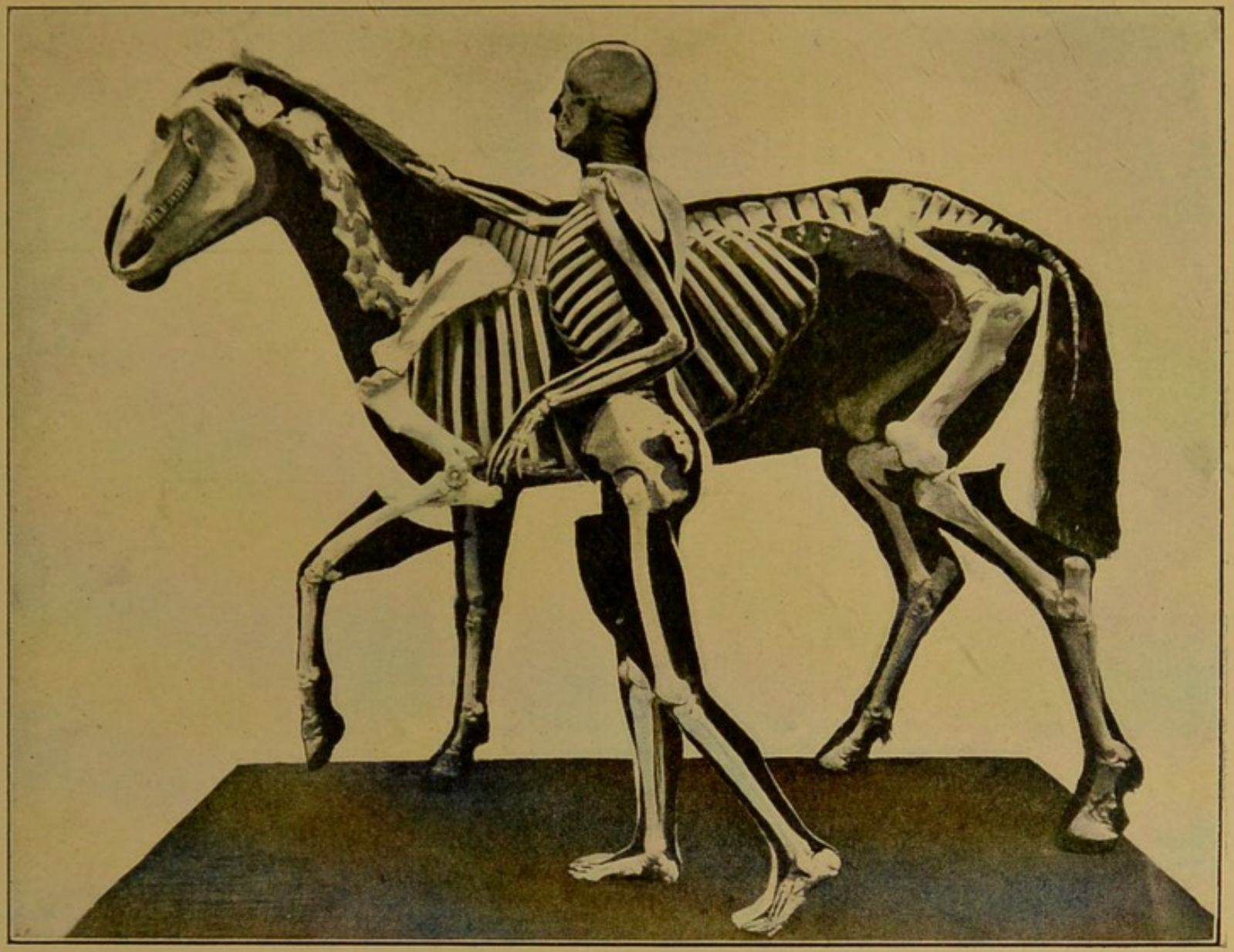


FIG. 4.—Skeletons of Man and Horse in the Great Hall.

thought well to set forth, in some detail, the more striking facts which the study of the evolution of the horse has revealed. To this end will be found a series of most beautiful and interesting preparations illustrating the evolution of the teeth and limbs, as well as skeletons of wild horses, both fossil and recent. And by way of driving further home the many and profound structural modifications which this noble animal presents, a combined model and skeleton of a horse and a man have been mounted together—thus at a glance one can contrast the most perfect forms of quadrupedal and bipedal progression in Nature.

Cattle, sheep, and pigs, dogs, rabbits, poultry, and wild animals which have been domesticated—from llamas to white mice—all find a place here. A brief survey of the sheep, we venture to think, will bring many surprises, for with most of us the word sheep conjures up pictures of a woolly animal, yet, as may be seen here, there are many tropical races of sheep which are hairy, like goats: while in the matter of horns the specimens here collected will afford no less striking surprises. Here also will be found a specimen of the celebrated Huina or fighting ram of India; the tiny Shoa sheep introduced into the islands of St. Kilda by the old Vikings; four-horned sheep, such as are to be met with from Iceland to China; the celebrated "Astrachan" sheep; strange-looking fat-tailed sheep; and all our own native breeds.

The collection of dogs will be to many, perhaps, more interesting than even that of the horses,

cattle, sheep and pigs, for these represent man's efforts on the sterner side of life: dogs, on the other hand, illustrate a wider range of man's activities, and other phases of his character. For while some breeds of dogs have been bred to aid him in the chase, and are reminiscent of days more arduous, in some respects, than fall to the lot of civilised man, not a few have been brought into being as it were out of mere caprice, possessing neither use nor beauty.

Among the nobler breeds are those of the chase—the great boar-hounds, wolf-hounds, deer-hounds, greyhounds, and foxhounds, retrievers, spaniels and pointers. The blood-hounds and bull-dogs conjure up an aspect of human society which is less pleasant. But it is to be remarked these breeds to-day are but "ornamental" figure-heads, the product of the show-pen, and not at all like the race which was used, the one for hunting down slaves and criminals, the other for the pursuit of that most barbarous of "sports"—bull-baiting. The characteristics of these two breeds have in modern times become so exaggerated that they have only a slight likeness to the dogs which bore their names in ancient days. The blood-hound, however, has by no means lost his cunning, and is used to-day, with success, in tracking criminals. In appearance he has certainly gained much, for no one can help feeling impressed by the wonderful head which distinguishes the latter-day blood-hound. There are several examples of this fine breed represented here—triumphs no less of the taxidermist's than

of the breeder's art. Like most of the modern work in the Museum, these dogs have been mounted in the Rowland Ward studios.

It is among the dogs of the terrier group that most of the merely "ornamental" races are to be met with—such as poodles, and the Maltese, Russian, and Mexican lap-dogs. But of these, and of the various species of wild dogs from which the numerous domesticated races have descended, much more will be found in the "Guide to the Domesticated Animals," to be had in the Museum for a few pence, than can possibly be set down in these pages, which must contain a general outline, at any rate, of the whole Museum! And for this reason we must pass without comment the various races of cats, rabbits, and guinea-pigs, poultry, pigeons and canaries: though we do so with regret, for they present some extremely interesting points for consideration.

We are tempted to dwell at length upon the splendid series of specimens contained in this room because the story of our domesticated animals is one of more than ordinary interest. In the first place the work of bringing wild creatures into subjection was one of the chief factors in the evolution of civilisation. That is to say, when primæval man began the work of taming wild animals, and making use of them for his needs, he began, at the same time, though unconsciously, the task of disciplining himself: he laid, in short, the foundation of the complex civilisation of to-day—though it must be admitted this has not proved an altogether unmixed blessing! A volume of en-

trancing interest could well be written on the animals here brought together; it would be futile, then, to attempt to do justice to the theme in these pages. Let those whose privilege it is to live near this Museum, or who have the good fortune to visit it frequently, come often to this room, carefully studying the specimens here set out; for, as we have hinted, they represent something more even than the outcome of the breeder's art; they are witnesses of the dominion which was given to man "over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth."

CHAPTER II

THE GEOLOGICAL GALLERY

"Once more to distant ages of the world
Let us revert. . . ."

THE galleries belonging to what is known as the "Geological Department" conjure up a spirit of awe and mystery: for they present a picture of the world before man entered upon the inheritance which he has so sadly misused. Here, in short, will be found a wonderful series of *tableaux* illustrating the past history of living things. This has been pieced together by slow and laborious research carried on by many generations of men, in many parts of the world. Their labours, combined with the results of the study of living organisms, have shown us that no man may pierce the veil behind which Nature has hidden the mystery of the origin of Life, yet she has revealed enough of the beginnings thereof to enable us to be certain that the earliest living things were of a very humble type, neither animal nor plant. During long ages of time, however—so long that they cannot be expressed in terms of years—these primitive living organisms began, as it were, to take on a more definite character, thereby giving rise on the one

hand to plants and on the other to animals, though still of a very humble type, and for the most part microscopic in size. Our ponds and ditches, our rivers and lakes, and the wide expanse of ocean teem to-day with their descendants, little if at all changed since the days of the Dawn of Life! But while some have kept through all the ages their humble station, others, by some mysterious inborn force, if we may so use the term, have developed a marvellous power of growth and change. Once started, this activity has gone on through the ages in countless ways, showing itself in forms of constantly increasing variety and complexity. For reasons which cannot be fathomed many of these forms, both of plants and animals, died out, some being preserved to us in the form of fossils, with peculiarities of form and structure quite unlike anything now existing on the earth. Yet, as we shall show, some of the strangest of these "fossils" —or things dug up—are the ancestors of the present-day inhabitants of the earth, and man himself is a part of the warp and woof of this great web of life.

It would be impossible, within the limit of these pages, to include a survey of the fossil plants, and hence these must pass without further comment than to say that in these galleries they are to be sought should any desire to see them. We cannot even include all the animals, nor would such a survey be either entertaining or profitable. Rather we propose to select a few of the more striking cases which serve to reveal the wonderful versatility of Nature. Here will be found the "missing links"

which explain many of the riddles in the structure of living animals: and here will be found the proofs of such astonishing facts as that the lion and the ox can be traced back to a common type! Here, in short, more than anywhere else in this great Museum, will be found the answer to that question so often asked, "What is meant by Evolution?"

Nowhere, then, are—

> "The steps of Time—the shocks of Chance—
> The blows of Death . . ."

more vividly brought home to us than in the history of the creatures entombed in the rocks.

The preservation and discovery of these remains is due to fortunate accident; they represent but a minute fraction of all the creatures that lived shoulder to shoulder with them. The study of fossils, in short, is like the study of fragments of some old book in a long-forgotten language; only bits here and there of the earth's history can be traced by these broken and battered remains, but enough can be made out to furnish a most wonderful story.

As we stand in the doorway of the long gallery at the right of the Great Entrance Hall, we may picture ourselves in the position of the prophet of old, in a valley of dry bones, "and lo they are very dry": and we may ask ourselves, as he was asked, "Can these bones live?" The answer depends upon our imagination, upon our ability to conjure up a mental image of strangely unfamiliar creatures

represented here only by their bony framework. But the effort is worth the making, the question is worth asking, "What did this or that beast look like when alive?"

Let us try the experiment on the elephants, which occupy the first part of the centre and left-hand side of this gallery, beginning with a glance at the stuffed Indian elephant, a little way down, as representing the last word in elephants, while the baby elephant at its foot may recall the fact that some, at any rate, of the earlier elephants were clad in long hair. This we know to be a fact because fossil elephants have been dug up embedded in ice, and so perfectly preserved that the flesh and skin have been intact, and the hide in these was thickly clad in hair. This young elephant repeats, as young animals commonly do, more or less completely, the phases through which his ancestors have passed.

Though now confined to the Indian and African region, during comparatively recent times elephants roamed over much of the northern hemisphere, and their bones and teeth are often dug up even in London; remains were found, indeed, on the site occupied by this Museum, and have been recovered from land in various parts of the City; even in the North Sea they are dredged up, for there was once a forest there! But these extinct elephants, which are known as the Mammoths, though wonderfully like the Indian elephant, differed, it will be noticed, in the huge size of the tusks, and further in that they were clothed in long, coarse hair.

Going back a stage further in time, we come to another elephant, differing still more from the living Indian animal—the Mastodon. The name of this creature, being interpreted, means "nipple-toothed," and you will see, in the specimens exhibited in the table cases, that the huge grinders of this beast differed remarkably from those of modern elephants. And mark this too, the *young* animal possessed a pair of small tusks in the lower jaw. These vanished before adult life was reached, but it will be noticed that the lower jaw is conspicuously longer than in the elephants so far noticed. The upper tusks were huge, but they were eclipsed by the immense tusks seen in the adjoining skull of *Elephas* or *Stegodon ganesa*.

Particular attention has just been drawn to the fact that the Mastodon had a remarkably long lower jaw, and that this, in the *young* animal, bore a pair of tusks. This fact, after what we have said of young animals repeating the phases of development of their ancestors, will prepare the way for the discovery of an elephant with a still longer lower jaw, and still larger tusks retained throughout the lifetime of the animal. And such a beast is found in the "long-chinned" elephant *Tetrabelodon longirostris*, wherein the lower jaw is produced into a spout-shaped rod, armed at the tip with a pair of chisel-like teeth, as may be seen in the skull of a nearly allied species on the pedestal at the foot of the Mastodon skeleton in the doorway. The Tetrabelodons were much smaller creatures than any of the elephants we have so far

noticed ; and this fact too is significant, as we shall see ; while in general appearance they must have looked rather strange owing to the great length of the face. Remains of the *Tetrabelodon longirostris* have been found at Epplesheim, in Germany.

In the nearly related species known scientifically

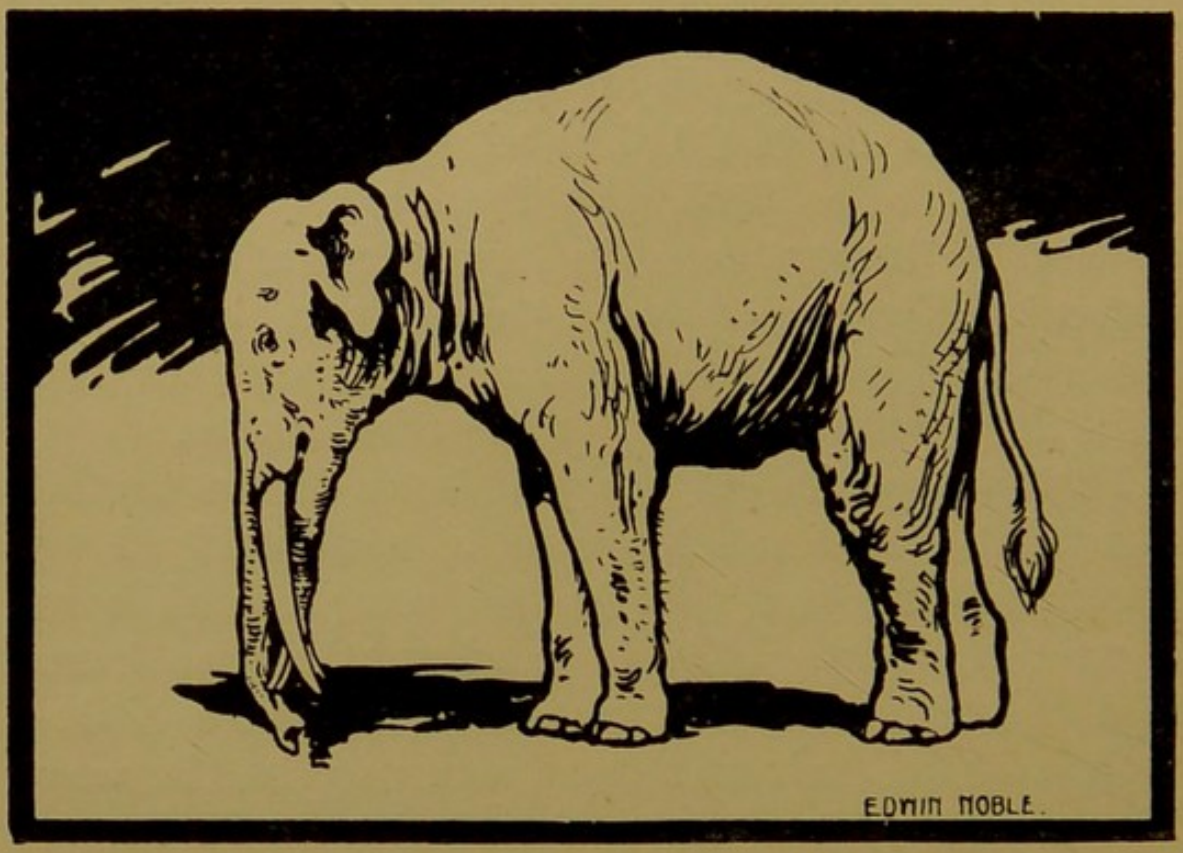


FIG. 5.—The Evolution of the Elephant.
I. Tetrabelodon angustidens.

as *Tetrabelodon angustidens* (Fig. 5), from deposits in France, the lengthening of the lower jaw had reached its maximum, and the grinding teeth are smaller and simpler in structure than in any of the elephants so far noticed.

To find the next link in the chain we have to pass to fossils found in Egypt, of a comparatively

small animal known as Palæomastodon (Fig. 6), which clearly represents an earlier stage in the development of Tetrabelodon, for while it has a similar lower jaw, the upper jaw, though of the same plan, is shorter, and has shorter tusks. The whole skull indeed is less elephant-like, and this

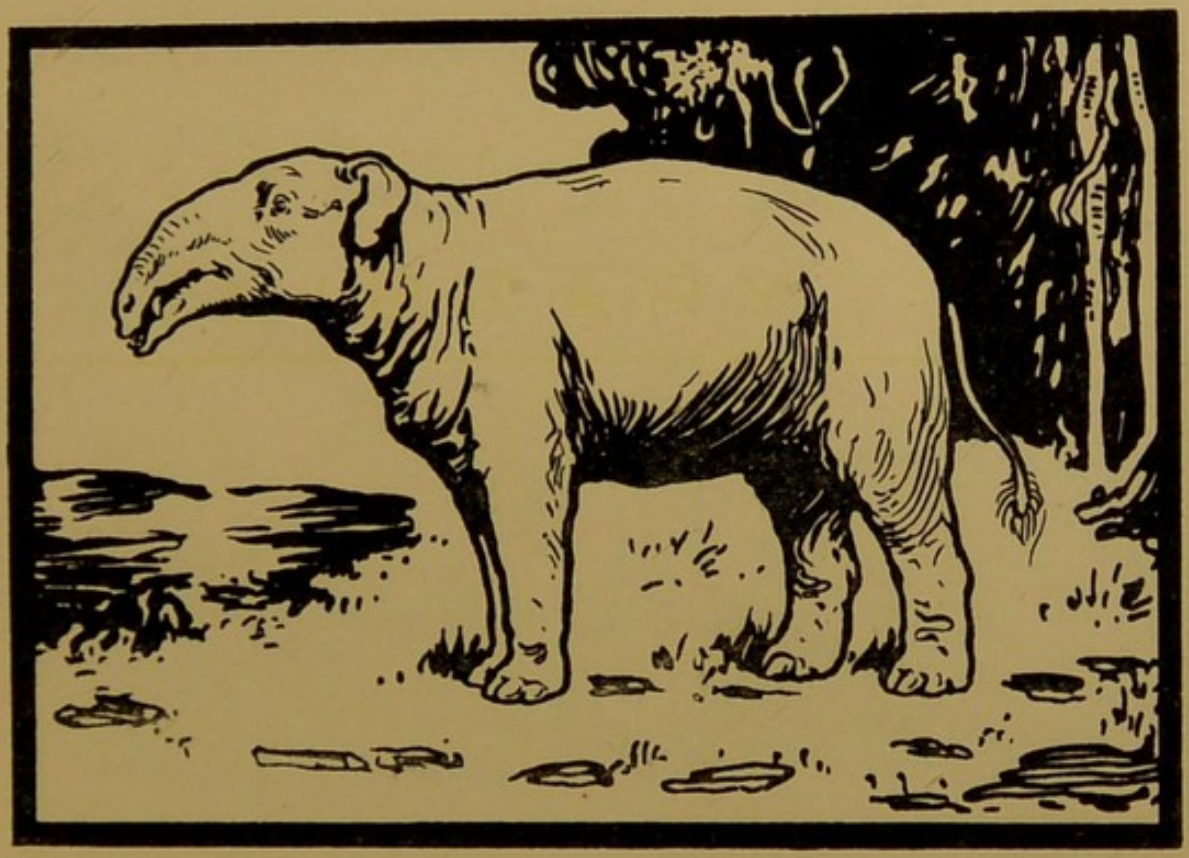


FIG. 6.—The Evolution of the Elephant.
II. The Palæomastodon.

fact becomes the more conspicuous when the grinders are examined, for these are more numerous and smaller than in any of the elephants so far examined. Finally, with but a very slight break, we come to what we may almost call the Adam among elephants, represented by the relatively tiny skull of the creature known as Mœritherium

(Fig. 7), whose remains have been found in the Fayum, Egypt. But for the intermediate links which have been passed in review, it would not have been easy, to say the least, to detect this creature even as an ally of the elephants. Yet it was something more than this : it was the ancestor

FIG. 7.—The Evolution of the Elephant.
III. The Mœritherium.

of the elephants ! The grinding teeth, it will be noticed, were smaller and more numerous than in any of the forms so far mentioned, while the tusks are represented by two larger blunt teeth at the end of the jaws, and separated from the grinders only by a slight gap. In the matter of size and shape it must be likened rather to a large pig than

to an elephant ; yet from this very humble-looking beast the lord of the jungle is descended !

What determined the tide of this strange history ? What were the moulding forces of Nature which, during long ages, slowly wrought out this marvellous chain of events of which a few links have been preserved to us ? The first elephant, the little Mœritherium—named after Lake Moeris in Egypt —was probably a marsh-dweller, and strove with other strange and as yet undiscovered beasts for his daily bread. Later, it would seem, a migration to the forest took place ; at any rate so much may be inferred from the skull of the Palæomastodon, and the later Tetrabelodons, whose long jaws and front teeth seemed to have served the purpose of digging up roots, and to have been accompanied by the development of a short trunk. Possibly, as this increased in length and mobility, and the legs lengthened with the increase of the body, a diet of leaves, gathered from low bushes, took the place of the diet of roots, for leaves would have become more easily gathered. Any tendency in the direction of an increase in the size of the grinders would now be highly advantageous, and these seemed to have increased at the expense of the tusks, at any rate of the tusks and long supporting base which are so conspicuous during the middle period of this history : till finally we arrive at the elephants of India and Africa of to-day !

But there is a side issue, so to speak, to be considered in this history. This was revealed by the discovery of skulls of strange elephantine beasts,

some of huge size, which appear to have descended from some near relative of one of the early and more primitive long-chinned species. The peculiarity of the creatures of this side branch lay in the fact that the lengthened jawbones grew downwards in a bold curve, instead of forwards, so that the tusks at the end of the jaw came to form a pair of huge hooks ! The upper jaw, on the other hand, seems to have lost the tusks, thereby reversing the order seen in the main line of evolution. The grinders, too, were simpler in type than in the true elephants. From the general shape of the skull shown on the stand in the gangway opposite the skeleton of the Mastodon, it would seem that these creatures—the Dinotheriums, as we must call them for want of a better name—must have had a trunk of some sort ; at any rate, the size of the cavity from the nostrils seems to justify this assumption.

As an answer to the question, " What is meant by Evolution ? " it would be hard to find a better illustration than that afforded by the elephants, and this wonderful story we owe, very largely, to the researches of Dr. C. W. Andrews in the burning deserts of Egypt, where the early links in this chain were found. And those who find this theme interesting should not fail to buy the small guide to be obtained in the Museum, wherein the story of the elephants is told at greater length than can be done here.

If only we could have devoted the whole of this book to the theme, a wonderful story could have

been written on the origin and evolution of that great group of animals known as the Ungulates, or hoofed animals, to which, by the way, the elephants belong. As it is, we must be content with a peep, here and there, at a few passages in such a story: remembering, at each halting-point, that whatever creature we may be looking at, we are gazing on some arrested picture in Life's Cinematograph. For, however solid bones may seem, they are after all but tokens of a slow but sure and subtle process of change, though it may be imperceptible except after centuries of time. The elephants are proofs of this. Whatever remains are being examined here, the questions must always be on the tip of one's tongue, "What were the ancestors of this creature like?" "What are its descendants like?" "What may be the meaning of the most striking peculiarities of these individuals?" "What determines this process of change from one form to another?"

To return to the Ungulates. This great group includes a wonderful variety of types, and extends far back in geological time. The earliest fossil forms so far discovered were small marsh and forest-dwelling species, which lived on succulent vegetation. The existing tapirs, pigs, and hippotamuses are the least modified survivors of this ancestry: the rhinoceroses, horses, cattle, giraffes, deer, and elephants, the highest and newest members of the order. The history of any of these groups is as full of interest and surprises as a fairy tale. Yet most of them we must pass without

comment. Look, for example, for a moment, at the skeleton of the magnificent Irish deer, with its superb antlers, measuring some nine feet across, and compare these with those of other skulls, noting the wide range of variation in palmation, and branching; or compare them with the antlers of other species of deer, and note how widely different they are in type! It seems impossible to realise the fact that these huge weapons were shed and renewed annually; yet so they were, just as they are in existing deer. What led to the extermination of the Irish deer—or Irish elk as it is commonly, but mistakenly, called? Time was when it roamed over England, and parts of the European Continent: but long ages ago it became extinct — exterminated possibly by pre-historic man.

Immediately behind the skeletons of the Irish deer stands a case containing the skull of a most wonderful animal—the Arsinoitherium—which roamed over what is now a part of the vast Egyptian desert. Wonderful because of the pair of huge horn cores which surmount the head, each supporting at its base a smaller horn core. During life these bony bosses were sheathed in horn, forming without question more formidable weapons than are borne by the African rhinoceros to-day, from which they differ in being ranged side by side, and not one in front of the other. But little is known of this creature, which is generally regarded as one of a group of animals of large size and strange appearance called the Amblypoda—or

"blunt-footed," from the stumpy, elephant-like shape of the feet.

Immediately behind the skull of Arsinoitherium will be found the skeleton of a huge and strange-looking beast from the Pampas formations of Buenos Ayres. This is the Toxodon. Its precise relationships have as yet defied discovery; all that can be said is that it is the descendant of some very primitive member of the order Ungulata. The skeleton of the huge creature with the weird-looking skull which comes next is another of those strange types, of uncertain origin, which, for some inscrutable reason, suddenly died out, leaving no descendants, at any rate so far as is known. The top of the massive head, it will be noticed, has several long, blunt-pointed horns, covered during life with a thick hide, while the upper jaws were armed with a pair of sabre-like teeth, for the protection of which, when not in use, it will be seen the lower jaw developed a pair of downwardly directed plates. Though large and powerful, these creatures must have been rather dull and stupid; at any rate we are justified in assuming this, on account of the ridiculously small brain, in regard to the bulk of the animal. Casts of the brain cavity are placed here to illustrate this fact.

That the little Mœritherium, semi-aquatic and marsh-loving, gave rise to the lordly elephant we have already seen, and it would appear that some of its relatives, on the other hand, becoming more aquatic, were slowly transformed till, as in whales, the fore-limbs became changed into paddles, while

the hind-limbs disappeared completely. A glance at the skeletons and stuffed specimens in the case behind the creatures we have just been discussing will show in a moment how great a change of bodily shape they have undergone. In the skeleton of the Halitherium all that remains of the hind-limb is a rod of bone, which was embedded in the muscles of the body, just as is the case in the living whales to-day, creatures which are of another line of descent altogether, but from living a similar life, have acquired the same general shape.

Stellers' sea-cow formerly browsed in herds on seaweeds off the shores of Behring Straits, but its flesh having been found palatable by Russian sailors frequenting this region, it was recklessly hunted down, and finally exterminated some hundred and fifty years ago. There are several different kinds, or species, of sea-cow known to science, most of which are now extinct. Stellers' sea-cow was not only the largest species of its tribe, but was further peculiar in that it has toothless, horny pads in the inside of the jaws, taking the place of teeth !

We have seen how the descendants of the little Mœritherium, migrating from marshy to forest regions, gradually increased in size, ending with the giant elephants, and how, from a similar ancestral form, whose descendants migrated on the other hand from the marshes to the rivers, creatures of a strangely porpoise-like form were evolved. Let us now turn to another phase of this wonderful story of evolution, another illustration of the building up of forest-giants, which,

while rivalling the elephants in size, have a totally different form.

Our examples are furnished by certain weird-looking animals which have been found in South America ; creatures which must possess for us an added interest from the fact that it was by the discovery of their remains in Patagonia that Darwin was first led to think on the problem of the origin of species, and to the building up of that world-revolutionising theory of evolution which has thrown such a glamour over the study of animal life.

These creatures, then, are the huge and strange-looking animals which dominate the pavilion at the end of this gallery. The largest of these, the Megatherium, rivals the elephant in size, though shorter legged. The huge stumpy feet look but ill adapted for walking, and this becomes clearer when they are more closely examined, for the soles of the feet tended to turn inwards as in the ant-eaters of to-day. The curiously deep lower jaw was a special provision to lodge the enormously long grinders. But the Megatherium, though like the ant-eater in the structure of its hind limb, was really closely related to the sloths, odd-looking creatures still living in the great South American forests. But while these are small animals which live amid the branches of trees, the Megatherium was far too bulky to do so, and instead pulled them down within reach of the powerful jaws by means of its great arms and hands. While the animal was thus engaged the tail was used to support the body, much as it is employed by kangaroos.

To the left of this strange beast will be found the skeleton of the Mylodon, a creature but little inferior to the Megatherium in size and similar in habits. The descendants of tree-dwelling animals, these two giants acquired their great stature only by slow degrees, apparently because they found on the ground a richer and more abundant food supply, more easily obtained, and freedom from enemies. The Mylodon was peculiar in having the skin studded with small "buttons" or nodules of bone, forming a sort of armour plating to the back, though less perfect than in the Glyptodon, to be described presently. The armature of the Mylodon, indeed, was precisely similar to that of a very remarkable creature, the Grypotherium, whose remains, marvellously well preserved, were found only a year or two ago in a cave in Patagonia, and under circumstances which make it certain it can only have become extinct within comparatively recent times. For the bones present a remarkably fresh appearance, and, as may be seen in the Table-case 15A in front of the Megatherium, they retain shrivelled remains of gristle and flesh. What is more, these bones show that they had been cut and broken by human agency, apparently to extract the marrow: while from the fact that large lumps of dung were found on the floor of the cave and quantities of hay, it would seem that the creatures were kept like oxen, for slaughter! The skin, in addition to the armature of bony "buttons," was hair-covered.

Perhaps the most remarkable of all the fossils in

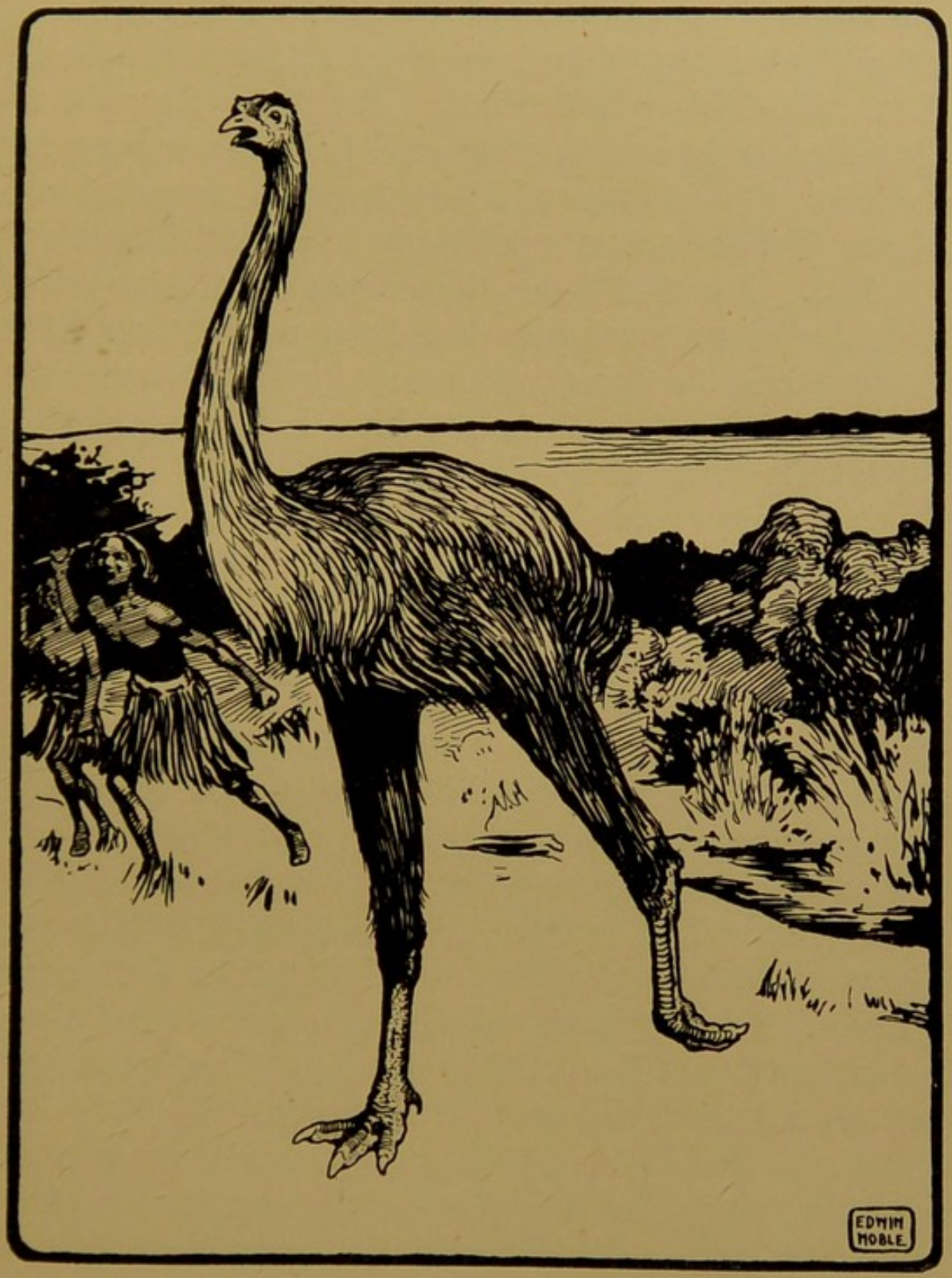


FIG. 8.—The Moa, an Extinct Flightless Bird of New Zealand.

this pavilion is the Glyptodon, a huge species of armadillo. The armadillos, it will be remembered,

have the upper part of the body encased in a shield of bony plates, so hinged that the animal can roll itself up like a ball. But in the Glyptodon, which stands in the great case near the window, it will be noticed that this shield was immovable, and formed of a number of pentagonal bones closely interlocked. For the sake of comparison the skeleton of a modern armadillo has been added, and this serves also to bring out more forcibly to what a huge size this creature attained before extinction overtook him and his race.

Just why some creatures attain to a gigantic size compared with the rest of their race no man can tell. The birds furnish other very striking examples of this. Of the Moas of New Zealand (Fig. 8) this is especially true, for, as will be seen here, some of these ancient birds did not greatly exceed a turkey in size, while others reached huge proportions. All were flightless: and what is more, they had so long been in this condition that the whole wing had vanished, wasted away as it were, leaving not the slightest trace of its former existence. The Æpyornis of Madagascar was another giant, compared to which the ostrich, the largest of our living birds, was but a pigmy.

When the earth yields up its dead, many surprising things are brought to light, and much that adds to our conceptions of the grandeur of life, while increasing the mysteries thereof. The reptiles have always been regarded as creatures of dull and listless habit, ugly as to shape, and venomous by nature: wherein they have been

greatly maligned. To-day they are a degenerate race, but time was when they were the dominant forms of life upon the earth. The history of life on the earth, it must be remembered, may be measured, as it were, by several great periods. The earliest of these is known as the Primary (*i.e.* first) or Palæozoic (*i.e.* oldest life) period, and during this time, while the lower orders of creation were represented by types still surviving to-day—such as sponges, corals, shell-fish, and crustacea—the only backboned animals were creatures of a very humble type—the fishes, and the ancestors of the frogs and newts of to-day. But towards the end of this period the reptiles made their appearance. In the next great period, the Secondary or Mesozoic (*i.e.* middle life), the reptiles reached the heyday of their development, and some attained gigantic proportions. They became fitted, as we shall see, for very various modes of life, peopling earth, sea, and air : some were flesh-eaters, others vegetarians. Late in this period the birds first made their appearance, and the first of the mammals arose, developing, during long ages, in numbers and variety up till the appearance of man, the crowning glory of creation, and creation's greatest scourge ; for man has wrought more destruction, often wantonly, on the humbler creatures than all the other factors of death put together !

But our conversation was of reptiles. Let us make our way to the Reptile Gallery, which is approached from the end of the gallery leading into the pavilion containing the giant sloths. Here

we are confronted with some of the most remarkable of all the reptiles—the Pterodactyles—remarkable because they were the first of the backboned animals to acquire the mastery of the air. The Pterodactyles (Fig. 9), which, it will be noticed, made their first appearance as very small creatures, had the jaws armed with teeth, while their wings were formed by enormously extending the little finger of the hand, and this served to support a thin sheet of skin which ran down the whole side of the body and hind leg. In some the tail was of great length, and also supported a membrane, but in many the tail finally disappeared. Similarly the teeth gradually disappeared, being replaced by a horny beak as in birds. And this loss of teeth was accompanied, in some species, by an enormous increase in bodily size, some of the giants having a span of wing of as many as eighteen feet! The chalk of Kansas has yielded the finest of these remains. What a contrast between such a specimen as this and the earliest of these creatures, which was little larger than a sparrow!

By way of another contrast let us now turn from these flying dragons, as they have been aptly called, to the old sea-dragons. The Ichthyosaurs come first in the series, and the magnificent array of these will be found in the table cases at this end of the room, while the still more imposing giants of the tribe will be found on the walls. Though fish-like in the general shape of the body, the structure of the skull and limbs will show at a glance that they were really reptiles. At the same

time these limbs are obviously unfitted for use as

FIG. 9.—Pterodactyles, or Flying Dragons, and the Hesperornis, a giant diving bird.

organs of locomotion on land, because they have become converted into paddles for steering purposes

when swimming. During this transformation the construction of these limbs, it should be noticed, has been most profoundly changed. The two bones of the forearm, for example—radius and ulna—which in animals that walk are long and freely movable at one end on the upper arm, and at the other on the wrist and hand, are all here extremely reduced; so much so that they are not easily distinguishable from the wrist-bones, which they resemble from their roughly hexagonal (six-sided) form. The bones of the fingers have become increased in numbers, and are also roughly six-sided; and with the wrist-bones, and bones of the fore-arm, they form a sort of mosaic work, so tightly are they wedged together. Thus this limb formed a very effective flexible paddle, but the bending back of the forearm upon the arm, and of the hand upon the wrist, was impossible. Finally the paddle, during the lifetime of the animal, was fringed by a kind of web, supported by rays like the fins of a fish, and in many species the number of the digits, or what answers to these, was increased, thus increasing the width of the paddle. And what applies to the fore limb applies also to the hind, though this last was very degenerate in size.

Another peculiarity about these old-time dragons was the fact that they possessed a third eye in the middle of the head, and the socket for this is plainly seen in many of the skulls here exhibited. But traces of this eye—the parietal eye, as it is called—are found also in many existing reptiles, though

no longer performing any useful purpose. The strange armature of bones around the eyeball is similarly met with among reptiles to-day and also among birds.

When the Ichthyosaurs first appeared on the earth they were comparatively small creatures, but before their race finally disappeared they acquired considerable size. There are specimens here of over twenty feet in length, and vertebræ at the bottom

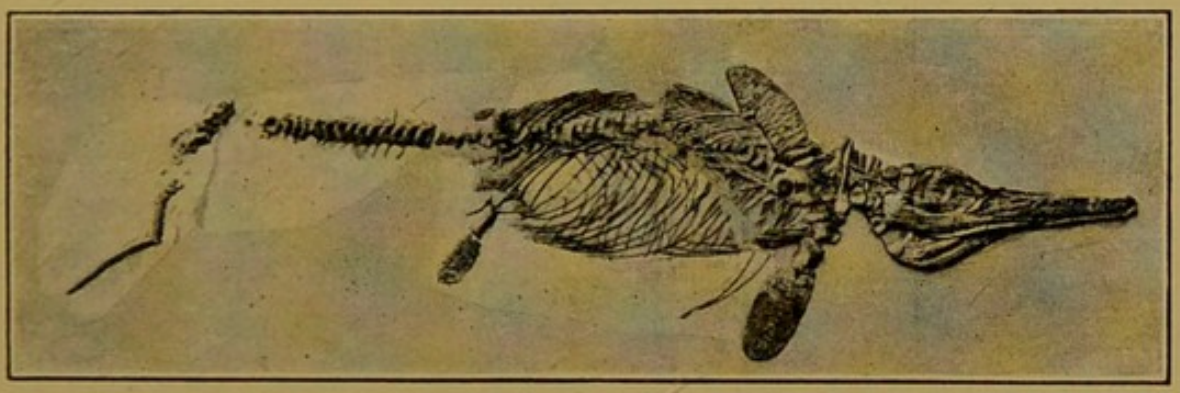


FIG. 10.— Ichthyosaurus, an old Fish-lizard.

of the wall-case in Gallery 3 show that much larger individuals lived.

There is much else that might be said of these strange creatures did time and space permit, but we must conclude this survey with the reminder that these creatures swarmed in the ancient seas which then surged over what are now the midland counties of England! And this is known because the "Lower Lias" rocks of Barrow-on-Soar, Leicestershire, have yielded abundant remains, as may be seen in the adjoining cases.

Passing on, we come to creatures agreeing in all essentials with the Ichthyosaurs, save that they

had extremely long necks—so that they might almost be called aquatic giraffes! There were the Plesiosaurs, and they lived and swarmed in the seas, side by side with the Ichthyosaurs (Fig. 10)—perhaps, indeed, they waged war occasionally on one another!

The huge skeletons, or parts of skeletons, in the centre of this room remind us that the land as well as the seas of these far-off ages boasted gigantic reptiles. These land-dragons, as they may be called, can be roughly divided into two kinds—those which walked upon all four feet, and those which walked only on their hind legs. On one of the stands opposite the wall cases containing the Ichthyosauria will be found specimens of the thigh-bones of some of these enormous creatures. The thigh-bone of the Cetiosaurus was found in the Stonesfield Slate near Oxford, while the adjoining larger case contains remains of similar animals obtained near Peterborough. It may come as a surprise to many to learn that these creatures, which reached a length of sixty feet, once roamed along the bottoms of the ancient rivers of this country, yet such is the case. But even these are overshadowed by the enormous size of some American fossils such as the Atlantosaurus and the Diplodocus. The thigh-bone of the former measured as much as six feet in length! The Diplodocus (see Frontispiece) attained a length of over eighty-four feet! The huge bulk of such creatures may well be seen in the cast set up in the Reptile Gallery. Remains of yet

other strange reptiles which wandered over this land of ours will be found in this gallery, but of these we can say nothing here just now. Let us rather proceed to another aspect of reptile life, where it touches upon its relation to the mammalia.

That the mammals or "beasts," the birds, reptiles, and amphibia—frogs, toads, and newts—are so many branches of a common ancestry there can be no doubt, and in the Wall-cases 9–10 in the pavilion we are now approaching—that at the end of the gallery opposite to the flying dragons, or Pterodactyles, and in the small Table-cases 30–33, which stand under Wall-case 12—will be found the remains of creatures which, though undoubtedly reptiles, yet in many respects are like the mammals. They may be regarded, then, as the ancestors of the mammals, and hence are of peculiar interest. Their nearest surviving relatives are the duck-billed platypus (*Ornithorhynchus*) and spiny ant-eater (echidna) of the Australian region, creatures which have the blood less warm than the rest of the mammals, and which, like reptiles, lay eggs.

The most mammal-like of these creatures are to be found in Table-cases 31–32, which contain some very remarkable fossils from the "Karoo" formation—extremely ancient deposits met with in Cape Colony. Look, for example, at the skull of the creature named *Ælurosaurus felinus*, and note the shape of the teeth, which are quite unlike anything met with among typical reptiles. In Case R will be found a skull which is curiously

like that of a dog—hence the name *Cynognathus* (dog jaw). The teeth, as in the first-named fossil, were evidently those of a carnivorous animal. But in the skull of *Tritylodon* (Case 32), it will be noticed the teeth are those of a vegetable feeder.

Finally we come to the Pariasaurus (Fig. 11). A complete skeleton of this strange animal will be found in the pavilion above referred to. Massive in build, it seems to have been a vegetable feeder, and the feet seem to show that much of its food was obtained by digging. Though first found in South Africa, numerous skeletons, remarkably well preserved, have since been found in Northern Russia. Here they are found in large lumps, or nodules, of stone, which for years were used for the purposes of road-mending in Russia! Fortunately Prof. Amalitzky discovered this fact, and for many years has devoted his energies to the examination of such nodules, which, for this purpose, are removed to the University of Warsaw, where the finest instruments and the most loving care are used to cut away the stone from the treasures therein preserved. From the great number of the remains found here it is clear these creatures must have roamed in great herds, though what brought about their extinction no man can say.

At one time it was believed that this earth of ours was periodically overwhelmed by some great catastrophe, generally in the form of earthquakes, which swept away every living thing, a new order

of creatures later coming into being to replace the victims. This view is now everywhere disbelieved, for there is absolutely no evidence to support such a theory. Nevertheless gigantic floods did occur in the past as now, bringing with them widespread death and destruction ; but these were always, as

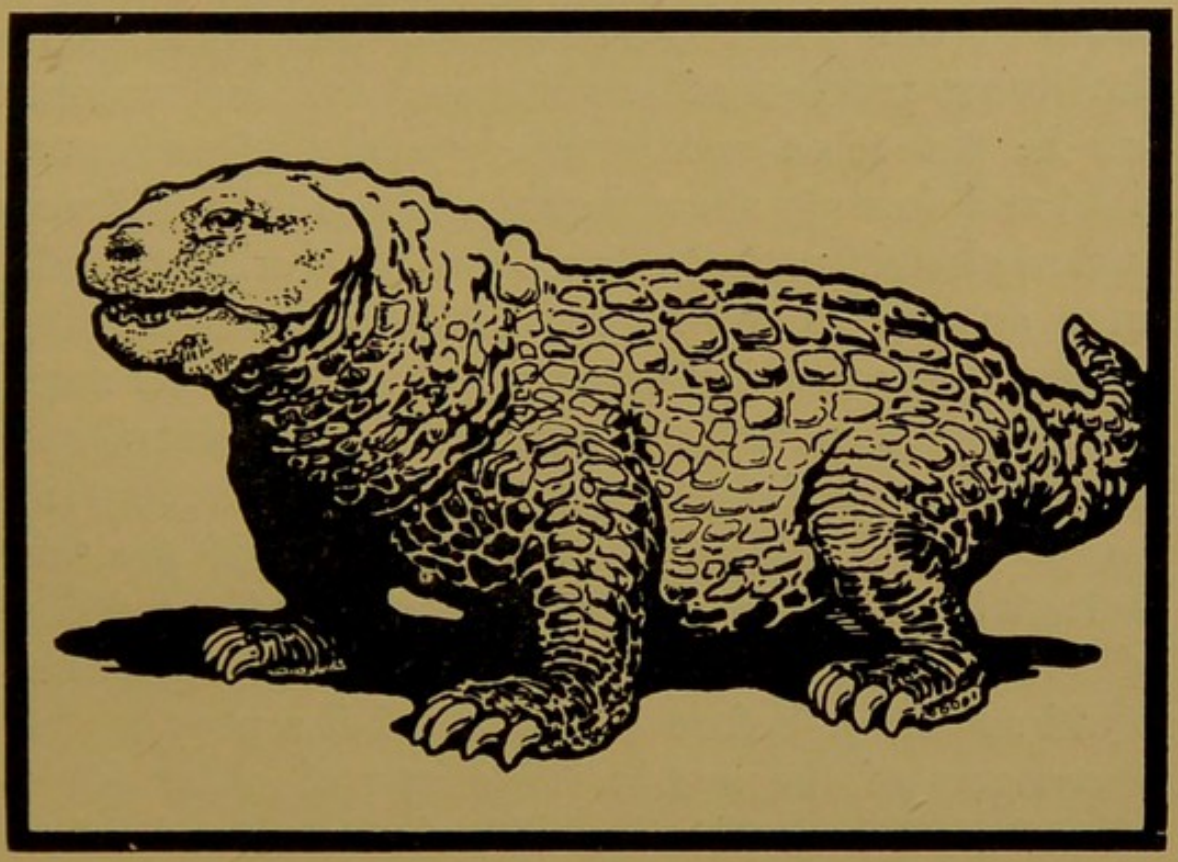


FIG. 11.—Pariasaurus, an ancestor of the Mammals.

now, confined to comparatively small areas. There are many evidences of such floods to be read in the history of the rocks. The giant Dinosaur known as the Iguanodon, described in our account of the reptiles (p. 159), was engulfed in such a flood. This skeleton was one of a number found in a great heap at Bernissart in Belgium a few years ago, in such a way as to leave but little doubt

that it and its companions had been swept along by some resistless flood, and at last deposited and buried, only to be discovered millions of years after! And we shall find evidences of catastrophes of yet another sort presently, in the gallery of fossil fishes. Here may be seen (in Wall-case 16) a slab of rock containing the remains of a shoal of fishes of the genus Holopteryx, a near relative of the living perches of our streams. These remains are in the most extraordinary state of preservation, and seem to show that this shoal was suddenly overwhelmed, perhaps by some volcanic disturbance on the floor of the sea. And this because these fishes are lying one upon another in all sorts of contorted positions, with gaping mouths and gills, and erected fins, suggesting suffocation by the escape of volcanic gases at the bottom of the sea, so that they became rapidly interred by the settling of suddenly raised sediment before decomposition could set in, or before they could fall a prey to the scavengers of the sea in the shape of other fishes of vulture-like habits, or of crustacea, and other carrion-eaters. How many thousands of years they may have lain there we cannot tell, but this we know, that a time came when this old sea-bed became dry land, and for thousands of years longer these victims so suddenly overwhelmed lay in a grave over which the green grass grew and birds sang. Finally, they were unearthed by some geologist intent on reading the riddles of the rocks, and here they are to-day to help us to learn something more of our earth and its story. But the fate

which befel these ancient perches was by no means an isolated incident. Far back in the world's history—as far back as the time when the old red-sandstone was accumulating—we have proof of just such another disaster as is shown in the slab containing the remains of some very ancient fishes long since extinct, and known to science as Holoptychius (Wall-case 5 and Table-case 11). Yet again another instance, this time indelibly stamped upon a slab of cretaceous rock from Mount Lebanon, in which are embedded the bodies of thousands of young herrings. These, however, lie flat, suggesting less violence in the manner of their death. And these, too, serve to show us, not only what kinds of fishes were living in this dim and distant past, but also once more to bring home to us the stupendous changes that the world has undergone at different times, in changing sea into land, and land into sea. For what is now Mount Lebanon was once fathoms deep in brine !

For most of us these galleries are deeply fascinating, because they afford us an insight into the many changes which this old world of ours has undergone, as well as into the life of creatures strange and wonderful, which have long since passed away. Each of the great groups of animals which we now know can here be studied, as it were, in the making, though some have passed the heyday of their development. This is true, for example, of the "shell-fish" or mollusca. Far back in time, so far back that we cannot conceive

the number of years, there lived a number of strange creatures known as "Ammonites," whose remains have been abundantly preserved in the form of beautifully coiled and ornamented shells. These Ammonites, strange as it may appear, were nearly related to the stock which gave rise to the octopuses and cuttlefishes of to-day. Our nautilus, and that mysterious little creature the "spirula," are the only nearly related survivors of these Ammonites. The oldest of these strange "medals of Creation" had a closely-coiled shell, as may be seen in Table-case 4; and some were of huge size, as a glance round the walls of the gallery will show. During what is known as the Liassic age, they must have swarmed in the seas, their shells accumulating at the bottom of the sea hundreds of feet thick. In course of time this mass of shells became converted into marble known as the "Ammonite marble," and this in time became thrust up from the bed of the sea and formed dry land, some of which forms a part of the ground we tread on, here in England, while some helps to make up the mighty Himalayas. A piece of this Ammonite marble will be found on the wall in this gallery. As one passes from the oldest known to the latest of these shells some wonderful instances of development in ornament and sculpturing and shape will be found, but this cannot be followed out in these pages. Let it suffice to point out some of the more remarkable changes in shape that are to be met with towards the end of the period of their maximum development. These will be found in Table-cases 14 and 15.

In Crioceras we have an open coil, in Turrilites a closed spiral, looking as little like an Ammonite as can well be. Macroscaphites shows a closed spiral tube bent back upon itself, while in Hamites we have a tube bent upon itself at each end ; finally, in Baculites we have a straight rod ! From certain details in the structure of the shell it is supposed that the animal must have given up swimming—the normal method of Ammonite locomotion—for crawling.

CHAPTER III

THE LOWER MAMMAL GALLERY

"But ask now the beasts and they shall teach thee."

I PROPOSE in this chapter to introduce you to many old friends in what I hope will prove a new light. We are, in a word, to talk of the "mammals," that is to say, of all those creatures most mistakenly called "animals," to distinguish them from birds, reptiles, fishes, and so on. But these are no less "animals," for it must be remembered that living things can belong but to one of two kingdoms—the animal or vegetable. Thus, then, we must, if we will not be inconsistent, consent to substitute for this much misused word the term mammal, or "beast." The latter, however, is open to many objections, and not the least of these is that it has an unkind ring about it.

Very well. If the mammals are less generally known, less popular, it is not because they lack interest as compared, say, with the birds, so much as because they are less in evidence in our daily lives. The horse, the cat, the dog, sheep, and oxen we have come to regard so much as part and parcel of our ordinary surroundings that we have ceased to think of them as so many domesticated

members of a wild stock. Yet they are so many links in a most wonderful chain of events, so many twigs of one great branch of the tree of life, since all find a place of honour in this gallery.

The array of creatures in this room is almost bewildering in its variety. Beauty and strength and frailty in many shapes are presented here, and all the world has been laid under tribute to furnish this gathering. The burning deserts, the mountain fastnesses, the impenetrable jungles, the icy regions of the far north, and the storm-beat coasts of regions where men but seldom go, have all been laid under contribution. Now such a gathering of the clans as this is apt to lose much of its meaning unless it is surveyed in a proper frame of mind. One should then constantly keep in remembrance the fact that these varied types—the leaping kangaroo, the tree-climbing ant-eaters, the beautiful deer and graceful gazelles, the camel, the zebra, the strange, unwieldy sea elephant, the seals and walrus, bears, lions and tigers—have all become what they now are, have been built up as it were, by a series of slow changes such as may be seen, for instance, in the story of the horse and the elephant (pp. 16 and 18). All these very different kinds of beasts, in short, have sprung from a common parentage, as is shown by the fact that to this day all agree, whatever their differences in other respects, in having warm blood. But gradually a great many of the characters which were shared in common have been lost. Thus all, at one time, were clothed in hair ; the whales have lost this, in

the porcupine and hedgehogs it has become transformed into spines, in the armadillos into bony armour, and in the African pangolin into horny scales. In the matter of teeth, again, similar remarkable changes have taken place suited to different conditions of life. Once on a time all beasts had similar teeth, but as they changed in shape to meet the needs of new modes of life, so the teeth often changed also for the same reason. Thus in some creatures to-day, as in the babirusa (Fig. 12), warthog, and musk-deer, one or more pairs project far out of the mouth to form weapons for fighting. Thus are new beasts made.

It is very difficult to understand how these wonderful changes can have come about, because there seems to be no real evidence that we can get hold of. But an inkling of the mystery may be gained if one remembers that they take place very, very slowly. Every generation of young animals differs from its parents in all sorts of ways, yet to an extent only which can hardly be measured. But as time goes on, these differences grow larger and larger, so that finally a new race of creatures has come into being. But as thousands of years are necessary for this transformation, it is no wonder that we can see so little in the short span of life that is ours. Similar changes happen in the growth of human society. Think for a moment of the ancient men of these islands, who clothed themselves in skins, and whose only weapons were bits of stone chipped into the shape of spear-heads

and axes ; compare them with the civilisation of to-day, and all that this embraces.

As Tennyson so forcibly reminds us, the teeming life of the world is wrought—

> "With many shocks that come and go,
> With agonies, with energies,
> With overthrowings and with cries,
> And undulations to and fro."

That there is, in short, a constant struggle for existence between the parts of the individual, between the individual and its kindred, and between that kindred and the alien creatures by which it is surrounded. More or less clearly we hope to show the results of this struggle, in so far as the mammals are concerned, in this chapter.

FIG. 12.—Head of Babirusa.

It is the rule, in studying any group of animals, to begin with the most primitive forms, that is to say, those which retain the greatest number of ancestral characters : of characters, in other words, which are clearly links with yet more primitive animals, such as the Pariasaurus, described in Chapter II., a creature which stood near the parting of the ways between the amphibia (Chapter II.) and the reptiles. Yet these same primitive forms often possess features which are by no means primitive—that is to say, are evidently not a part of their original make up, so to speak.

An ordinary rowing-boat fitted with a motor and a propeller, and thus converted into a motor launch, may serve as an illustration of what is meant by this process of grafting new mechanism on to an old framework. But this matter will become clearer presently, when we come to speak of the duck-billed platypus (Fig. 13), one of the lowest of the mammals.

FIG. 13.—The Duck-billed Platypus.

This, and the equally remarkable echidna or spiny ant-eater (Fig. 14), will be found immediately on entering the Lower Mammal Gallery, in a table-case in the centre of the bay on the right-hand side of the doorway. The platypus, I should remark, is a native of Australia and Tasmania, the echidna of Australia and New Guinea.

FIG. 14.—The Echidna, or Spiny Ant-eater.

They alone among the mammals lay eggs, which, like those of the reptiles and the birds, have a hard shell; but their young are nourished by milk, like those of all other mammals. Now the fact that they lay eggs is in itself enough to mark them as the most lowly creatures of their kind; but in the matter of their skeleton, brain, and other

anatomical characters there are many points which also are evidently inherited from creatures humbler in the scale than themselves. On this foundation, then, on this old stem, newer characters have, so to speak, been grafted. The jaws, for example, though in some respects resembling the jaws of reptiles, have been changed to a semblance of a duck's beak (hence the name "duck-billed"), while the legs have similarly been altered and shortened, and the toes webbed, to serve as oars; hence the second part of the name, "platypus" or flat-foot. For the creature was at one time a land-dweller, but is now aquatic, living in burrows in river-banks like a water-vole. But this tale of new lamps exchanged for old does not even end here, for in very young animals the jaws are armed with teeth, three in each jaw, answering to the cheek-teeth, and these are of a very primitive pattern, such as were common to their immediate forbears. Later in life, however, these teeth are shed, and are succeeded by horny pads. The food of these creatures consists of small aquatic animals which are obtained in the mud of the bottom of the stream, and these can be crushed better by such pads than by teeth. The echidna, or spiny ant-eater, has gone yet further in its changes, for the hair has been largely replaced by spines, while the jaws are also horny and beak-like. Teeth have long since vanished, and the tongue has become worm-shaped, so as to recall that of the woodpeckers among the birds. In both bird and beast this tongue serves the same purpose—the capture of

ants and other insects ; for this reason it is coated, before being thrust out amid the insect swarm, with a sticky saliva. Some other ant-eating mammals have adopted a similar device, as we shall see. Though the spiny ant-eater has no teeth, the palate is armed with horny spines, which serve to thrust the ants off the tongue as soon as they have been drawn into the mouth.

Like the duck-bill, as we have remarked, the spiny ant-eater lays eggs ; these are two in number, and are carried about by the mother in a pouch until they are hatched. In the case of the duck-bill, however, they are laid in a burrow. In the matter of its feet it will be noticed the spiny ant-eater's are also "specialised," since the toes of the fore-feet, armed with strong claws, are obviously well adapted for digging, and the more perfectly they become transformed to serve this end the less useful they become for other purposes ; hence they are said to be specialised. External "ears," it will be noticed, are wanting.

The duck-bill platypus and the echidna stand apart from all the rest of the mammalia on account of their lowly structure, and they deserve to be most carefully examined on this account.

We pass now to another very primitive group, and one of quite exceptional interest. Its members show a wonderful versatility and variety of form. The marsupials, it is to be remembered, are now confined to the Australian region, with the exception of the opossums, which occur in America : though earlier in the world's history marsupials

roamed over practically the whole earth. Later they were replaced by more vigorous types, and have survived in the Australian region—which includes the continent of Australia and adjacent islands to the north and south—owing to their isolation. Thus shielded, they have, as it were, branched out in all directions: have become adapted to all modes of life. But of this more presently.

In Case 70 a selection of most interesting types will be found. Look for example at the strangely mole-like "Notoryctes" in the right-hand corner of this case (1443). It is a dweller in the under-world, as its shape demonstrates, burrowing in sandy soil and feeding on grubs and worms. It differs externally from the mole in having a blunt snout protected by a horny pad, and in having but few toes on the fore-feet, which are armed with huge claws, as in the golden moles to be described later. The ears have disappeared, while the eyes, as in the moles, have almost completely vanished.

Of the opossums—the extra-Australian members of the order—there are many species, some of which are arboreal or tree-dwelling, some aquatic in habits. The arboreal members, like some other mammalia, have prehensile tails, which serve as a fifth foot.

We come now to another ant-eater—the banded or marsupial ant-eater (1469), one of the few mammals marked with cross-bars; but it is a far less "specialised" creature than the spiny ant-eater, though it has a similar tongue. In the matter of its colour comparison should be made

with the thylacine, or pouched wolf, to be described presently. For while in the one the stripes are white on a dark ground, in the other—the thylacine—they are dark on a light ground. The curious dasyures, on the other hand, differ from both in being spotted with circular discs of white; while, to complete the story, we have the beautiful little three-striped phalanger with longitudinal bands of black on a white ground. All the various types of mammalian coloration, in short, are presented in these nearly related and primitive creatures. I want my readers to pay particular attention to this matter of coloration, for it is one of great importance, and presents some of the most fascinating and most puzzling problems to be met with in the animal kingdom. Again and again we shall have to refer to this theme in these pages.

Of the carnivorous marsupials there are some very remarkable species, such as the strange-looking bandicoots, the great pouched wolf, the fierce and untameable Tasmanian devil, and the native cats or dasyures, which in their habits recall the weasels, martens, and other small carnivora belonging to that other great and distinct group of mammals to be dealt with later. The pouched wolf or thylacine, it will be noticed, is transversely striped, a type of coloration rare in mammals. The skull of the creature is so remarkably dog-like that only an expert could distinguish it from a dog's.

The phalangers demand a special, if brief notice, for some are of great beauty, and are interesting.

Some are quite mouse-like, others have acquired remarkable skill as parachutists. And this fact is really the more wonderful, because, as we shall see, other mammals, in no way related, have acquired a precisely similar mechanism—the extension of a fold of skin along each side of the body and expanded by means of its attachment to the fore and hind limbs. By way of contrast with these active little sprites, turn to the strange-looking koala (1414), a near relative of the phalangers, and the no less strange and clumsy wombat (1393–1395). The first-named, it will be noted, is a tree-dweller, the last a burrower, yet there is a certain likeness between them.

Finally we come to the most wonderful of all this really wonderful group—the kangaroos.

In the typical kangaroos, as everybody knows, the hind legs are of enormous length, while the tail, which is long, is of great length and thickness. These animals are thus enabled to progress in a quite peculiar manner. When at rest this tail serves as the third leg of a tripod, and when moving slowly it is used to thrust the hind part of the body forwards while the hands are resting on the ground; then the hands move forwards, and again the tail lifts the hind part of the body and thrusts it forward, and so on. But when alarmed a marvellous change takes place, for the creature immediately rears itself up, and with a series of prodigious bounds on the hind-legs it races along at a perfectly astounding speed. The large "old man kangaroo" is hunted with dogs, but when it is

brought to bay, woe betide the dog that comes within reach of the great claws on the hind toe !

In the kangaroos the curious pouch in which the young are carried reaches its highest and most perfect form, and in this strange nursery the young are carried till they are too big.

Somehow it seems difficult to imagine kangaroos climbing trees ! Yet some species pass their lives amid trees. Such arboreal forms, however, have much shorter hind-legs than their ground-dwelling relations. They would seem to have descended from short-legged, ground species or " wallabies," some of which are but little larger than a rabbit.

Most of my readers, I take it, have read " Alice in Wonderland," and will remember the Cheshire cat, which gradually faded away till nothing but the smile was left ! The kangaroos always recall this whimsical picture to my mind, for starting with the giants of the tribe they seem to gradually fade out till nothing but a little rat-like beast, with a short, scaly tail, remains. This last term in the series is represented by the curious little musk kangaroo, *Hypsiprimnodon moschatus*.

The marsupials and their kind afford one of the most striking illustrations in Nature of the way in which animals are moulded by their mode of life, since from some generalised ancestor—that is to say, from some ancestor which presented no striking peculiarities of form or structure—flesh and insect-eating animals, and vegetable-eating creatures with teeth recalling those of the rodents, as, for example, of the squirrel and rabbit, have come

into being. Compelled by force of circumstances, in short, to adopt these various modes of life, they have come to bear a striking likeness to other creatures in remote regions of the world leading similar lives, but having a different parentage. Similarly, burrowing types like the burrowing mole "Notoryctes" are matched by the golden or common moles of other regions, and the kangaroos by the jerboas and jumping shrews, and so on. But no animals answering to the horses and oxen ever seem to have come into being in this group.

Somehow or another no one has yet succeeded in making the subject of the classification of animals really interesting, yet it is a theme which is full of possibilities, for classification nowadays is not merely the grouping together of creatures which *look* alike, but the arrangement of animals—and plants—according to their relationship one to another, a relationship to be discovered only by a study of anatomy: yet the tracing out of these pedigrees is fascinating work, but bristling with difficulties. We must be content with the bald statement of fact that the marsupial must be regarded as a side branch of the great tree of mammalian descent, and that we are now to pass in review some of the more striking fruits of the branches of the great main stem of this tree.

The first of these branches bears a number of most extraordinary creatures: the sloths, the ant-eaters, and the armadillos of South and Central America, and the pangolins and ant-bears of

Africa. These will all be found in Cases 67* and 68, near the entrance to this room, and on the right-hand side.

Let us begin with the African ant-bear, or aard-vark. As its name implies, it is an ant-eater. Now there are really not many animals which prey on ants, for these little creatures are unusually protected against attack by means of a powerful acid, known as formic acid, which by means of their sharp, hooked jaws they can introduce into the flesh of their enemies with most painful results. Hence any animals which are to succeed in thriving on their bodies must effect very considerable changes of their bodily shape. The transformation of the tongue to form a long, worm-like rod, which can be thrust far out of the mouth, and huge glands secreting a sticky saliva to cover this, seem to be absolutely essential, for both birds and beasts have adopted it. The varied shapes the body may take to suit this habit of feeding we are now to survey. One illustration we have already had in the marsupial ant-eater—the echidna, with its tube-like snout, spines, and strange deformed-looking feet. Now contrast this with the great aard-vark. Though far less transformed than the echidna, it is yet obviously an animal on which the influence of a peculiar life has set its mark. The snout here is tubular and rather pig-like, the limbs very powerful, but well shapen: and the body retains its normal coat of hair. The great size of the ears cannot fail to attract attention, and hardly less conspicuous is the large tail. The aard-vark

is a great burrower; he lives in burrows, and uses his big feet also for tearing down the walls of the huge citadels erected by the termites or so-called "white ants," which build hives, as it were, of mud, ten feet or more in height! The aard-vark alone can storm and ravage the teeming life of these wonderful cities.

The pangolin of West Africa is a much more remarkable animal (1362–1368), for the whole body is covered with a most wonderful coat of mail, in the form of overlapping scales, giving the creature a likeness to a huge pine-cone! These scales are really modified hairs, or spines perhaps, greatly flattened out. Of its internal structure much might be said, but let it suffice to remark that its jaws are toothless, as with so many ant-eaters, and that it has a breast-bone which runs down nearly the whole length of the body, and to the hinder end of this the muscles of the tongue are attached. A tongue like that of ant-eaters, which can be protruded a long way, of course requires a special mechanism for its working, and Nature has adopted some very ingenious devices to secure this. But we have yet to mention another remarkable fact about this most remarkable creature. The tail, it will be noticed, is of great length, and serves to support the body in such a way that it can be inclined at right angles to the tree.

It will have been noticed that the creature is a tree-dweller, and among such animals it is unique, for, owing to the great length and power of its tail, which is used like the third leg of a tripod, the body

can be inclined at right angles to the tree, so that it comes to bear a remarkable likeness to a dead limb! To complete the likeness the fore-legs are drawn close up to the neck, and the head is turned upward. The only grip is that afforded by the hind-legs. By this device, the animal is probably able to avoid enemies, which have come to regard pangolins as edible.

Contrasts are always helpful. Turn, then, now to the great South American ant-eater, with its long, tube-shaped head and enormous hairy tail. And look, too, at the strange, apparently deformed fore-feet, with their enormous claws. The creature walks upon its knuckles, apparently to protect the claws, which are very powerful, and are employed for tearing down the walls of ants' nests. The jaws are absolutely toothless, yet this animal is a formidable foe when attacked, for the long talons make most deadly weapons, on occasion.

The precise purpose of the huge hairy tail is apparently not known, but it is interesting to note that some near relations of this strange-looking beast, small in size, and tree-dwellers, use the tail as a grasping organ, like the African tree-dwelling ant-eater—the pangolin—which also uses its tail as an organ of support, though in a quite unique fashion.

Some of my readers may ask, How is it that animals, which in the matter of diet are so similar, are in the matter of clothing so different? We have had already the echidna with its spines, the short-coated aard-vark, the scale-covered pangolin, and the long-haired South American

ant-eater. The armature, or the lack of it, can have no relation to the nature of the food. How, then, is it to be accounted for? We frankly do not know, but it is probably connected rather with the problem of the avoidance of enemies in the search for daily bread. This certainly seems to be the case with the armadillos, wherein we have an even more remarkable armature, the original hairy covering having been almost completely suppressed, and replaced by an armour plating of small, four-sided bony plates, forming a great shield covering the back, while the forehead and tail are similarly protected. By means of a hinge, or hinges, across the middle of the great back shield, the animal is enabled to roll itself up into a ball, the head and tail making the surface complete.

Armadillos are ground-dwellers, living in burrows, which they dig with amazing ease and rapidity, either for the purpose of escaping enemies, or to procure food, which consists of roots, insects, worms, reptiles and carrion.

Natives of Central and South America, these creatures to-day represent but a pygmy race in the matter of size, for the largest species does not exceed two feet in length, but time was when armadillos of gigantic size roamed where now these pygmies dwell. The huge Glyptodon described in Chapter II., and exhibited in the gallery of Fossil Animals, is the best-known of these. Unlike their smaller relatives, these bulky animals could not roll up their bodies, for the great back shield lacked the hinged arrangement. The modern

armadillos, it must be remembered, are not to be regarded as the degenerate descendants of these giants : side by side with the large ones lived also small species. The mammoth editions, so to speak, sprung from some pygmy race, and apparently found life too strenuous, and so vanished again, leaving the earth to the smaller folk of their kind !

A similar story is to be told of the sloths, to which we come now. Ages ago—in the Pampa formations of S. America—there lived huge creatures rivalling elephants and rhinoceroses in size, and these, as their bones testify, were near relatives of the quaint-looking sloths of the South America of to-day (Fig. 15). But these giants were, as may be supposed, ground-dwellers, who contrived to feed upon the lowermost boughs of trees by sitting up on their haunches, supported by a powerful tail, and pulling down the boughs with their great fore-limbs, when the leaves were drawn into the mouth by a long worm-like tongue like that of the giraffe. Skeletons of these wonderful animals will be found in the Fossil Gallery.

But the sloths which have survived are certainly in every way as remarkable as their extinct relatives. The naturalist Buffon, indeed, was so impressed with their extraordinary appearance and mode of life that he deemed them creatures afflicted of God ! Yet in this he was assuredly mistaken, for we may be certain that the sloths, in their own peculiar way, contrive to get as much enjoyment out of life as other creatures enjoying their freedom.

But what made Buffon take this gloomy view? Apparently the fact that these creatures pass the whole of their lives suspended by the feet from the branches of trees, back downwards! And this fact, added to a peculiarly melancholy expression and extraordinarily slow movements, led him to believe that they found life both a sad and serious affair. Yet, being to the manner born, they are

FIG. 15.—The Common Sloth.

no more to be pitied than the mole; indeed the very peace of their lives may seem to some of us enviable. A very slight examination of these creatures will show that they are admirably equipped for the niche in life which Nature has ordained for them. Look at the feet, for instance: the toes, armed with powerful claws, form the most perfect climbing organs that could be devised. That they cannot run is nothing to the point, for neither can the race-horse or the antelope climb trees!

There are two very distinct types of sloths—the one with three toes on each foot, the other with only two on the fore-feet, and besides this there are other anatomical differences in regard to the teeth and hair.

In the matter of the hair, however, they have one remarkable peculiarity in common, and that is its strange green hue, whereby the animals get so close a likeness to the grey-green lichen-covered bosses of the branches amid which they live as to be practically invisible: and thus they escape the eyes of hungry carnivores! This most unusual colour, strange though it seems, is not the natural colour of the hair, but is due to a lowly plant related to the algæ, such as the confervæ and lichens, for instance. This fact in itself is wonderful enough, but more amazing still is the fact that the two types of sloth have each a different kind of alga, and after a different fashion. In the three-toed species these algal bodies are lodged in cracks in the outer sheath of the hair, while in the two-toed species they hide themselves in long grooves carved, so to speak, out of the surface of the hair! These plants are in no sense parasites, for they get their nourishment from the moist atmosphere of the tropical forests; like funguses, in short, they thrive in damp places. In the whole animal kingdom there is surely no more remarkable fact than this.

So far we have taken but a few samples of the marvellous changes of form which animals undergo in fighting the battle of life, and these samples have

been, for the most part, furnished by harmless and inoffensive creatures; dwellers in Nature's by-ways. Let us, then, now take a rapid survey of that great and wonderful group of animals known as the "ungulata"—the hoofed animals—on the one hand, and of that other and no less wonderful group the carnivora, or flesh-eaters.

These two, seemingly as far as the poles apart, are yet descendants of a common stock! What this stock was like you may gather, at least in a general sort of way, by an inspection of a remarkable fossil exhibited in the Fossil Gallery on the ground floor, in Case 9. This is the Phenacodus, which partakes of the nature of both ungulate and carnivore, though inclining more to the former. Of the various grades in the evolution of these two groups this is not the place to speak, even did space permit. It must suffice to state the fact that the two groups, now so utterly unlike, the one commonly preying on the other, may boast the same ancestry, developing, however, along widely different lines.

The ungulates, or hoofed mammals, are represented to-day by four great groups—the little hyrax, or "dassie" of Africa (Case 35*), the elephants, the horses, tapirs, and rhinoceroses, and the hippotamus, swine, camels, deer, giraffes, antelopes, sheep and oxen. The horses, tapirs, and rhinoceroses are known as the odd-, and the rest as the even-toed ungulates. All have more or less well-marked hoofs, in place of nails and claws; all are vegetarian, and have complicated teeth, while in the nature of their covering they

present a great range, some being naked and some woolly, while the majority are hair-clad. Some attain a gigantic size, and some are remarkable for their beauty; but perhaps the most striking feature which they present is that relating to the weapons of offence and defence which so many develop.

The earliest members of their race were small, marsh-dwelling creatures, but as in course of time many migrated to drier and more open ground, they took a new turn of development, whereby the legs increased greatly in length and the number of the toes decreased, till, as in the horse, but a single perfect toe on each foot remains, though vestiges of a toe on each side thereof remain to tell the story of the lost members.

This great group, it is obvious, is one which contains many lessons in animal structure. Of these we can select but one or two. Let us take those which bear more directly on the two great factors of life—the escape from enemies, and the conquest of rivals, choosing the latter to begin with.

Rivalry arises out of that critical period of life when the choice of a mate has to be made. At this time the males develop unusual ferocity, and fight with great fury among themselves for the possession of territory and the female which harbours there. As a rule more or less powerful weapons have been developed for this purpose. Among the pig tribe the teeth are the chosen weapons. In the wild boar (Case 7, 1344), it will be noticed that the canine teeth of the upper and lower jaws fit closely

together, and are of considerable length, so as to project well beyond the muzzle, and then they form most dangerous weapons. But in the great wart-hog they attain a far greater size, while the face is rendered hideous, to our eyes, by huge bosses of skin, which doubtless, however, serve to ward off blows during battle. As in so many other cases, this development runs to excess, as may be seen in the strange babirusa of Celebes. Herein the

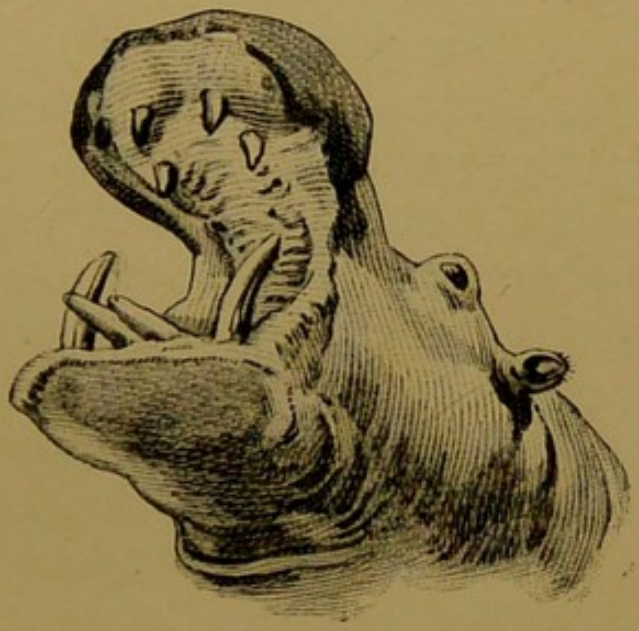


FIG. 16.—Head of Hippopotamus.

upper tusks, instead of passing upwards outside the lip, pass through it, and curving backwards continue to grow until, occasionally, they pierce the skin, and even the brain case !

In the matter of coloration pigs have one noteworthy feature. The adults are uniformly coloured ; but this is not true of their young, with certain exceptions. The young are striped, longitudinally, with alternate bands of light and dark, resembling,

it will be remembered, the adult stages of some of the marsupials. Stripes of this kind are rare among the mammals, whether adult or young. Such markings, in many animals at any rate, serve as a protective livery, enabling the wearers to escape the notice of their enemies. The adult members of the pig tribe, being large and powerful creatures, need no such protection, and apparently have discarded it. With the young, however, the case is different. But to this point we shall have to refer again in these pages.

And now, for a moment, let us pass to the huge and unwieldy hippopotamus (Fig. 16). Herein the tusks assume the form of enormous pegs, and are doubtless in every way as effective, as weapons, as are the tusks of the pigs just referred to.

But the hippopotamus has another lesson to teach. This creature spends the greater part of its waking hours afloat, and this much might be gathered from a glance at its head. In the first place the nostrils and eyes are both placed on the upper surface of the head, so that the animal can lie submerged with only the nostrils and eyes above water; in which it resembles the scaly crocodile. Now this being so, it is strange to find the legs in no wise transformed by this aquatic life. Such stumpy, pillar-like supports one would imagine could ill serve the purpose of swimming organs; yet they do. Evidently they have kept their peculiar form because these animals cannot find enough food in the rivers which they haunt, which during the dry season shrink considerably in volume, and even dry

up. At such times more or less extensive migrations in search of food are necessary, and at all times more or less prolonged sojourns ashore seem needful, when, of course, only the most powerful limbs could support so bulky a body. The extraordinary shape of the mouth, and the small ears, are also to be noted.

Though now restricted to Africa, the hippopotamus in times past ranged as far north as England, while earlier still, several species flourished in India and Burma. What led to the present restricted range is a mystery, for it began before man appeared on the scene.

In the course of our gossip on the different kinds of creatures brought together in this wonderful Museum, I want my readers to remind themselves, every now and then, that they are, in effect, discussing *live* animals: to try and picture these members of the pig tribe, for instance, amid the forest glades and jungles, turning up the soil with their tough, disc-shaped snouts (hence their shape) in search of roots, fighting with their rivals, or with enemies in defence of their young: to try and get a glimpse of what may be the causes which determine their bodily shape, their colour, and the character of their young—whether they are active at birth, or remain long helpless, and tended by their parents, for example. Every now and then, too, a comparison should be made between different types of the same great group of animals, and between them and the ancestors thereof, when these are more or less certainly known. Compare,

for instance, the pigs and the hippopotamus ; and both with that strange, short-legged, five-toed long-tailed fossil beast the Phenacodus ; for, as we have already remarked, from some such creature the great group of ungulates, or hoofed animals, so rich in contrasts, has been derived.

If, at this stage, such a survey is made, a far better grip will be gained of the essential peculiarities of that section of the ungulates which constitutes the " ruminants "—the cud-chewers.

Though we commonly associate this process of digestion with the deer, antelopes, oxen, sheep, and goats, there are yet others in whom it is developed, such as the members of the camel tribe, which will be found in the bay next to that set apart for the pigs. The new-world members of this group, the llamas and their kind, differ from the members of the old world, the camels, in lacking a hump on the back.

What is this hump : and why, of the two species, should one have but one, and the other two humps ? The second question we cannot pretend to answer. As to the first, it was and is still commonly supposed that this acts as a reservoir for the storage of water, enabling these creatures thereby to live on sandy deserts where water is hard to come by. As a matter of fact, these curious humps are made up of a mass of fat, and serve therefore as a supply of food during periods of enforced fasting—strange as this may seem. The storage of fat either throughout the body, or in special regions, as in the case of the camel's hump, or the tail, as in some breeds

of sheep, is a device adopted by many animals, whereby they may tide over periods of famine, or of enforced inactivity, as in the hibernating dormouse. So long as a particle of fat remains, the animal will not starve, even though it should not eat for weeks on end! The camel can and does store water, but this is done in a specially modified compartment of the stomach.

The one-humped or Arabian camel, by the way, is now nowhere found in a wild state, but the two-humped, or Bactrian camel, still runs wild in Turkestan, extending east to the Crimea and Lake Baikal, and west to Pekin. The "dromedary" is not, as some suppose, a distinct species of camel, but is really a very highly bred race of the one-humped Arabian camel, noted for its great speed.

The camel tribe are desert dwellers, hence the curious cushion-like feet, which are admirably adapted for travelling over loose and often burning sands, the soles of the feet being extremely hard.

Between the camel tribe and the rest of the ruminating animals on the one hand, and the pig tribe on the other, there is a striking contrast; and this will be clearer after we have finished our survey of these ruminating types, which should be undertaken in leisurely fashion, though in these pages no more can be done than to point out one or two of the more peculiar forms. The most outstanding feature of these is the fact that the head is provided, in the males at least, and sometimes in both sexes, with more or less formidable horns. All horned animals indeed are ruminants, though the

opposite is by no means true. These horns appear to serve principally as weapons of offence against rivals, though they also stand in good stead in keeping enemies at bay. In Case 64, Nos. 1331 and 1334, will be found an interesting exception to the rule furnished by the little mouse deer or chevrotains, creatures intermediate in structure between pigs, camels, and deer! Herein horns are wanting, but the upper canine teeth, answering to the fangs of the lion, are enormously developed, forming a pair of powerful tusks.

This brings us to the deer, the first of a great series of creatures whose heads bear horns. In the deer these horns are known as "antlers," and they differ from all other horns in some important points. In the first place they are bony outgrowths of the skull unprotected by an outer sheath of horn, such as is seen in the oxen and antelopes, for example: then they are invariably more or less branched; and finally (and this is really very wonderful), they are shed, and renewed annually! It seems hardly possible that such huge structures can be shed and replaced in the space of a few weeks, yet such is the case.

Soon after the old pair are cast off a pair of velvety knobs make their appearance, and these rapidly increase in size, and begin to develop the branches peculiar to the race. At this time the growing antlers are extremely sensitive, the velvet-like skin protecting a mass of bloodvessels whose function is to build up the bony matter. When the growth of the antlers is complete a rough ring

of bone is formed at the base of each, and this ring cuts off the blood supply. So soon as this takes place the "velvet" dies and peels off, the process being hastened by the animal itself, which rubs the antlers against the boughs of trees. In young stags the antlers are very simple; that is to say, they are small, and have few branches, but yearly, with increase in size, the number of the branches or "tines" increases, till the hey-day of life is reached, when a marked decline sets in. On the walls of this gallery you will see the cycle of development, as displayed in different species, fully set forth.

A comparison should be made between the antlers of the roebuck, fallow, red deer, and wapiti, for example, and these should be contrasted with the wonderful antlers of the caribou as displayed in a superb pair of specimens mounted in the great case near the doorway—perhaps the most perfect examples of taxidermy in the gallery. Note the forward curve of these antlers, and curious, flattened brow-tines. Turn next to the strange antlers of the moose, and the still more remarkable examples seen in Père David's deer, a species now extinct in a wild state (Case 59). Schomberg's deer (Case 62) and the Virginian deer should finally be examined, when I venture to think a lesson in Nature's methods of "ringing the changes" on a given theme will have been gained that will not soon be forgotten.

It should be noticed, furthermore, that while the young deer or "fawns" are invariably spotted, this is by no means true of the adults. It would

seem that these white spots occur generally in adults which pass their lives in forests wherein the leaves remain upon the trees all the year round; where, in short, there is no winter—no period of prolonged cold. In the fallow deer, the adult is spotted during the summer months, but in the autumn this livery is exchanged for one of uniform hue. This curious change is apparently due to the fact that the spotted coat gives the animal some protection against its enemies during the summer months, the spots resembling discs of light penetrating foliage, thus rendering the animal practically invisible. In the winter, when the trees are bare, such spots would render the animals conspicuous, for the play of sunlight through the leafless trees produces a totally different effect.

Why these antlers should branch is an unsolved problem. The fact that they do so is sometimes fraught with direful results to the deer, for when fighting—for which purpose they were developed—these "tines" or "points" occasionally get inextricably interlocked, and as a consequence, the wretched combatants either kill one another in their struggles to get free, or die of starvation. Save in the reindeer the males only carry antlers.

Of the "hollow-horned" ruminants, to which we must now pass, but the briefest account must suffice. The weapons of these creatures differ from those of the stags in that they are never branched, and are encased in a horny sheath—hence the term "hollow-horned." In the antelopes the horns curve gracefully, sometimes forwards, as in the reed-buck, or

backwards, as in the sable antelope, or they may be twisted corkscrew fashion as in the great eland and the kudu, while they are commonly more or less ringed. Some species have but the merest apologies for horns, while in a few two pairs are present, as in the four-horned antelopes in Case 57. In the matter of size and colour also there is a wonderful range.

Some of the most remarkable of the antelopes will be found in the corridors running down each side of the Great Central Hall, and these should be most carefully studied. Note, especially, the curious hartebeestes, the gnus, and that wonderful creature, the okapi. The hartebeestes show a wonderful series of stages in the evolution of the horns peculiar to this race, while in the matter of their supports these horns are unique, arising from a cylinder of bone raised high above the crown of the head! The strangely crooked horns of the white-tailed gnu—now, alas, nearly extinct—should also be noticed. These in the young animal point straight upwards, like those of ordinary antelopes, but as the creature grows older they gradually attain the peculiar adult shape.

When you come to the okapi (Fig. 17) look well at it, for it is one of the treasures of the Museum, and was discovered only a year or two ago in the Great Semliki Forest in the heart of Africa, the event causing quite a sensation the world over. Not the least remarkable feature of the creature is its strange coloration, the hind quarters being striped after the fashion of a zebra, while the rest

of the body is of a dark mahogany red above, and cream colour below. The specimen with the neck drooping forward was the first brought to this country, and the first ever seen in Europe. Unlike the others in this case, brought home later, it is hornless, and it was therefore supposed at first that okapis were always hornless. The horns, be it noted, are covered with skin, and this fact, and the peculiar shape of the outer teeth in the front of the lower jaw, which have a notch along the edge, show that this strange-looking animal is related to the giraffe, though totally unlike in colour, and not very similar in shape. Casts of the skulls of its nearest fossil relatives, as well as of giraffes, and of the okapi itself, show the features which these creatures share in common, and their differences.

Of giraffes a splendid series is here exhibited. A group mounted as in life illustrates at once the enormous length of the neck and the difficulty experienced in bringing the head to the ground, for to accomplish this feat the fore-legs have to be set wide apart. But in the adjoining case a number of heads have been placed which illustrate the way in which the coloration of animals changes in different parts of their range. That is to say, these show that the giraffes of the northern part of Africa differ, for instance, from specimens killed in the southern parts of the continent. These differences in coloration are conspicuous, as a comparison of the blotched type with that in which the ground colour is of a dark mahogany cut up, as it were, into squares by a white network, will show. Yet in the

FIG. 17.—Baby Okapi.

The sheep will be found in the pavilion at the end of this gallery. To those who have no knowledge of sheep save of our domesticated flocks the collection here gathered will surely come as a revelation. The superb horns which some species carry defy description. To properly appreciate this collection one should try and picture these beautiful creatures standing proudly on some frowning pinnacle of rock—mountain-tops, snow-capped, towering above them, yawning precipices beneath, and a blue sky by way of a canopy.

The rest of this pavilion is occupied by the various species of oxen, among which the American bison, now unhappily all but extinct, the European bison, brought to a like pass, the yak, and the Asiatic and African buffaloes should especially be noticed. Not only in their horns, but also in their general shape, they present strong contrasts. The underlying causes of these differences are to be sought for in the varied regions of the world from which they have been drawn—the boundless prairies of America, the mountain regions of Thibet, the vast river-courses of Africa, the jungles of India, the fast-vanishing forests of Europe, have all contributed to this collection. Stuffed, and mounted in this gallery, like printed statements read apart from their context, these specimens of Nature's handiwork lose much of their beauty, much of their majesty, much of their meaning; but yet the glamour of the wilds clings to them. And if those who can spare the time will try to imagine these varied types, each in its own setting, each in the

great solitude which formed its home, a species of magician's wand will speedily effect a transformation scene delightful to contemplate. Think of the American bison, roaming in herds numbering thousands of individuals, over rolling prairies: think of the African buffalo wallowing in the mud at the margin of some mighty river, the companion of the lordly elephant, the ponderous hippopotamus, the huge and formidable rhinoceros, herds of zebras and antelopes, coming to slake their thirst; scaly crocodiles in wait for victims; and crowds of strange birds basking in the glorious sunlight, or flying hither and thither out of the sheer joy of living. Then think of the same buffaloes spreading out to feed, and attacked by lions: and try to picture the sequel to such an attack—the crowd of hyænas and vultures, come to gather up the broken meat. Studied in this light, these dead effigies become once more endowed with life, and with this we get an insight into the possible meaning of much in their make and shape that otherwise seems inexplicable.

But this is by the way. Let us now take a hasty glance at the last of our horned mammalia—the rhinoceroses. The horns of these creatures differ from the horns of all other animals, for they are formed entirely of closely welded hairs! In the African species there are two such horns, which may attain a huge size. But the African and Indian species differ also in their hides, for in the huge Indian species the skin is thrown into great folds, like so much armour plating. In the olden times,

before the invention of the modern rifle, bullets were turned aside easily by such a covering.

From the rhinoceros to the horse seems a far cry indeed; yet this is really by no means the case. In short, the rhinoceroses, the somewhat pig-like tapirs (Case 36), and the horses all agree in being three-toed, though in the case of the horse only the middle toe is apparent, the toes answering to the second and fourth having become reduced to mere vestiges concealed beneath the skin, and known as the "splint" bones.

The horse family—which includes the true horses, zebras, and asses (Cases 38,39 and 39*)—is now represented only by a single type, differing only in matters of size, colour, and small structural details. The horses differ from the asses in having the tail covered with long hairs from its very base, shorter ears, broader hoofs, and last but not least, a curious oblong, prominent mass of horny matter, known as the "chestnut," on each leg, just above the knee, and below the hock, while in the asses the "chestnuts" are wanting on the hind-limbs.

In colour there are striking differences, the zebras being the most conspicuous in this particular. As everybody knows, this coloration takes the form of stripes, and an inspection of the specimens here exhibited will show that these stripes differ much in their size and distribution in the different races and species. Compare, for instance, the Grevy's and Burchell's zebras. In some the stripes extend down to the very hoofs, while in the now extinct quagga the stripes were confined to the fore-part

of the body. Now seen at close quarters, and especially as specimens in a museum, the peculiar pattern which these stripes form seems to be one calculated to attract attention. Yet, as a matter of fact, this is by no means true in the living animal, for, especially during the twilight hours, this curious pattern, even at a short distance, assumes a blurred character, which melts, as it were, into space. Now it is just when the light is fading, and at dawn, that some sort of protection against prowling lions is most needed, for in broad daylight such powerful enemies can be plainly seen and avoided.

But surely the most fascinating chapter of the story of the horse and his kin is that which tells the manner of his upbuilding. In part this has been pieced together from the testimony of the rocks, and in part from evidence obtained from the horses of to-day. It should be sufficient here to give but the bare outlines of this wonderful history, which carry us back into a past so remote, so distant, that the mind cannot grasp its immensity. Just as our knowledge of the history of the rise and development of the human race, and of the gradual growth of civilisation, rests upon the discovery of rude implements of the chase, of crude ornaments and carvings in bone and stone, leading up to finer workmanship in metal of later periods, so what we know of the history of the rise and growth of the humbler creatures of creation is gathered from a study of such of their bones as fortunate accident has preserved from destruction. Again, just as in studying the history of the human race, the further

we go back in time the more unlike this history becomes to our own, so the further we go back in time in studying the history of any given race of animals, the more unlike we find them to those now existing. And thus it is that we get at last to creatures which have no resemblance in themselves to their descendants of to-day.

In tracing back the history of the horse, for instance, we get at last to creatures of which it can only be said with certainty that they are, if not the actual ancestors of the horse, at least near relatives of it. The strange-looking Phenacodus was such an one. From the structure of the skeleton we can say, with certainty, that Phenacodus may be regarded as standing, so to speak, at the parting of the ways of two great divisions of the mammalia —the carnivores, ending with the lion on the one hand, and the ungulates, ending with the horse on the other. Among the contemporaries, and probably among the actual descendants, of this beast —no larger than a fox—some took to eating flesh, others to a strictly vegetarian diet. All were small creatures, with five toes on each foot, short-legged and long-tailed. Among the vegetarian branch some made themselves a home amid swamps and marshy places, and therefrom were developed, as we have shown, the various type of hoofed animals other than horses. The horse tribe soon, it would seem, migrated to drier ground, and with this began a gradual reduction of the toes on either side of the middle toe—that answering to our middle finger and toe. The little Hyracotherium, marks

the beginning of the true horses, and of this transformation of the feet. The next stage is that presented by Mesohippus, wherein the side toes barely reach the ground, and later we come to the Hipparion, whose side toes, like those of cattle, no longer bear any part in the support of the body. Finally we come to the modern horse, of which the great shire-horse represents the giant of the horse tribe. Now if you will look at the skeletons of the feet of race- and shire-horses displayed in the Gallery of Domesticated Animals you will find the last vestiges of these lost toes in the form of long, slender rods of bone running down on either side of the shaft of the middle toe: they are known as the "splint" bones, and at the ends thereof will be seen slight knobs—all that remains of the hoof-bearing portion of the toes.

With the change in the form of the foot the teeth changed also, becoming more complicated in structure, and more useful as instruments for the mastication of grass, which had now become the staple food. This change in the structure of the teeth was further accompanied by a lengthening of the jaws, whereby the front teeth became separated from the cheek-teeth by a wide gap. Thus was formed the space into which men thrust the bit by which horses are driven. And thus the gradual growth of this gap may be said to be the foreshadowing of man's dominion; that is to say, of the day when that gap should lodge the bit, that little rod of iron wherewith man imposes his will upon one of his most willing and faithful servitors.

Let us now briefly summarise that opposite side of the picture, which concerns the carnivora. This great group in the course of time has branched out into several very distinct types—some of which are aquatic, some terrestrial. The latter have multiplied into an amazing number of forms, varying surprisingly both in the matter of size, shape, and coloration, as a stroll round the rest of this gallery will show. Some, like the bears, are largely vegetarian in their choice of food; some, like the hyænas, are carrion feeders. Some, like the wolf, track their prey by scent, and run down their victims in packs; while others, like the lion and the tiger, hunt in solitude. But in no case have these land-dwellers passed through structural changes so striking as are to be seen in the case of their aquatic relatives.

Take the sea-lions, for instance (Case 27), and note the profound modifications which they have undergone. Note the huge size of the eyes, the great coarse "whiskers," the tiny vestiges of ears, and last but not least, the strange transformation of the legs. As walking limbs they are at best but makeshifts, but as propellers they are admirable. At least the fore-limbs serve this purpose; the hind-legs are used as a rudder, the tail having been reduced to a mere vestige. In the seals this evolution of the limbs has proceeded a stage further. the hind-limbs being now no longer capable of acting as supports on land. The huge sea-elephants—now, alas, almost extinct—represent in some respects a half-way stage between the seals and sea-lions or fur-seals, so ruthlessly slaughtered to supply

the demands of the fur-trade. The superbly mounted sea-elephants, in Centre-case F, are among the most wonderful things in this gallery, for they illustrate one of Nature's marvels of transformation, and incidentally the triumphs which the art of taxidermy has attained in this country. The huge, ungainly walrus is in some respects a more wonderful beast than the sea-elephant, and this because of the strange armature of the jaws. The purpose of the enormous tusks is not certainly known; but they seem to act chiefly, if not solely, as weapons of offence, and this because the rest of the teeth are reduced to mere pegs, and barely cut the gum. What these creatures live on is not certainly known, but we may surmise that small marine organisms floating in the sea form the staple diet. Two young walruses, which I had the good fortune to study alive in the gardens of the Zoological Society of London, secured their food in a most peculiar fashion. They were fed upon fish roes and fat, and as these delicacies were thrown into the water they were drawn into the mouth by a curious sucking action, and swallowed without any pretence at mastication. The huge bristles which adorn the muzzles of these creatures may thus serve as sieves in the capture of their food.

As an object-lesson in the transformation of animals it would not be easy to find a better than that afforded by the carnivores, taking the case of the seals and sea-lions on the one hand and the lion or the tiger on the other. And more particularly compare the fore-limbs, contrasting the huge flipper

of the sea-lion—with long nails embedded in a fold of skin which projects far beyond the nail itself—with the tiger's mighty paw and retractile claws. Try to imagine the sea-lion chasing its finny prey in the clear waters of some rock-girt shore, the tiger crouching, with flashing eyes and swinging tail, for that awful bound which is to bring down its unsuspecting victim with a crash!

But in this work of transformation Nature has achieved far more striking results, and these will be dealt with in Chapter V., on the whales.

CHAPTER IV

THE UPPER MAMMAL GALLERY

"Yet turn thee to the doubtful shore,
Where thy first form was made a man."

THE Upper Mammal Gallery is a storehouse of strange contrasts, for here will be found the blind and grovelling mole, the bat, the gibbering ape, and last, not least, man himself—presented in the light of a zoological specimen! The stern reminder, that "Man is but mortal and must die," was framed to act as a check upon his pride: but surely even more forcible is this reminder of his place in the scheme of creation. But to this we shall return presently.

The mole, the bat, and the ape may be taken as the representatives of the three great orders of mammalia exhibited in this room. These are creatures which have little enough of interest for most people; yet each in its way is marvellous.

The mole is one of the order "insectivora" (Case 15), the insect-eaters, claiming as blood-relatives the hedgehog, the shrew, the curious flying lemurs, and many other strange and unfamiliar forms which must be passed over in these pages.

Let us begin with the hedgehog (247–249), inasmuch as though in the matter of its bodily covering

it has become highly "specialised," in other respects it has undergone far less structural change than the mole. This bodily covering, as all my readers must know, takes the form of sharp spines, and these are highly modified hairs, serving as a most effectual armour against the attacks of enemies, such as foxes: for when threatened by danger, the creature rolls itself up into a ball, studded with needle-like points. This it is able to do by means of a powerful sheet of muscles beneath the skin; and thus rolled it is able to set most enemies at defiance. Like all the rest of the creatures included in this order it feeds on insects, varying this diet with an occasional frog, or an egg or two. By what chain of circumstances the hair of the body gradually became coarser and coarser, till finally spines came into being, no man can say.

Now let us turn to the mole (274–275). Mark its shape, the pointed snout and cylindrical body, and stranger still, the great broad hands and powerful claws. "But what has become of its arms?" I hear some one ask. For the great hands look as though they had been severed from the arm at the wrist and joined on again to the trunk! "And where are its eyes and ears?" Before answering these questions, let it be remembered that the mole is a dweller in the nether regions; at any rate the greater part of its life is passed beneath the surface of the ground, though on occasion it will come to the surface to bask in the sun, and even to feed. Now this underground life implies movement of some sort, and it is obvious that a creature which depends for its

daily bread on its ability to force its way through the soil, in search of food, must undergo material structural changes to attain this end. Accordingly its fore-limbs have become immensely powerful, the arm-bones tremendously shortened, and worked by powerful muscles, and the hand broadened, while the snout has become lengthened to serve as a wedge in pushing away the soil. Eyes in such journeyings would not only be useless, but a source of danger, and hence they have been reduced to mere vestiges, barely visible when sought for among the fur. Similarly, ears would be in the way, and hence have also vanished. But the fur too has become changed, inasmuch as it has become thicker in the middle than at the base or top. And thus it can be rubbed either way and yet presents the same velvety surface. This change of structure in the hair enables the creature to move backwards or forwards in its burrow without damage to its coat.

Worms and grubs form its staple diet, and in the pursuit of these it displays great activity and a ravenous appetite. For its size, indeed, in strength ferocity and activity it exceeds the lion! Its appetite is astounding; and by way of illustration we may remark that instances are on record when two moles, having been placed in the same cage, have immediately attacked one another; the victor in the fray killing and eating the vanquished, leaving nothing but the bones and the skin! That any animal should have contrived to lead a life so strenuous, and under such apparently unfavourable conditions, as that of the mole, seems strange enough.

But stranger still, this dweller in the under-world boasts several cousins, two of which, the star-nosed mole (277) and the golden moles (240 and 241) should be specially noticed ; the first-named because of the curious fringe of tentacles round the snout, the second on account of the difference in the digging apparatus, for in the golden moles this is formed by huge claws. Furthermore, the hair is remarkably iridescent, as may be seen in the specimen in spirit. Among the marsupials, a mole-like type has been developed (p. 51). This is a fact of extreme interest, illustrating what is known as "convergence" in nature—that is to say, the evolution of two very similar forms from totally unlike and unrelated ancestors.

Since the order insectivora contains representatives over the whole world, save only Australia and the greater part of South America, it is not surprising to find that its members have assumed diverse shapes in adapting themselves to their peculiar needs. Some, as we have seen, are burrowers, some haunt the undergrowth, and some ascend the trees in their efforts to gain a living.

Now, these last have given rise to some quite peculiar types—nothing less than parachutists, in fact. These are the so-called flying lemurs, or taguans (284) of the Indo-Malay countries. As with the flying squirrels in the Lower Mammal Room (Case 32), they are sustained in mid-air by means of a sheet of skin stretched between the fore- and hind-limbs. They cannot of course fly, as birds and bats fly, but only take great leaps

into space from a height and gradually glide downwards, supported by the membranes stretched between the limbs. They may be called living aeroplanes.

To appreciate the vast difference between these parachutists and the creatures of true flight, a comparison should be made with the bats (Cases 16 and 16*). Herein it will be seen the fore-limb has been strangely transformed, the fingers being extremely slender and long, while there is no

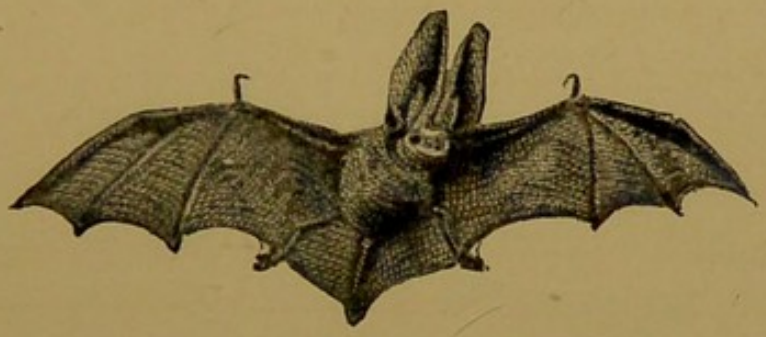


FIG. 18.—Long-eared Bat, flying.

" palm " to the hand, the palm-bones being divided so as to form, with the rest of the fingers, so many continuous rods, and between these rods, like the ribs of an umbrella, is stretched a thin sheet of skin, which is connected to the sides of the body and runs backwards so as to include the hind-leg, and in some species, even the tail. Such an arrangement forms an admirable wing, in every way as effective as that of the bird (Fig. 18). But though active enough in mid-air, these creatures walk indifferently ; they crawl, indeed, rather than walk, and that but slowly.

While some of the bats are insect-eaters, some

feed upon fruit, and these last are among the giants of the tribe, attaining a wing-span of as much as five feet ; they are also the most comely in appearance, for some of the insect-eating species are very repulsive in appearance—as, for example, the hammer-headed bat (317). A few species of bats are carnivorous, preying upon their smaller relatives, while one or two have earned an evil name as "blood-suckers." These are the vampires, of which we have all heard so much. Happily there are but three species, of which a specimen is exhibited here (400).

Many of these bats have remarkable developments of skin round the muzzle, often taking strange forms, while others have enormous ears. These excessive skin growths seem to possess an exceedingly delicate sense of touch, whereby the bats are enabled to dispense with eyes. At any rate, save in the "fox-bats," the eyes are very small, and only discoverable among the fur of the head with difficulty.

As a rule, it will be noticed, bats are dull-coloured creatures ; but some, like the painted bat (369) have orange and black wings, whereby they come to bear a close likeness to the decaying leaves of the banana trees among which they live, thus escaping the prying eyes of their enemies.

But the most extraordinary species of all is the African false vampire (*Megaderma frons*), which from a curious kind of puff-box in the lower part

of the back covers the whole upper surface of the body with a wonderful sulphur-coloured powder, thus recalling the powder-down feathers of herons and parrots.

The chief attraction of this room is without question furnished by the great apes, the monkeys, and the collection of human skulls. Man, the great apes, the monkeys, and the lemurs are grouped together to form one large group, the primates; for however they may differ externally, at bottom all are fashioned on the same plan. Man differs from these lowlier creatures physically only in degree; but he rises far above all in his mental capacity. The lowliest savage is far above the most intelligent ape that has ever lived, or ever will live.

The lemurs (Cases 13–14), to the inexpert, would not seem to possess much in common with the monkeys, yet such is the case. They represent, indeed, the stock from which the higher types were derived. For the most part they are found in Madagascar, but some occur in Africa, and some in Southern Asia. They are tree-dwellers. The most remarkable are the tarsier (220) and the aye-aye (229). The latter has an additional peculiarity in that the third finger of the hand is most strangely shaped; being a mere skeleton. This curious finger is used for extracting the wood-boring caterpillars, on which the creature largely feeds, from their holes.

The gradual evolution of the monkeys, and of

the various types which they present, must be traced, then, from the lemurs.

The least monkey-like of the monkeys are to be seen in the marmosets (Case 12, Nos. 156–168) of South America. And from these we may pass to their cousins and neighbours, the South American monkeys, which differ from all other monkeys in having a prehensive tail—that is to say, a tail which can be used as a grasping instrument; the whole body, indeed, is swung upon this tail just before some flying leap is taken, from the topmost bough of some forest giant to the lower limbs of another.

Of the old-world monkeys there are many species, presenting a wonderful range in size, shape, and colour, as a glance at the specimens in this room will show. Some of these have at least a claim to be regarded as comely, but many are, to say the least, ugly! And this is especially true of the baboons (79–90). The snub-nosed monkey (Case 9, 24) and the proboscis monkey (Case 9*, 23) have an unmistakably human look! But the most remarkable of all are the chimpanzee, gorilla, and orang-utan (Case 8). These most nearly approach the human race in their bodily structure. The terrifying appearance of the gorilla is due to the enormous development of the brow-ridges and teeth. The orang-utan, on the other hand, irresistibly reminds one of Shakespeare's Caliban. Fine specimens of this creature confront one at the very entrance to this gallery. One hangs suspended from a bough, gazing suspiciously in front of him. The neck, it will be

FIG. 19.—The Gorilla.

noted, appears enormously swollen, and this effect is produced by a huge wind-bag connected with the voice organ. This strange contrivance enables the creature to produce a singular cry, commencing with high notes, and ending in a loud roar, like that of a panther. Just behind him will be found another resting on a nest of sticks: a pile of which are used nightly as a bed, and by day as a couch.

The gorilla and chimpanzee are natives of Africa, the orang-utan of Borneo.

The story of man, and of his relation to these hideous creatures, cannot be told in these pages, for it would require a volume in itself. But a very slight study of the skeletons of these apes, and of man, will leave little doubt as to the racial connection. Those who are interested in this subject will find plenty of food for reflection in the casts, skeletons, and photographs of the various human races displayed in this gallery.

CHAPTER V

THE WHALE ROOM

"Canst thou draw out Leviathan with an hook?"

THE first glance at the enormous creatures gathered together in this gallery fills one with amazement, and even after this wonderment has somewhat subsided a feeling of unreality remains: for somehow, it seems difficult to bring oneself to regard bodies framed on such huge lines as those of animals still existing; and still less as animals nearly related to the carnivora. Most of us have been taught to believe that we live in a day of small things—in a world of pigmies—whereas in days past giants roamed everywhere. This is by no means true; and certainly not in the case of the whales, which far exceed in size any pre-existing species of their kind, or indeed any animal which has ever lived. Whales little short of a hundred feet long have been met with, which compares favourably with the greatest of the giants of olden times, even though some of the land-dwellers attained a length of as much as eighty feet.

In times past, and by many people even to-day, whales were supposed to be fishes. Yet they are undoubtedly mammals: for they breathe air by

means of lungs, and not by gills, and nourish their young on milk.

Time was when their ancestors were land-dwellers, haunting the marshy ground, and swamps in the neighbourhood of estuaries, where tall reeds, and cotton plants, marsh-marigold, spikes of purple loosestrife, and other water-loving plants made a riot of colour in the summer sun. Amid such scenes these forerunners of the whale-people lived, and hunted—for they were carnivores. But they seem to have taken very early to an aquatic life, and eventually forsook the land entirely. What these ancestors were really like we do not know, but fossils have been found—in the Egyptian desert of all places in the world —which, in the structure of teeth and skull, backbone and ribs, show them to have been related to certain primitive types of carnivores known as Creodonts—the "flesh-toothed"—some of which were as large as lions or bears.

So far, however, we have but a shadowy picture of the early phases of the whale's ancestry. To-day these creatures are represented by quite a number of relatively small animals—the porpoises and dolphins —and a few giants, the whales proper, which can be divided into two well-marked types—the toothed whales, and the whalebone whales: but of this more presently.

All whales are alike in having a perfectly naked skin, a spindle-shaped body, ending in a great tail fin, and but one pair of limbs, answering to the fore-limbs of land-dwellers. They have no pro-

jecting folds of skin or "ears," and small eyes, while the nostrils open in the form of slits on the top of the head, and can be closed at will.

The absence of hair is accounted for by the enormous development of fat, or "blubber," beneath the skin, while in the sperm whale the head is fashioned so that its roof forms a huge basin, filled with the much-prized "spermaceti." This fat is far more efficient in retaining the warmth of the body than hair would be. Fins are represented in many species by a more or less well-developed triangular "cut-water" on the back, serving as a balancer, and a pair of enormous "flukes" attached to the tail, answering to the tail-fin of fishes. But there is a marked difference between the two, for it will be noticed that whereas the tail-fin of fishes is placed vertically, that of the whales and their kind is horizontal in direction. This difference is easily explained. The fish, being a gill-breather, does not need to rise to the surface for air; consequently, its fin is placed so as to drive the body forwards. The whales, on the other hand, being lung-breathers, must come to the surface to breathe, and hence the tail has developed horizontally so that it serves to drive the body, now upwards in search of air, now downwards in search of food. Finally, this fin differs from that of the fish in lacking bony supports.

Once on a time, as we have remarked, the whales walked on land, the body being supported on four limbs. But they were by force of circumstances compelled to lead a partly aquatic life, and these

limbs gradually became fashioned to form swimming organs, and by the time the life on land had become entirely forsaken the hind-limb seems to have vanished, while the fore-limb had assumed the form of a "paddle." Now carefully examine one of these paddles, and note the change which this limb has undergone. It can no longer be flexed, or bent, the arm upon the fore-arm, or the hand upon the wrist, while the fingers similarly stand out stiffly, entirely concealed, in the living animal, in a mass of flesh. The whole limb has, as it were, been thrust into a mitten, packed so tightly as to prevent all motion save where the arm joins the body.

Surely no better illustration than this could be found of the way in which the organs of the body respond, as it were, to the demands of their physical surroundings. For we find a precisely similar transformation of an ordinary, five-toed, walking limb, in those old sea-dragons, the Ichthyosaurs and Plesiosaurs, which were not in the remotest degree related to the whales, and we meet with it again in the turtles and penguins, between which, again, there is no relationship. But in these last the limbs act as propellers; in the sea-dragons and whales they are to be regarded rather as balancers and steering organs, for the driving power is furnished by the tail. Of the obsolete hind-limb only the merest trace remains, in the shape of vestiges of the hip girdle and thigh bone, which in life are embedded in the muscles of the abdomen, and thus it is that, in the skeletons here exhibited, they are

suspended by a rod in the place they occupied during life. But there is yet another feature to be remarked in the skeletons, and that concerns the number of the neck vertebræ. The mammalia, by some mysterious law of Nature, are allowed only seven vertebræ in the neck! One or two, indeed, have been allotted but six, and a very few privileged ones may boast eight! But the long-necked giraffe, and the whales, wherein no neck is visible externally, alike have but seven. Some of the whales, indeed, seem to have found even seven too many. At any rate, in the species known as "right whales"—of the genus Balæna—these vertebræ have become extremely reduced, and welded together to form a solid block of bone, whereby the ribs have been brought close up to the head. Near one of the skeletons of these monsters a specimen of such fused vertebræ has been placed, and this is quite worth careful study.

The shape of an animal is largely determined by its food. That is to say, the body becomes transformed in this or that direction mainly in accordance with the nature of the food, or the way it has to be captured. The whales, and their kin, however, seem to show that over and above this, there is another force which shapes them—a sort of inherent tendency to grow along particular lines, which appears in some way to be associated with the relation of the body to its physical, inanimate environment. The whales and their kind, it may be remembered, feed upon fish, small floating crustaceans, or minute mollusca and jelly-fish

(Fig. 20). Some feed almost entirely on cuttle-fish, or "squids," like the huge sperm whale, for example. But all these forms of food are sought with equal success by other creatures which have sacrificed, so to speak, far less of freedom in its pursuit. That is to say, these other types—many different kinds of birds, for instance—while pursuing such prey, have yet retained the power of flight, and the use of the limbs in walking; they are free to come ashore at will. But a stranded porpoise or a whale is doomed to death.

FIG. 20.—Food of Whales, actual size.

Cetaceans, as the whales and their kin are commonly called scientifically, abound in all seas, and some dolphins ascend the rivers of South America and Southern Asia. But judging from the fewness of the species which have contrived to find a permanent abiding place in fresh water, this home has its drawbacks. Indeed, in the Gangetic dolphin, or susu (*Platanista gangetica*)—which will be found on the left-hand side of the vestibule to this room—blindness has followed this migration, the creature being compelled to seek its food by groping in the mud for crustaceans and small fishes!

In size the cetacea vary enormously; some of the smaller dolphins not exceeding four feet in length, while some of the whales attain to one hundred feet.

With a few exceptions they are timid, inoffensive creatures, active in their movements and affectionate

in their disposition. And this is especially true in regard to the conduct of the mother towards her young. They are, too, sociable creatures, swimming in herds, or "schools," sometimes numbering many hundreds, though some species are met with only in pairs.

A glance round this wonderful gallery will show that the cetacea may readily be divided into two great groups: one in which the jaws are armed with teeth, though these may be reduced to a single pair in the lower jaw; and one in which the upper jaw supports a marvellous arrangement of long closely-fitting plates, known as "whalebone." These two divisions form the sub-orders Odontoceti—the toothed whales, and the Mystacoceti—or whalebone whales.

Now there are some who find the study of Natural History rather a dull pursuit—prejudiced, perhaps, by the cut-and-dried fashion in which animals are so commonly described in books. In scientific books, of course, this is inevitable. But just go to Nature for facts, and lo! the dull, bald statements of the books are found to be of entrancing interest.

Take the "Odontoceti" as a case in point. These creatures so labelled seem little likely to be of interest. But just look round at all of the whale kind displayed in this gallery which have teeth, beginning, for choice, with the killer-whale—*Orca gladiator* (Fig. 21). Here we find a veritable mouthful of teeth, both upper and lower jaws being well armed. And this creature is one of the fiercest tyrants of the sea, preying upon the weaker members

of his own kind, seals, and even the giants among the whales. Then turn to the enormous sperm whale, or cachalot, which stands at the right hand of the doorway as we enter. This was cast ashore on the coast of Caithness in June 1863, and is fifty-four feet long—the average length of a full-grown specimen. Herein the teeth are confined to the lower jaw. These monsters of the deep contrive to find a living by preying on cuttle-fish, some of which are of

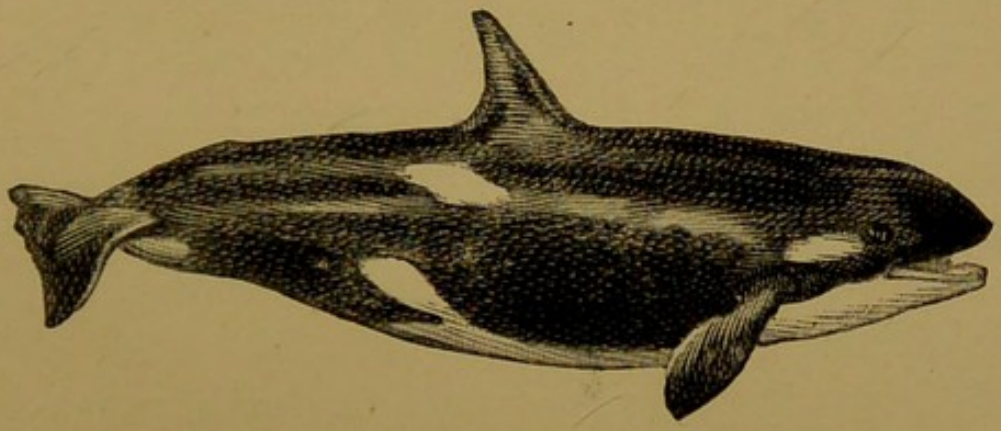


FIG. 21.—The Grampus or Killer.

huge size, and are obtained only by descending to great depths. Note the extraordinary blunt shape of the head: then walk round to the other side, where within the modelled exterior will be found the skeleton. The roof of the skull forms a great basin, open in front; during life this lodges a number of receptacles containing the precious oil known as "spermaceti," the use of which to the animal is unknown. The "blubber" or fat, which encases the rest of the carcase—the "sperm oil" of commerce—is, as in all the whale tribe, a substitute for hair, to keep in the bodily heat. From this whale, too, is obtained the equally precious ambergris or "grey

amber "—a concretion formed in the intestine, and found floating on the sea in masses of considerable size. When analysed it is found to contain the horny beaks of cuttle-fish, on which the creature feeds. How highly prized is ambergris may be gathered from the fact that it commands a high price in the market—as much as 90s. per ounce! A specimen of this will be found in a small glass case in the north-west corner of the room. By way of contrast let us next take the strange narwhal or sea unicorn (Fig. 22). Herein the teeth take the form of a pair of curiously twisted tusks projecting from the upper jaw. More commonly only one, the left, is present, the right being found as a mere vestige, concealed in the jawbone. In the female both tusks remain in this undeveloped condition! What purpose such teeth serve is as yet undiscovered.

More remarkable still is the case of one of the beaked whales, known as Layard's beaked whale, wherein the teeth are reduced to a pair of strap-shaped plates projecting upwards from the lower jaw to embrace the upper jaw in such a way that the creature is almost unable to open its mouth! Why Nature has imposed such a muzzle is a mystery. With its teeth so lengthened, how does it feed, and what does it feed on?

And now let us pass to the whalebone whales, taking as an example the half-model and skeleton of the colossal North Atlantic black right whale (*Balæna glacialis*), (Fig. 23). Note first the absence of a back fin, the relatively enormous

size of the head, and extraordinary size and shape of the lower jaw, which is toothless. The upper jaw bears on each side, in place of teeth, a row of long plates, closely packed, and having their inner edges frayed out to form a hairy, mat-like surface. The creature feeds, strange as it may seem, on minute crustacea, and small molluscous creatures known as pteropods, of which specimens, preserved in spirit, will be found affixed to the wall near at hand. These small animals swarm, in myriads, in the seas where the whale lives. And thus, when

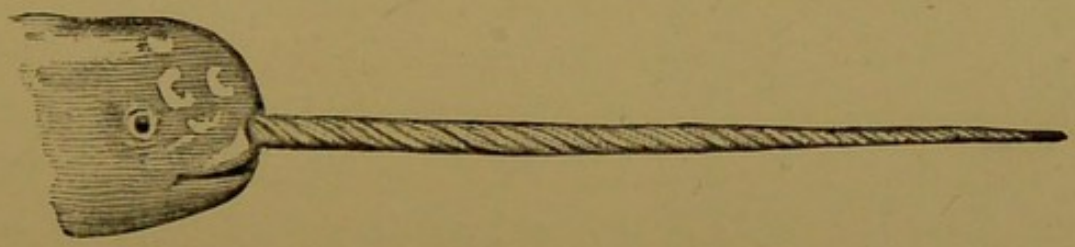


FIG. 22.—Head and Tusk of Narwhal.

it opens its cavernous mouth, it is immediately filled by a semi-solid mass of these small fry. Then the jaws are closed, and the huge tongue is forced up to the roof of the mouth, thus driving the water through the spaces between the plates, and leaving a very substantial bolus of food to be swallowed! It seems almost incredible, that so vast a body should be nourished on such a diet.

Though the whale is now toothless, it is to be remarked that this was not always so, since in very young whales teeth are found in the jaws which never cut the gum—and as development proceeds they slowly vanish.

The black right whales are further peculiar, in

that the top of the head is surmounted by a curious horny excrescence known as the "bonnet," and this is tenanted by numbers of parasitic crustaceans. How such a tenement came into being is one of the many unsolved problems still left to us.

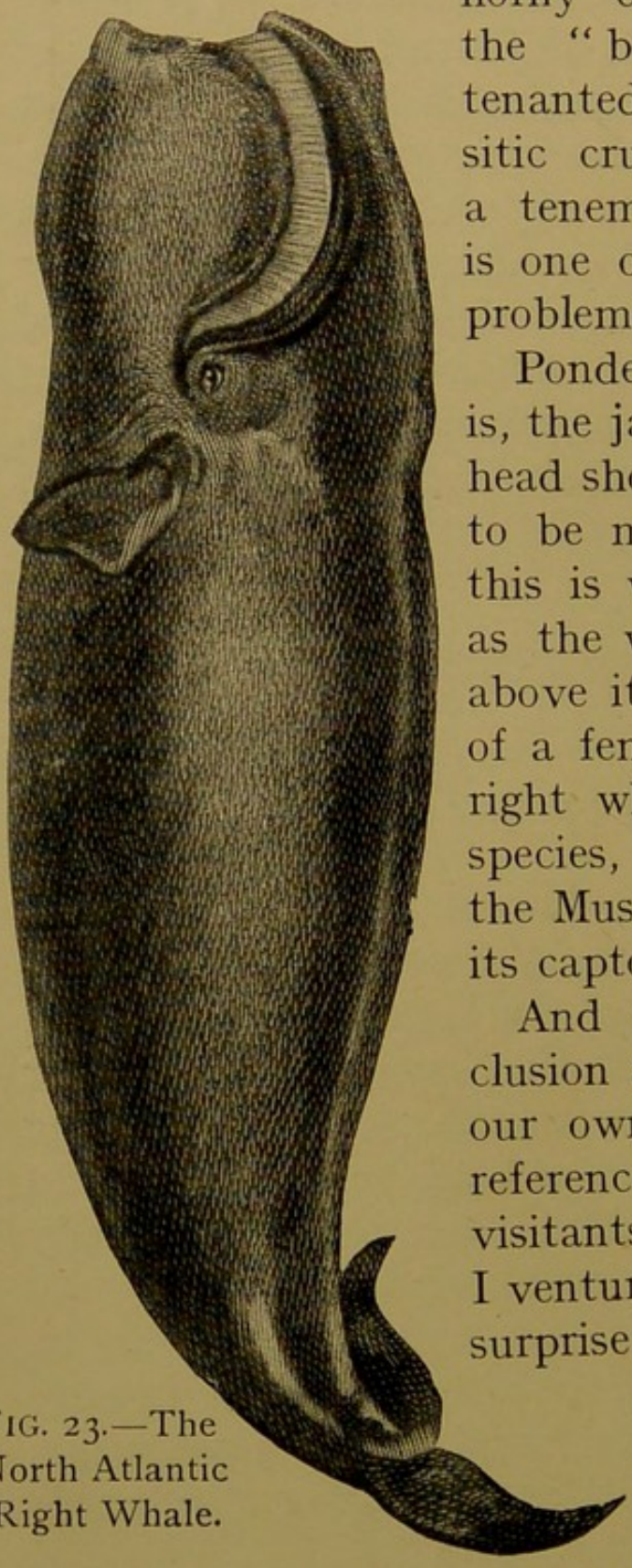


FIG. 23.—The North Atlantic Right Whale.

Ponderous as this specimen is, the jaw lying just under its head shows that far larger are to be met with, inasmuch as this is well-nigh half as long as the whole body suspended above it! This jaw was that of a female of the Greenland right whale, a nearly related species, and was presented to the Museum by Captain Gray, its captor.

And now a word in conclusion as to the cetaceans of our own seas. Omitting all reference to rare and casual visitants, we have what will, I venture to think, come as a surprise, quite a number of species which are fairly common around our coasts. Among these may specially be mentioned the bottle-nosed whale, which

yields spermaceti, and oil of a quality in no wise inferior to that of the sperm whale or cachalot, a species which rarely visits us. A fine skeleton of this whale is exhibited here, and should be specially examined because of the extraordinary shape of the skull. Then we have the "black-fish," or ca'ing whale (*Globicephalus melas*) — a cuttle-fish feeder, which is found occasionally off the Shetlands—and no less than four species of rorquals, the largest of the whales. The giant of all is Sibbald's rorqual, of which a specimen sixty-five feet long, taken off Moray Firth, is exhibited here, while another eighty-five feet long, taken at Wexford, Ireland, is in the Museum collection. These whales, as a glance at the beautiful model will show, are "clipper-built," and capable of travelling at a great speed. The long grooves down the throat are folds or pleats of skin, which allow of distension of the mouth when feeding. Finally, we have the killer whales, which are by no means rare. So late as 1890, indeed, three made a notable journey up the Thames, but soon discovered their danger, and promptly turned back again for the open sea, and safety!

CHAPTER VI

THE BIRD GALLERY

"The birds, who make sweet music for us all
In our dark hours, as David did for Saul."

THE high place which the birds hold in our affections is not difficult to understand, for in their beauty of form and colour they are unrivalled, while not a few are songsters of rare sweetness. As architects many display the most amazing skill; and in their powers of flight they are the envy of man himself. In short, from the cradle to the grave there is no phase in their life-history that is not of interest. This being so, it sounds almost like a contradiction to say that some are branded as "vermin," while against others an infamous war is perpetually raised to serve the ends of so-called "fashion." Yet such is unhappily the case. Man, though given the dominion of the fowls of the air, from the day when he became a rational being until now, has persistently misused his rule, and abused his trust; and thus it is that some of the most beautiful and most interesting species have been absolutely wiped out of existence, or are fast approaching that fate.

Though, from an anatomical point of view, birds

are very uniform in structure, they appear to most of us, as a matter of fact, to present a wonderful range of variety. But these apparently conflicting aspects are the very natural results of different points of view. The anatomist regards only the details of structure, and the relative uniformity which these present is due entirely to the fact that birds are creatures of the air, and must necessarily have in common all those physical peculiarities which are essential to flight. All birds have wings, even though, in certain cases, these are no longer able to fulfil their purpose; and all birds are feather-clad, and this fact also is due to the needs of flight. With the mammals, on the other hand, the structure of the body presents great differences. Thus the fore-limb may serve as a wing, or a paddle for use as a swimming organ; it may be modified to serve the purpose of a shovel, or of an instrument for the slaughter of prey; it may be a pillar for the support of the body, or used as a climbing organ. And similarly in the matter of the body covering, variety and not uniformity is the rule. Thus this covering may be of scales or spines, of horny plates or long hair, of soft wool or coarse bristles, or the body may be absolutely naked, as in whales and porpoises.

But if the birds, by reason of their mode of life, have a sameness from the anatomist's point of view, there is nothing monotonous in their outside appearance; here, on the contrary, variety is well-nigh endless. And this fact will most certainly be very thoroughly driven home after a walk through the

Bird Gallery of the British Museum. It will leap to the eyes, indeed, if one keeps at the back of one's mind, so to speak, a mental image of some familiar bird, like a crow, for instance, to serve as a standard of comparison. For the crow has no distracting peculiarities; it flies well and walks well, and is no less at home among the tree-tops. In its choice of food it is by no means nice. Now this all-round efficiency it enjoys because it has not become what is called "specialised"—gradually moulded so as to fit into one little niche in Nature, as is the case with so many birds. It has nothing in the way of ornament, either in the matter of colour or in the shape of crest or tail.

But for the full appreciation of the delights of this gallery it should be remembered that birds, in common with all other living things, can meet the changing needs of life, within certain limits, by slow changes in coloration, or in structure, according to need. And, in this way, the many great divisions of the bird world have come to be, divisions which break up into smaller and smaller groups, till at last we come to the study of individuals.

But so exhaustive a study as this is hardly likely to be embarked upon by any save the specialist. Those whose interest in birds is more general will, however, find this gallery vastly more interesting if the specimens here exhibited are regarded not as so many isolated units, not as so many "stuffed birds," but rather as a collection of some of Nature's "winners in life's race," to use

a happy phrase coined on another occasion, to serve a similar purpose. Surveyed from this standpoint, the varied forms and coloration of the birds here displayed assume a new and deeper meaning.

Let us go the round of this gallery in such a frame of mind, beginning with the birds on the right-hand side of the doorway.

First of all we are confronted with a picture of a strange-looking bird with outspread wings and a long tail. This should be very carefully examined, for it represents the Adam among birds, and differs from all its descendants in some very striking particulars, only one or two of which can be referred to here.

In the first place it was a tree-dweller, of about the size of a jay, or rather smaller. Its feet differ in no wise from those of the commoner perching birds of to-day. But the wings were armed with claws, and the jaws with teeth. Some few other fossil birds have been discovered whose jaws were similarly armed, but it would seem that these were soon discarded in favour of horny jaws such as ensheath the beaks of modern birds. It is not easy to see why this change should have taken place, but it seems to have allowed a wonderful range of variety in size and shape, as will become apparent in the walk round this gallery. As to the tail, this differs from that of all other known birds in that it is made up of a number of separate vertebræ, like the tail of a lizard, and each of these bones supported a pair of feathers. Now in modern birds this long tail has become, as it were, "tele-

scoped," bringing all the feathers to a common centre, so that they are arranged fan-wise round a common supporting plate of bone. This, however, when examined in the very young bird, before the period of hatching, is found to be composed of a number of separate plates of bone representing the originally distinct vertebræ seen in Archæopteryx!

Very well: in our further survey of the birds, it would be well to bear this ancient type in mind as a sort of fixed standard wherewith to measure the range of departure which the several types have taken during the course of ages. That is to say, we are to remember that the earliest-known bird was a tree-dweller, and bore teeth in its jaws, and claws in its wings (vestiges of these, by the way, are still to be met with among birds); and finally, had a long tail supporting pairs of feathers all the way down instead of having these feathers arranged fan-wise about a single small plate of bone.

We pass now to the ostrich tribe, and the passage brings us up with a jerk, as it were, for these are the giants among birds, and flightless! The suddenness of the change is not so clear till we realise the vast difference between them and the Archæopteryx. They are very plainly not tree-dwellers, and a very little inspection will show that, save in the African ostrich, all are tail-less, and some are practically wingless; while the feathers, in all, lack that firm, well-knit character so familiar in birds of flight. But why, it may be asked, are these birds placed here? why begin the survey of living birds with the ostrich and its kind? Because, as a study of

their anatomy would show, these birds are of a lowly type : they evidently more nearly approach their cousins the reptiles than any other birds : and birds are classified, at least nowadays, so as to express, as nearly as possible, their relationship one to another. Hence we begin with the most lowly types, and lead on to those which have become more highly organised, because it is evident that these last are later comers on to the world's stage, just as, in tracing the history of, say, modern weapons we should begin with flint implements, and pass from thence to spears and bows and arrows, then to the earliest known fire-arms, till finally we should reach the latest thing in 100-ton cannon !

Except for the tinamous of South America, the ostrich tribe have all lost the power of flight, and in some, as will be seen, the wings have dwindled away to mere vestiges. This loss would have meant extinction, but for the fact that these birds live where enemies are few and food abundant the year round, within easy reach. As the power of flight grew weak, so the legs gained in strength, and changed in form, so as to secure efficiency in walking and running. The hind toe, so necessary for grasping to a perching bird, has vanished completely, and in the African ostrich the inner toe also has disappeared.

The African ostrich, indeed, the largest of living birds, has become more profoundly modified in regard to the hind-limb than any other bird which has ever lived. To appreciate this fact properly, a careful examination should be made between the skeleton in the wall case, and the great glass case

containing the stuffed bird in the centre of this bay. The skeleton shows that the third toe has attained a huge size, while the outer toe is slowly vanishing, as may be seen by the small size of the nail. If this should finally disappear, then the ostrich, like the horse, will have but a single toe on each foot, and in both cases this transformation is due to the same agency—an answer to the requirements of running on hard ground.

Turning now to the case containing the stuffed birds, it will be noticed that the wing, in proportion to the size of the bird, is ridiculously small, and is obviously useless for the purposes of flight. The conspicuous white plumes were once stiff quills, like those of birds which fly; now, like the tail feathers, they serve merely as ornaments. Next it must be remarked that the colour of the sexes is quite different: a fact which seems to be closely connected with the bird's life during the perilous time of brooding. During these labours the hen sits by day, her sober dress of brown harmonising well with the arid waste of sand surrounding her, while the cock takes on this task during the night, his black garb becoming a mantle of invisibility during the hours of darkness.

From the ostrich we pass to the South American rhea, wherein the sexes are coloured alike. Here also the wings are large, but useless as organs of flight; the tail, however, has absolutely vanished.

In the table-case by the window, in this bay, may be seen a number of anatomical preparations showing the chief structural peculiarities of the ostrich tribe.

And special attention should be paid to those illustrating the form of the breast-bone—which differs from that of all other birds in lacking the median "keel"—and the various stages in the decay of the wing. The absence of the keel to the breast-bone, and the gradual reduction in the size of the wing, are complementary, as it were, to the increase in the size of the leg. As flight gradually became less and less resorted to, the muscles concerned therein degenerated, and with their decay the keel of the breast-bone, to which these muscles were attached, and the wing, followed; till, as in the case of the cassowary, and the apteryx, the hand has almost completely vanished.

The emu and the cassowary, natives of the Australian region, are other members of the ostrich tribe. The first-named is being slowly exterminated by the sheep-farmers. To all intents and purposes it is wingless, and no trace of wings can be seen in the living bird. Both sexes are alike in colour, and very soberly clad. They are remarkable, among other things, for the wonderful wind-bag which is lodged in the neck to serve as a sound-producer. This bag is formed by the inner lining of the windpipe, which is, as it were, pushed out through a long slit in the middle of that tube. With this curious musical box the bird produces a most marvellously resonant sound, which resembles the distant beating of a drum!

The cassowaries, though closely related to the emu, are far more striking-looking birds. Both sexes, as in the emu, are alike, but they have a

lavishness of ornament that is really remarkable. The plumage, it will be noted, is of a rich, glossy black, and this is relieved by the brilliant coloration of the naked skin of the neck and head; a coloration which varies much among different species. No less strange is the curious casque, or helmet, which surmounts the head. Though very solid in appearance, it is really very delicately wrought, consisting only of a thin shell of horn enclosing a filigree of the most delicate bone-tissue. But there remain yet other features worthy of note in these birds. One of these concerns the wing, which is represented by some half-dozen black quills sticking out from the side of the body. What purpose they can possibly serve we cannot tell. Another feature concerns the huge size of the claw of the inner toe, which is used for fighting purposes, and can inflict the most severe wounds.

The great casque, the brilliant colours of the bare skin, and the glossy black plumage are only gradually acquired, for young cassowaries are brown as to colour, lack the casque, and have the head and neck feathered.

The nestlings of these birds are still more peculiar. They are marked with broad parallel bands of a rich deep brown and white (Fig. 24). And in this they agree with young emus, rheas, and ostriches. But, it should be noticed, young rheas and ostriches are much less conspicuously marked. In the nestling ostrich the head and neck alone bear these markings, for the down feathers of the rest of the body are peculiar in that their tips are

modified so as to form little ribbon-like scrolls, suggesting fine, shiny shavings, producing a mottled coloration. This curious device is not restricted to the young of the ostrich tribe, however, as will be seen presently.

In this case will be noticed the skeleton of a

FIG. 24.—Young Cassowary.

positively gigantic bird, one of the moas of New Zealand. Time was when these birds roamed in great numbers over New Zealand, some species attaining huge proportions, others not exceeding a turkey in size. All have long since been numbered on the calendar of departed species, and it is probable that the last of their race were exterminated by

the savage tribes who peopled New Zealand in the remote past. They were not only flightless birds, they were wingless; so much so, that not the smallest vestige of a wing was present; so that in this point they differ from all other birds, living or extinct!

Finally we come to the kiwi or apteryx, a quite small species when compared with the ostrich or the extinct moas. Yet it is one of the most interesting of all birds; and this because of the fact that it ranks alone among birds in having the nostrils at the extreme tip of the beak. Having but small eyes, and feeding by night, the bird has come to depend very largely on its nostrils as a means of finding food, which consists largely of worms. It has perhaps the keenest sense of smell of all birds. It is furthermore remarkable for the enormous size of its egg. Only one is laid each year, wherein it differs from the rest of the ostrich tribe, which always produce a large number. As in the ostrich and rhea, the shell is white; but the eggs of the cassowary and emu are of a wonderful bronze-green colour.

Our survey of the ostrich tribe ends with the tinamous—small birds, comparatively, which are met with only in South America. Specimens will be found in a separate table-case. Though they still retain the power of flight they are by no means good flyers, and this explains the feeble tail, which at first sight appears to be wanting. In coloration, it will be noticed, they recall the more soberly clad of the game-birds. But if in the matter of

general appearance they present little that is striking, this is by no means the case with their eggs, for these are remarkable for the extraordinary burnish which their shells present, resembling that of the glaze of porcelain, while in the matter of colour they present a very wide range.

We pass now to birds of, so to speak, more modern type ; that is to say, judged from a scientific standpoint. Anatomically, though differing much one from another, all present certain characters in common which are not met with among the ostrich tribe. Into the nature of these we need not enter here, further than to remark that these differences are rather those of degree than of kind. If the ostriches had not lost the power of flight, and so become degenerate as to their feathers and gigantic as to size, the present-day distinctions would have been impossible. The tinamous well illustrate this fact. The only really striking characters by which the two great groups can be distinguished are to be found in the structure of the palate ; and this is a theme for the anatomist, rather than for these pages.

No better beginning of this series could be found than with the gallinaceous birds—pheasants, partridges, grouse, and their kind—inasmuch as these have retained many primitive characters, and in no way have become very highly specialised ; hence they thrive in many diverse places—mountain and moor, dense forests and plains, all furnish congenial homes to more or fewer species.

All are vegetivorous when adult, and have under

gone no very marked specialisation, either in the form of the beak or of the feet, though many species have the legs armed with long spurs, constituting powerful weapons of offence. The young are hatched in an advanced stage of development, like young reptiles, and display a striped down-plumage, as in the case of the primitive ostriches, and some other ancient types. The adult plumages present some very remarkable illustrations in the matter both of decorative as well as of protectively coloured liveries (Cases 7–18).

As examples of primitive game-birds the megapodes of Australia and New Guinea stand easily first; while in the matter of their nesting habits they are unique. Briefly, these birds lay their eggs either in huge mounds of decaying vegetable matter, collected by the birds, or in the ground, in the neighbourhood of hot springs, and then leave them to incubate. In course of time the young hatch out, and, what is really most surprising, emerge fully fledged, and able to fly! They come into the world, in short, quite able to fend for themselves, and appear never to need, or to obtain, the least aid from their parents. This would not be possible, but for the fact that these birds lay very large eggs, so that the store of food contained therein is sufficient to enable the chick to pass through the early, downy stage of development before leaving the shell. The adult birds are remarkable rather for the huge size of the feet than for beauty of plumage. Some species, however, wear bright raiment, while one or two have assumed odd rather

than beautiful distinguishing marks. The Australian wattled brush turkey, and the maleo, are striking examples of this quality of oddness, so to speak. The first-named bird is peculiar in having the head and neck bare, the exposed skin being brilliantly coloured, and, at the base of the neck, capable of being inflated with air, forming a somewhat gaudily coloured cushion of considerable size.

Now this development of ornament, of conspicuous coloration, whether formed by sharply contrasting areas of brightly coloured feathers, or of bare skin, is to be met with among birds in bewildering variety, as we shall see. And it would be well to remark here that this ornamentation follows certain fairly well-defined rules. Briefly, it seems to be developed first by the males, the females being dull-coloured throughout life. When this is the case the young at first resemble her, but sooner or later the male gradually assumes the livery of his sex. Next we find the female assuming the hues of her mate, though they are generally less vivid; and where this is the case the young have a dull dress, which represents the more ancient female livery. Finally, some species have arrived at a stage where both male, female, and young are coloured alike, as for example in young kingfishers and young parrots. Such are the main facts in regard to the plumage of birds, which should be carefully borne in mind; and this because a walk round this gallery will then become ten times more interesting

Very well. We may now return to our megapodes,

but only to remark that in the Australian wattled brush turkey just described both sexes are coloured alike: and here we may gather what the ancestral and duller plumage was like by a study of the young birds, which are quite sombrely clad. The maleo furnishes a similar case. This bird, it will be noticed, has a bare red face, and the head surmounted by a curious, horny, brightly coloured helmet, while the breast feathers have taken on a rosy hue. The young, on the other hand, have no helmet, but the crown instead covered with feathers.

Briefly surveying the strange-looking curassows and guans of the vast forests of South America, and the equally unfamiliar American partridges and quails, some of which have very quaint-looking devices in the way of ornament, we come to the turkeys and guinea-fowls, and their less-known relatives. The turkey shown here is the "American turkey," and bears a striking likeness to our familiar farmyard bird. This, however, is descended from the Mexican turkey, a mountain species, strangely enough, inhabiting the high tablelands of North Mexico. It differs from the American species in having the tail coverts broadly tipped with white. Somehow, one feels that a mistake has been made, and that the real "Christmas turkey" should have been the Honduras turkey which stands beside the American bird. And this because of the singular ornamentation of the head, a brilliant blue, bestudded with red berries! Certainly it is handsomer in plumage. Of the guinea-fowls it will be noticed there are several species other than the one

so common in our farmyards. And of these, by far the most beautiful is the vuturine guinea-fowl, a native of East Africa (Case 10, No. 80).

To pass from the guinea-fowl to the peacock seems natural enough, since for centuries it has been one of the most highly prized of our ornamental fowl. In olden times, indeed, it was held as one of the chief dishes in all great feasts. Yet few of us, probably, realise what a wonderful bird it is, for surely splendour of plumage can no further go. We miss this just because it is so commonly to be seen. How many, I wonder, realise that the superb train, with its wondrous eyes, is *not* a tail, but is made up of the feathers which in all other birds cover the base thereof? But so it is. These are just "tail coverts" enormously developed, and marvellously coloured, so that at every turn they take on a different tint. In the living bird, it will be found, this train is so raised as to conceal the whole body save the breast, the long feathers at the base of the fan sweeping the ground on either side. The bird seems quite conscious of his beauty, for when displaying his glories to his mate he walks backwards, presenting only a screen of dull grey; but suddenly, with a swirl, he turns round, and sets every quill vibrating, making a sound like the pattering of rain on leaves! That this train is not a tail, can easily be seen from the stuffed specimen shown here, for the tail will be found behind, supporting the train. The peacock is a native of India and Ceylon. But in the Indo-Chinese countries, the Malay Peninsula, and Java, there is found

another equally beautiful bird, differing from our domesticated bird chiefly, it will be noticed, in the form of the crest, and the neck-feathers which, compared with the commoner species, will be found to differ in that they are of great size, and overlap like fish-scales. This is the bird which is always chosen for illustration by the Japanese.

One can hardly believe that the peacock can have a rival, yet it must be admitted that the argus pheasant, which is mounted in the adjoining case, is, in its way, an equally wonderful bird. But here the wing-feathers are the principal feature. Some of these have been, it will be noticed, enormously developed, and are ornamented in a most remarkable way. As in the peacock, this decoration takes the form of "eyes," but so marvellously shaded as to appear like richly coloured balls lying within a deep cup! When the bird is displaying before his mate he spreads the two wings in such a way that they form a great circular screen, and through this he occasionally sticks his head to see if she properly appreciates his efforts!

In these two species we have the most striking illustrations of ornaments that are to be met with among the birds. And they were specially selected to serve this purpose by the greatest naturalist who has ever lived—Charles Darwin. The females, it should be noticed, are quite soberly, almost dowdily clad. Finally, attention must be drawn to the nestling of the argus pheasant, which is included with the adults in this case. And this because it is conspicuously striped, after the fashion

of the young ostrich tribe, and others to be noticed later.

And now we pass to the jungle-fowl; interesting because they are the ancestors of our barn-door fowls, and all the many varieties thereof that are to be met with at our poultry shows, many of which would hardly be recognised as relatives of this parent stock.

But the jungle-fowl has yet another claim on our interest. In the early part of this chapter, it was pointed out the brilliant colours of birds were first assumed by the males, and later by the females, while in other species the female has also assumed a brightly coloured livery. In the jungle-fowl, we have, as it were, a reminiscence of this earlier, dull-coloured stage, for during a few weeks in each year the male sheds his long neck-feathers, or "hackles," and assumes short feathers recalling those of the hen. This is all that remains to tell of a time when, like so many other birds, he assumed during the greater part of the year a dull-coloured garb, putting on his bright livery for the critical work of courting. But to this aspect of bird-life we shall have to return later.

One would fain linger over the pheasants which come next under review, for many of these, like the golden and Amherst pheasants (Case 10, Nos. 90, 91), and the Reeves pheasant (Case 11, No. 104), are birds of most beautiful plumage; but we must pass on with our survey, briefly remarking as we go, the wonderful variety in size, shape, and ornament which the pheasant tribe displays.

The partridges and quails, which come next (Case 15), while they present a wide range in the matter of colour and ornament, contrast with the pheasants in that the sexes differ little in appearance.

The grouse, which complete this really wonderful group of birds, demand a little more attention, because of the interesting phases of plumage which they present. In the giant capercaillie, and in the blackcock, the females, it will be remarked, wear a dress of sober brown barred with black, and their young, as is the rule, resemble them, while in the red grouse and the ptarmigan the sexes display a precisely similar coloration. The ptarmigan, a mountain dweller, it is to be noticed, during several months in the year puts on a livery of pure white, for protection against its enemies—eagles, and other birds of prey. For this white dress, amid the snow, becomes a veritable mantle of invisibility, assuring the wearer against surprise. With the return of the welcome spring this white dress is put off, and the mantle of summer is donned. This is no less protective, for the general hue of dull gold and grey harmonises perfectly with the lichen and rocks amid which the birds crouch when at rest: so that only by their movements are they betrayed. But when once on the wing, they can generally out-distance pursuit. The red grouse, dwelling in the lower regions, where snow never lingers, makes no such change, but its near relative, the willow grouse of Europe, changes like the ptarmigan to white in winter, and for the same reason.

The grouse are peculiar in having the legs and

toes more or less completely feather-clad, and in the ptarmigan even the soles of the feet are so covered.

Our survey of the game-birds, or "gallinaceous birds," as they are often called, is now ended: and it only remains to remark that few birds show such a wonderful power of adapting themselves to different conditions of life, for some contrive to thrive in the wild fastnesses of the mountains, others in the dark recesses of the forest and jungle, while not a few are dwellers in the plains, or on lonely heaths and moorlands. And it will be noticed that in these last the hues of the plumage harmonise so well with surrounding vegetation and rocks, that the bird is practically indistinguishable from its surroundings, and thus escapes attack by prowling carnivores: while, on the other hand, species which live in jungles have developed gorgeous liveries, for they dwell where escape from enemies is easy, and where food is to be had in plenty. Thus they can live secure in their native strongholds, without exposing themselves to the dangers of the outer world.

Our conceptions of the gallinaceous birds in broad outline will be more easily framed if they be contrasted with some other group of birds living in a similar environment. And it would be difficult to find a more suitable group for this purpose than that of the pigeons, which will be found in the adjoining Cases 19 and 20.

The pigeons are essentially tree-dwellers, and thus it has come about that their young, being reared in nurseries amid the tree-tops, are born blind,

naked, and helpless. For the most part they are birds of strong flight, and short-legged ; while as to plumage, it is to be noted, though some are brilliantly coloured, none have run to that extravagance of ornament seen in the peacock and argus pheasant, or in the Reeves pheasant, whose tail attains a length of several feet! And this because these birds must often fly far in search of food, when such ornamental plumage would hamper flight, and render the wearer incapable of escaping the pursuit of birds of prey.

In the matter of nest-building pigeons have acquired no great skill, a mere platform of sticks sufficing them, and on this two white eggs are laid ; no pigeon lays more, thereby contrasting strongly with the game-birds, which lay many, and in some species more or less strikingly coloured eggs. While most build in trees, some species seek crannies in masonry and rock-cliffs, and here the young remain till able to fly, being fed by both parents. At first they are nourished by a curious milky fluid formed in the parent crop and known as " pigeon's milk," but this is soon replaced by more solid food. In this helplessness of the young it should be remarked the pigeons differ from the game-birds.

To appreciate the many peculiarities of this group a careful survey should be made of the general appearance of such familiar types as the wood-pigeon, stock-dove and rock-dove, in the right hand of Case 19. They form a most excellent standard for comparison. Note their coloration, for instance,

and compare them with the gorgeously hued fruit-pigeons such as the orange fruit-pigeon (No. 262, from far Fiji, and the tambu fruit-pigeon (271) from Borneo, or with the beautiful "blood-breasted" pigeons. The majority of the fruit-pigeons are, however, green or green and yellow. One of the most striking species is perhaps the beautiful milk-white nutmeg pigeon, with black flight feathers and black tail band. This bird is a native of the Malay Archipelago, and feeds, as its name implies, chiefly on nutmegs. By way of contrast, this should be compared with the very curious Nicobar pigeon, of a dark metallic green, with long neck-hackles recalling those of a fowl.

The range in size is no less striking, as will become apparent by comparing the little, long-tailed African dove (No. 228), one of the smallest of the pigeons, with the large Chatham Island pigeon, and those near it, on the floor of Case 19, or still better, with the giant crowned pigeons or gouras.

How closely related are habit and structure may be seen by comparing the arboreal, or tree-dwelling types, with those species which have taken to the ground, and hence are known as "ground pigeons." The tree-dwellers are all short-legged, the ground-dwellers relatively long-legged, as in the crowned pigeons, and in the Nicobar pigeon, for example.

The pigeons, as we have remarked, all have small families, never exceeding two; yet in spite of this, some species are extremely numerous; and this is, or was, peculiarly true of the passenger pigeon of America. Only a few years ago this bird was met

with in such countless flocks that the naturalist Wilson, on one occasion, saw a colony which he estimated to contain more than 2230 millions! As late as 1878 a "roost" of these birds at Petosky, Michigan, occupied an area twenty-eight miles long by three or four broad, and during the nesting season millions of birds are said to have been slaughtered without producing any appreciable reduction in their numbers. Yet to-day the bird is extinct!

In two table-cases in this bay will be found skeletons of the world-famous dodo, and the less known but not less remarkable solitaire. These are giant forms long since exterminated by man. This untimely fate overtook them because they were flightless. Living amid an abundance of food, free from enemies, and in an equable climate, the dodo in the island of Mauritius, the solitaire in Rodriquez, these birds had no need of flight. Hence they forsook the trees and gained amazingly in stature; meanwhile the wings, and the keel of the breast-bone supporting the breast muscles, slowly dwindled till flight became impossible.

The solitaire, though less well known than the dodo, was a more remarkable bird, if only because of the fact that its wings have huge knobs of bone, which, as we know from the old voyagers, were used in fighting for mates.

When these islands were first discovered by Europeans the dodo and the solitaire swarmed over the land, but they were rapidly killed off, partly by man, and partly by dogs, cats, and swine intro-

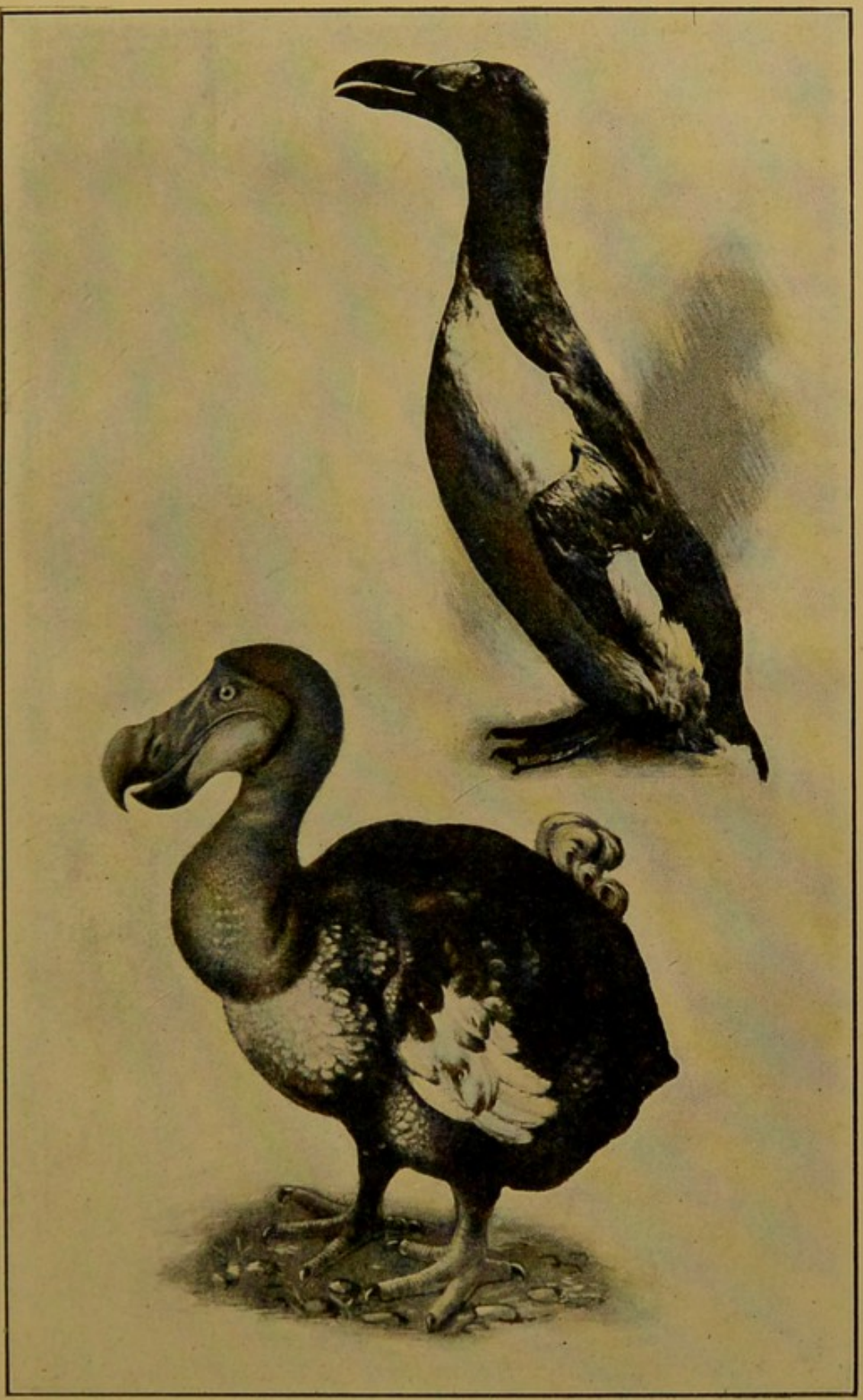


FIG. 25 (below).—The Dodo ; and
FIG. 26 (above).—The Great Auk.

duced by settlers. By the end of the seventeenth century the whole race of both species seems to have been wiped out, and all that we know of them is derived from skeletons and the accounts of the old travellers. Living specimens of the dodo were brought to Europe. One was actually exhibited alive in a show in London, afterwards finding its way to Oxford, where its remains were stuffed and placed in the old Ashmolean Museum. In course of time it fell a prey to moths, and was destroyed, though happily the head and feet were preserved, and are still to be seen in the University Museum. Fortunately a Dutch artist, one Roelandt Savory, painted the dodo from life, and one such portrait can be seen in the Wall-case No. 20 (Fig. 25). This picture was once the property of Sir Hans Sloane, but it came into the possession of the British Museum in 1759.

Let us now turn from the birds of the field and forest to birds which have contrived to find a living on the turbulent sea, or on the placid waters of lakes and streams.

We have shown that the shape and coloration of a bird are largely affected by its "environment" —that is to say, by the conditions of life. In other words, the enemies which must be avoided, the nature of the food and climate, all have a share in moulding the body. But this environment changes, enemies increase or decrease, food grows more or less plentiful and new kinds of food have to be eaten, the climate grows warmer or colder, and so on, as the years roll on. And thus the bird living

under such conditions must change according to need. Birds which find an abundance of food all the year round, on the ground, and without the trouble of having to fly a long distance to find it, lose the power of flight; birds which have to wade in water to obtain food must have long legs, tree-climbers short legs, and so on. As generations pass, and the conditions of life change, the birds too must also change accordingly, or they will no longer be able to obtain a living, and will become extinct. Thus among birds which obtain their food from, say, the banks of streams, some sooner or later will contrive to enter the water itself for food, acquiring the art of swimming, and often of diving, in the chase of a swiftly moving prey. In the passage from one mode of life to another, the body slowly changes in shape, and in proportion to the need for change. If they cease to be able to do this they must soon cease to exist. Webbed feet, however, are not absolutely necessary for swimming and diving. The rail tribe, of which the familiar coot and waterhen may be taken as types, are excellent swimmers and divers, yet they have long, slender toes, with no webs. These birds, however, pass much of their time and find much of their food on land, and hence there are limits to the amount of change in any one direction. In grebes and divers swimming and diving have been, as it were, brought to a fine art; the whole frame-work of the body has been moulded to attain the highest possible skill in this direction, but they have in consequence almost completely lost the

power of walking, and hence if it ever became impossible to find enough fish in the water to support life these birds would become extinct, for they would be unable to obtain a living on land.

Examples of these birds are to be found in Case 21 ; and the first point about them that will attract attention will be the great length of the body, and the extremely backward position of the legs, which seem to spring from just under the tail ! On this account, and because of certain structural peculiarities of the skeleton which would be too technical for profitable discussion in these pages, the grebes find locomotion on land rather difficult, the divers extremely so ; indeed the latter cannot walk. When ashore they can but shuffle along, the belly resting on the ground, and the body being propelled by the legs. But once afloat, all is well. They can catch the swiftest fish, pursuing them under water for considerable distances. But while the grebes are rarely met with on the sea, the divers are common on inland waters in Scotland, where two species breed, or rather endeavour to do so, for owing to the depredations of egg-collectors only a few ever succeed in rearing young. Much of the year, however, is spent at sea, when long journeys down the coast are made. Long ages ago there lived a diver—the Hesperornis—which was far larger than any living species, from which it further differed in having teeth in the jaws, and being flightless. So completely, indeed, had the wing degenerated that only the upper portion thereof, a mere stump, was left !

In the matter of plumage it should be noticed the grebes and divers agree in having a distinctive nuptial or "breeding-dress," which in some species is of a highly ornamental character.

No evidence could be more emphatic as to the way birds are moulded, so to speak, by the conditions of their mode of life, than that furnished by birds which depend for their food on their ability to dive, for we find that a precisely similar shape has been impressed upon a number of quite unrelated groups of birds. The auks and guillemots are striking instances of this, for these birds are certainly in no way related to the divers and grebes, but to the plovers, yet they bear a strong general resemblance to the divers, and none whatever to the plovers! It is only when the anatomy of these birds comes to be examined the truth becomes manifest.

This fact will leap to the eyes of all who, examining the divers, will turn to the case immediately opposite, containing the auk tribe. These birds gradually lost their likeness to their relatives the plovers, and assumed a semblance to the divers, in proportion as they pursued a similar mode of living. The final result we see to-day. The plover tribe, as we know them, are mostly birds of the shore and fens. Some, however, like the crab-plovers, and the curious sheath-bill (*Chionis*) (to be seen in Case 27, No. 464), pass their whole lives by the sea. The sheath-bills, indeed, spend much time far out at sea, as Darwin remarked during the celebrated voyage of the *Beagle*. And this, be it

noted, though the toes are not webbed after the fashion of swimming birds. That they go to sea to find food is evident, and it is easy to see how, from seeking their daily bread on the surface of the water, some ancient plover may have contrived to procure it beneath the surface owing to some fortunate peculiarity of structure not possessed by its neighbours. The descendants of such diving birds would naturally inherit their parents' peculiarities, and in a more marked degree in form. Thus, in the course of ages, a process of slow transformation took place, ending with the "auk tribe" of to-day, which presents striking differences in the matter of size, but a decided likeness in coloration, the upper parts being of a dark slate or sooty brown colour, the under parts white. But here, as with grebes and divers, distinct summer and winter liveries are worn, the summer vestments differing chiefly in an increased amount of the darker hues on the neck. The puffins affect the brightest colours of them all, and these are displayed on the strange-looking, somewhat parrot-like beak. This beak, by the way, is even more remarkable from the fact that portions thereof are shed with the autumn moult, thus reducing both its size and colour. But stranger still, these birds, as a part of the summer ornament, develop a little horny cone on the upper eyelid, and this is shed with the basal part of the beak sheath just referred to!

The most famous of all the auk tribe is the great auk (Fig. 26), a bird which is now quite extinct, but which was at one time to be reckoned among

our native birds. Off the coasts of North America this bird lived in huge colonies, which were exterminated by sailors, partly for the sake of food, and partly prompted by greed. Once the war of extermination began escape was hopeless, for these birds had lost the power of flight. Their helpless condition in this respect will become at once apparent to any one who pauses to examine the stuffed specimen exhibited in this gallery—one of the last of its race, for its wings are no larger than those of a guillemot, though the bird was many times the size of this species. But it is with the razor-bill that the great auk should rather be compared, as may be seen by comparing the two species here exhibited, for both have the same curiously grooved beak, lined with white.

The extinct great-auk represents the largest member of this family, the little auk the smallest. The latter should be carefully examined, and then compared with the little diving petrel (*Pelecanoides*), which will be found on the right-hand side of this case. The likeness between the two birds is most striking, yet they are no more related one to another than are the little auk and the diver. We have here, then, yet another instance of the effect of a similar mode of life on unrelated forms, another illustration of what is known, scientifically, as "convergence"—that is to say, of birds which originally were quite unlike and unrelated, but by a similar mode of life have "converged" to meet at the same point. This little diving petrel, which is so like the little auk, should be compared

with one of the smaller petrels, such as with the species known as "Mother Carey's chicken"—the storm petrel—when the great change it has undergone will become clear, for the storm petrel, it will be noticed, is long-legged and carries the body horizontally, the legs springing, as it were, from the middle of the trunk. But in the little diving petrel these legs have become greatly reduced in length, and the body is carried in a more or less vertical position.

But let us return for a moment to the guillemots, auks, and puffins. These birds are all, without exception, dwellers by the sea, and for the most part they associate in huge colonies wherever precipitous cliffs occur. Here, on ledges and in crannies of rocks, or in burrows, they rear their young, then put out to sea. The puffin breeds in burrows, preferably those dug by rabbits, whenever they are to be found, but will content itself with a rock-crevice, or natural cave, laying therein, as with the auk tribe generally, but a single egg.

Inasmuch as birds so totally unrelated, and in the beginning so totally unlike, as the divers, auk tribe, and the little diving petrel have come to assume such a striking likeness one to another, it is a matter for surprise to find such a group as that of the penguins, wherein the fore- and not the hind-limbs have become the organs of locomotion under water. These odd-looking birds are happily so placed that they can readily be compared with the forms just referred to; and it will be seen that what answer to the wings are here transformed into

paddles such as are met with only among the turtles and the whale tribe among living animals, and the old sea-dragons—Ichthyosaurs and Plesiosaurs—among creatures which have become extinct. The feet in the penguins are used only when on land; in the water they propel themselves at a rapid rate by means of the paddles. From the structure of these we know that long ago they must have served the purpose of flight; how it was they came to supplant the legs in swimming no man can tell. When, however, this change of function did take place the quills, or flight-feathers, gradually degenerated, and at the same time the hand began to lose its power of being bent back upon the fore-arm, as in birds which fly; it assumed, in short, the form of a paddle. The penguins, it should be noticed, are the product of the southern hemisphere, for though they range as far north as South Africa, they nowhere pass the equator, while the finest specimens of the race are the king and emperor penguins of the inhospitable Antarctic regions. The emperor penguin, indeed, never touches dry land, but spends its whole life on floating ice. And this fact has caused a very remarkable fashion of brooding the eggs and young. For these, instead of being deposited in a nest, are borne by the birds upon the back of their feet, being further sheltered from the icy cold by the overlapping of the feathers of the belly.

Before leaving this bay a few moments may profitably be spent in studying the petrels, for some members of this group have a very striking likeness

to the gulls—the fulmar petrel especially so—and to this fact we shall return presently. The fulmar petrel may be used as a standard of comparison on the one hand with the smaller petrels like the little "Mother Carey's chicken" (No. 381), and on the other with, say, the Manx shearwater (No. 370), wherein it will be noticed the legs are short, and placed much nearer the tail; thereby it approaches the diving birds. These three birds are all natives or Great Britain, and those who have the good fortune to study them in life will notice that the Manx shearwater, as one would expect, spends far more time afloat than its relatives, wherein it approaches the diving petrel. The giant albatross represents the largest of the petrel tribe, and on the bottom of the case will be seen a downy nestling.

This brings us to the gulls, which are to be found in the next bay. By the older ornithologists these birds were regarded as near relatives of the petrels; we now know that the resemblance of the two groups one to another is no evidence of their affinity, for there can be no doubt but that the gulls are really much modified plovers. The gulls and the plovers, in short, are divergent branches springing from a common stock. While the petrels are exclusively marine the gulls are by no means so, some species, as in the case of the black-headed and common gulls, and the herring-gull, making their way long distances inland. The black-headed gull, indeed, congregates in hundreds during the winter months on the Thames, thereby greatly

enlivening the dull days of this great city. Gulls differ from petrels, again, in that many species, like the terns, which are diminutive gulls, put on a distinctive summer dress. The black-headed gull, indeed, derives its name from this fact; for during the winter the head is pure white, but with the approach of spring it assumes a dark, sooty brown colour; the terns, on the other hand, put on a jet-black crown. In the smaller species the adult dress supplants the plumage assumed on leaving the nest, in the autumn, but with the larger black-backed and herring gulls their adult dress is only very gradually acquired, some three years at least being taken to effect the change. As may be seen here, the immature plumage is of a greyish brown colour, while in the adult the upper parts are either of a beautiful pearl grey, as in terns, or black. In some species the whole plumage, save the breast, is of a sooty brown colour.

Of the true plovers little can be said here, and this because there are so many species, presenting so wide a range of variety in shape, size, and colour, that any attempt to describe them in detail would require a much greater space than can be afforded in these pages.

Shore and marsh-haunting birds for the most part—though some, like the Norfolk plovers and coursers, affect dry heaths and wastes—they present a great variety in the shape of the beak, and in the length of the legs. Compare, for example, the beaks of the ringed plover, or of the golden plover, with those of the snipe, avocet, and curlew;

and the legs of the turnstone, say, with those of the stilt.

Some species, like snipe, undergo no seasonal change of plumage; others, like the ruffs, godwits, knot, golden, and grey plovers, and dunlin, undergo a very striking change of livery in the spring; and this is especially remarkable in the ruffs, to which we have already referred.

The strange-looking seed-snipe, the crab-plovers, and the sheath-bill, on the floor of the case, and the coursers and pratincoles in the next bay, are all "aberrant" members of this group—that is to say, they have no near relatives among the existing species of plovers. The ibis-billed curlew (No. 520) should be especially noticed in this connection, for it combines the plumage of a gull with the beak of the curlew dyed red! In its style of coloration, in other words, it stands alone among the plovers. The seed-snipe similarly are quite unlike plovers in their general appearance: and the same is true of the strange-looking crab-plovers and sheath-bill. These types are of quite peculiar interest to the ornithologist, for they all represent ancient forms having no near relations among existing birds. They are therefore worthy of more than passing attention, and will be found in the upper part of the next bay. Here also are placed those very remarkable birds, the pratincoles, which long puzzled ornithologists. The earlier naturalists never even suspected their relation to the plovers, for they were guided solely by external appearance, and hence it is not surprising that they regarded them

as related either to the swallows, or the nightjars. The Norfolk plover is another puzzle. By some experts it is believed to be nearly related to the bustards, by others to the plovers, and it must be admitted that, judged solely by external appearances, it has a very bustard-like appearance. Yet another riddle was presented by the jacana (Fig. 27), which is included in this case though presenting an undoubted likeness to the rail tribe, especially in regard to the long toes, while in the extraordinary length of the claws it is unique. The toes and claws together give the foot an enormous surface, and this makes it possible to walk with ease over the floating vegetation which this bird constantly explores in search of food. But the head and wings of the jacana are no less remarkable, the former because of the ornamentation of fleshy wattles, the latter on account of the armature of long, sharp spurs which are seated on the wrist. And in these particulars they resemble the "spur-winged" plovers in the bay we have just left, and to which a return may profitably be made for the sake of the comparison (Case 28, Nos. 543, 548, 555). These spurs are used in fighting rival males, and inflict serious and often fatal wounds. But few birds are so armed; indeed such spurs are met with again only in certain ancient types of geese to be discussed presently, and in the blunt knobs of that extinct pigeon, the solitaire, which has been already described.

We have had occasion eariler to refer to the strange antics and displays of plumage which birds

make during that anxious time when they are trying to win their mates: and we find yet other and no less strange variations on this theme among the bustard and crane tribe. And of these the most striking are afforded by the great bustard—once common on the heaths of our eastern counties—and

FIG. 27.—The Jacana.

the sun-bittern. The first-named bird is a regular acrobat, for when striving to win the esteem of his mate he assumes a posture which is as unlike that of a bird as could well be imagined. Nature has come to his aid in this matter by providing him with a great pouch which, opening under the tongue, and running down the neck, can be filled with air, enormously increasing the bulk of this region. Then, drawing the neck down upon the back, and

bending the head downwards till it is half buried amid this cushion of air and feathers, he next pulls the tail forwards, and twists the inner wing-feathers upwards, until he assumes the strange shape shown in the case in the centre of this bay! The form and position of the pouch is shown in a dissection in the adjoining case. The display of the sun-bittern, as will be seen in Case 31, is very different; here an attempt seems to be made to make the most of the wonderfully coloured wings.

Mention has been made already of "protective coloration" among birds—that is to say, of birds whose plumage harmonises so completely with their surroundings as to make them invisible. In the bitterns we have a most wonderful example of this: they will be found in the next bay (Case 33). The bitterns, it should be remembered, are birds which haunt the fens and marshes, and are all birds of sober hues. The most noticeable feature is the curious coloration of the neck, the front of which is marked by longitudinal stripes. Now these birds, when alarmed, instead of trying to escape by flight, assume a strangely wooden attitude, thrusting the neck and body straight upwards, and keeping the front of the body facing the enemy. The use of the longitudinal stripes now comes into play, for they closely resemble the interspaces between the reeds amid which they hide, while the ground colour of the plumage blends with that of the dead foliage, and hence the birds, while in this attitude, become absolutely invisible, for they are careful not to make the slightest motion, which of course would

at once betray them. The little bittern has been specially selected to illustrate this point. Here, of course, the birds are plain enough, but in Nature, it is obvious, detection would be practically impossible.

The bitterns are near relatives of the herons, birds very commonly confounded with cranes, to which, however, they present a not very close resemblance when the two types come to be compared. The herons, again, are members, like the bitterns, of the stork family, of which four or five species are occasionally found in Great Britain—the black and the white stork, the glossy ibis, the spoonbill, and the flamingo.

The ibises and flamingoes present some gorgeously coloured species—as a glance at the flaming red birds in this bay will show (Case 35). The flamingoes are, however, not included in this series, but will be found on the opposite side of the gallery, because, by many authorities, these birds are supposed to be more nearly related to the goose tribe: because, like the geese, ducks, and swans, the edges of the beak are provided with horny plates like the whalebone plates of whales, and used for a similar purpose—the capture of small living organisms from water. But the occurrence of similar structures in such widely different animals as whales and birds ought to be sufficient to show that this is a character not to be relied on as a mark of kinship. Precisely similar lamellæ are to be found in certain petrels—*e.g.*, the broad-billed petrel (Case 24, No. 380), while in the shoveller duck they attain

the maximum development among birds (Case 40, No. 737).

How profoundly modified birds may become to suit an aquatic environment, we have seen in the case of the grebes, divers and penguins. In the goose tribe we have a further illustration of this, and one furnishing some interesting intermediate stages.

To begin with, it would seem that though now web-footed the ancestral stock was not so. At any rate, the birds which are generally regarded as representing the most primitive of the goose tribe are not web-footed, though exclusively aquatic in habit. These are the screamers, and before attempting to survey the more typical members of the order—ducks, geese, and swans—the screamers should be carefully examined. For this purpose it will be necessary to cross the gallery to Case 42. The beak, be it noted, is fowl- rather than goose-like, while the wings, like those of the spur-winged plovers, are armed with formidable spurs.

Returning again to the bay containing the ducks, perhaps the first point that will strike the attention is the great variety of colour which these birds present; some, indeed, are of great beauty. Among these are the eider ducks, birds which stand almost alone in having the under parts more darkly coloured than the upper—darker below, indeed, they could not be, for the breast is of a velvety black!

All the ducks are webbed-footed, and all dive at need. But the "surface-feeding" ducks, as they are called—the mallard, teal, wigeon, and so on—

FIG. 28.—The Great White Heron (*Herodias alba*).

This is one of the birds so much in demand for millinery purposes, and hence is threatened with extinction.

dive only when at play, or when in danger. Vegetarians, they obtain all their food from the surface of the water, or from shallow water. When they desire to browse off the bottom of the stream, they, like the swans, have a habit of plunging the head and fore part of the body under water, keeping the body in a vertical position by means of the paddling action of the feet. But some species of ducks, largely marine, feed chiefly on fish and molluscs, and these can only be obtained by long submergence and great activity under water; hence these have assumed a likeness to the divers in having the legs placed much further backwards than in surface-feeding ducks.

A very different aspect of bird life—one which reveals what we generally regard as a rather painful side of Nature—confronts us in those ministers of death, the birds of prey (Cases 45–53). But they do their work painlessly, and what is more, they very largely help to maintain that high standard of efficiency, that wonderful ability to lead the strenuous life, which is so characteristic of birds. The weaker, the less efficient, are the first to fall victims, and so check the increase of their kind, and at the same time make room for the more active. Furthermore, these birds keep in check species, both of birds and beasts, which without such restraint would bring starvation and disease to creatures of all grades, even including man himself.

The term "birds of prey" includes two very distinct groups of birds, at one time regarded as

nearly related, but now known to have no sort of kinship whatever. These two groups are made up of the typical birds of prey—hawks, buzzards, eagles, and falcons—and of the owls. The first named formed the "diurnal" and the last the "nocturnal" bird of prey of the older naturalists.

Of the hawk tribe the most unhawk-like in many respects is the great, long-legged, secretary bird of South Africa, a bird regarded with peculiar favour because of its habit of preying upon poisonous snakes. These it kills by trampling underfoot, the long, scaly legs being in no danger of wounds from the fangs of these deadly reptiles. Though a real member of the hawk tribe, this bird is very like one of the primitive or ancient types of the crane family—the seriema, or cariama, as it is sometimes called, of South America (Case 31)—a fact which is due, as in so many other cases which have been cited in these pages, to similar habits.

The hawk tribe are typically birds of vigorous flight, having the feet fashioned to form grasping organs, and armed with sharp and powerful claws, and strong, hooked beaks capable of tearing up the prey while held within the grasp of the feet. Some pursue and catch their victims in mid-air, others seize them from the ground; some feed solely on fish, which they catch by plunging into the water at the end of a great swoop; and some feed almost entirely on insects. The little hobby, at one time common in this country, is such an insect-feeder, but owing to the ignorance of gamekeepers, and game-preservers, it has been ruthlessly shot down as "vermin,"

wherever met with, and hence is all but extinct in this country.

On the other hand, certain of the birds of prey have adopted a diet of carrion: these are the vultures, of which some splendid examples are shown here (Case 45). Though their method of feeding seems to us repulsive, these birds are really great benefactors, for they remove what else would breed pestilence and death. Whether the vultures which are found in the new world are really related to the old-world vultures is a moot point; there are many facts in regard to their anatomy which show that they are certainly not near relations. The two forms can readily be distinguished by the shape of the nostrils, for these in the new-world forms are perforated so that we can see quite through one side of the beak to the other. Some of the new-world vultures have curious fleshy wattles around the beak, while the head is vividly coloured. Further, they claim the distinction of including among their numbers the largest bird that flies—the condor (Table-case).

To pass now to the owls. As we have already remarked, these birds, though in some respects so like the birds of prey, are really near relations of the nightjars, transformed by their predatory habits, thereby providing us with yet another illustration of the way animals are moulded by the necessities governing the pursuit of their daily bread. Hunting chiefly by night, it is essential that they should be able to approach to within striking distance of their prey without any warning, for pursuit in the dark would be impossible. And to

secure this end the wing-feathers are so modified as to deaden all sound, for such a swish of the wings as may be heard in the lighting rush of the falcon would of a certainty give warning to the intended victim.

It would require a long chapter to do justice to these fascinating birds: and unfortunately all that we can do here is to draw attention to one or two of their more striking peculiarities. In the matter of size it will be noticed they present a wonderful range, beginning with the pigmy owlets (986) and ending with the great eagle owl (Case 54). The beautiful white snowy owl is a near relation of the eagle owl. The significance of its coloration, it may be remembered, was pointed out when describing the treasures in the Great Central Hall (p. 5).

After what has been said concerning the relationship between the owls and the nightjars, it is but natural that space should be found here for a few words on the latter.

The nightjars, using this term in a wide sense, are divisible into three more or less well-marked groups—the curious oil-birds of South America and the frog-mouths of New Guinea and Australia, to be found in Case 57, and the more typical nightjars, still further on, in Case 61. It is to the oil-birds and frog-mouths that the owls are perhaps more nearly allied. Neither the one nor the other, it must be remembered, can be regarded as entitled to rank as the ancestor of the owls, but rather these and the owls must be regarded as descendants of some common ancestor, unlike any

of the three types we are now discussing, but possessing characters common to all. The further development, in the course of ages, of these common characters, some in one direction, some in another, resulted in the three types of to-day—oil-birds, frog-mouths, owls. The typical nightjars represent yet another branch of this family tree. Like the oil-bird and the podargus, these have enormous mouths and large eyes, being birds of the night. For the most part protectively coloured species, some have developed excessively long quill-feathers, which form "streamers" during flight, as, for example, in the pennant-winged nightjar, wherein the inner "primary" feathers are all unusually long, and the innermost excessively so, forming the "streamers." In some other species the tail feathers are elongated.

Our survey of this wonderful gallery is now drawing to a close. We have passed in review forest and fern-haunting birds, aquatic birds of many kinds, flightless birds, and birds which depend for their very existence on their ability to outdistance all other birds on the wing. We must now pass to the consideration of a marvellously varied array of forms, all of which are essentially tree-birds, or "perching birds," for, whatever their mode of life may be, almost without exception when at rest they "perch"; it may be amid scrub, it may be amid the branches of lofty trees, but they rarely remain longer on the ground than is necessary to obtain food, whenever this must be sought in so lowly a situation. And it is curious

to remark that this arboreal life is associated with a strange diversity in the form of the foot, a diversity which, contradictory as it may seem, makes for uniformity, inasmuch as whatever the form of the foot, or rather the arrangement of the toes, may be, the end to be attained is always the same — to bring the hind and front toes down to the same level, so that a sole of uniform surface is formed, thereby assuring a good grip of the branches of the shrubs and trees which afford the desired shelter.

The pigeons and game-birds pass much of their time in trees, but they also walk much. Some rarely or never perch, and in them, consequently, the foot has not been remodelled, so to speak, so as to increase its power of grasping, for this would have decreased its usefulness in walking. It has not, in short, become what is in scientific language described as "specialised." For specialisation means restriction—that is to say, when animals, of whatever kind, become perfectly adjusted to any restricted form of environment they become unfitted to live elsewhere, and hence, any change of environment means extinction.

Very well. The commonest type of foot of the kind we are now concerned with is that known as the zygodactyle, wherein two toes are directed forwards and two backwards. The parrots and woodpeckers, for example, have feet of this kind. Another type is the syndactyle, where the three front toes are all bound together, and the hind toe only is free, as in the kingfishers and bee-eaters, for

example. Save in this peculiarity of the feet there is nothing else that would indicate that the bird was a "perching" bird. The shape of the beak, however, assumes in some groups strange forms, as will become apparent presently. Finally the birds now left to consider present an amazing variety of coloration, often of rare beauty.

The parrots are the first to be considered. The beaks of these birds recall the teeth of rodents, inasmuch as they are employed for similar purposes—depriving nuts of their shells, and trees of their bark and leaves. In some species, which feed almost entirely on nuts encased in exceedingly hard shells, the beak is of enormous size, as in the great black cockatoo (Case 56, No. 1089) and in the gaudily-coloured macaws. But there are exceptions to every rule, and these are found in the brush-tongued parrots of New Guinea and Australia. These birds live largely on honey obtained from flowers, and to obtain this the tongue has become peculiarly modified, ending, as the name implies, in a brush-like fringe, which readily sucks up the precious liquid. This love of liquid food has led one member of this family into evil habits. This is the kea of New Zealand, which has taken to attacking sheep for the purpose of obtaining blood and flesh, inflicting injuries which sooner or later prove fatal. Thereby they have brought down upon themselves the very natural and cordial hatred of sheep-farmers, so that their extermination is but a work of time. Few birds present such a range of coloration as the parrots—pure white and

jet black, as in many of the cockatoos, grey, as in the African parrot, and every possible combination of red, blue, green, yellow, and violet.

As a study in coloration it would be hard to beat the kingfishers. Here the starting-point should be made with the quaint-looking "laughing jackass" of Australia, wherein sombre shades of brown and grey predominate. From such a beginning several distinct groups of coloration can be traced—black and white, green and white, blue and white, green and red, and red, different species combining these hues in different fashions (Case 57).

While most of the kingfishers are birds which haunt streams and feed upon fish and aquatic insects, some are wood-haunting birds, and feed upon insects and small reptiles. Though almost universally distributed over the globe, the real home of the kingfishers is to be found in the Malay Archipelago and New Guinea; at any rate, more species are met with here than elsewhere in the world, and here are to be found some of the strangest forms, such as the beautiful racket-tailed kingfishers, and the curious shoe-billed kingfisher to be seen on the floor of the case, which in the matter of its beak recalls those odd-looking birds, the whale-headed stork (Case 35, No. 654), and the boat-billed heron (Case 34, No. 629); and those who can afford the time would do well to cross the room again to the bay where these birds will be found, for the sake of comparing the one with the other.

So far, in this chapter, but little has been said of

the domestic life of birds, but we come now to one or two instances so remarkable that they cannot be passed over. The first of these is furnished by the hornbills, of all birds perhaps the strangest in their general appearance. The nursery chosen by the hornbills, of which there are many species, is always a hollow tree. To this retreat, as soon as the eggs are laid, the hen-bird retires, when her mate at once proceeds to close up the entrance by a masonry of mud, leaving but a small hole through which she thrusts her bill, and here she remains a close prisoner till the young are ready to leave the nest. Meanwhile she is fed assiduously by her faithful partner, in a most extraordinary fashion, since the food is brought up from his stomach enclosed within a thin skin, like a pudding cloth, according to some authorities formed by the lining membrane of the stomach! Be this as it may, his life during this period is a strenuous one, so much so that he frequently dies so soon as he recovers his freedom, for he is virtually as much a prisoner as his mate. A word as to the huge beaks of these birds. Solid though they seem, they are yet extremely light, because the horny, external sheath encloses nothing more than a delicate filigree work of bone, except in the case of the helmet hornbill. Here the fore-part of the great casque is of extreme thickness and hardness, and from its superficial appearance appears to be used as a hammer, perhaps for cracking nuts with. At any rate, the bony skeleton behind this horny pad is of great hardness and thickness, and is so arranged as to give the appear-

ance of being contrived to resist the shocks of hard blows, as may be seen in the section of a skull in the wall-case of this bay (Case 60, 1212).

To return now to domestic habits for a moment. Our next case is that furnished by the little edible swiftlets. The swallow tribe—with which the swifts are commonly but mistakenly confounded, for they have nothing to do with one another—it is well known, in building their wonderful mud nests use a certain amount of saliva as cementing material. Very well: in these swiftlets, the supply of saliva is so copious that the whole nest is made of it! And it is this hardened saliva that is so sought after by the Chinese for the preparation of their "birds'-nest soup" (Case 61, 1244).

Of the humming-birds, gorgeous in colouring, strangely delicate in shape, and marvellous in the variety they present in the matter of beaks, a whole chapter could be written. All that space allows us to say of them is that they are near relatives of the swifts, and are confined to the American continent. They have their counterparts in the exquisite little sun-birds of the old world (Case 77), and these should be carefully examined in this connection.

The cuckoos and the woodpeckers, like the king-fishers, are groups peculiarly suited for the study of the way in which evolution works in the production of various lines of coloration, so to speak, from a common starting-point. The real purport of this condensed statement can best be grasped by taking some familiar species, such as the common cuckoo (Case 64, 1385), and comparing this from the

point of view of coloration, and also of size, and of length of leg, with the various forms of cuckoos to be met with when all the principal types are compared one with another. Here will be seen plain, brown-coloured cuckoos, barred cuckoos, and cuckoos of marvellously metallic-looking plumage ; most of them, it will be noticed, are tree-dwellers, for they have short legs, but there are some species which have taken to living on the ground, and these have long legs, as in the " road-runner."

With the woodpeckers and their allies this assemblage of strictly arboreal birds ends. Only two families of this order can be specially mentioned—the toucans and the woodpeckers proper (Cases 65–66).

The former, often confounded with the hornbills on account of the great size of the beak, differ therefrom in the much greater brilliancy of their plumage, and of the horny beak sheath. This beak, by the way, like that of the hornbills, is extremely light, the thin, horny sheath covering nothing more than a delicate filigree work of bone. Though highly ornamental, this beak is also contrived to be useful, for therewith the bird is enabled to reach to the end of twigs too slender to support the weight of the body, for the purpose of plucking the luscious fruit which else would be out of reach ; but this vegetarian diet is varied by an occasional egg, or young bird. By a peculiar arrangement of the joints of the tail bones these birds are enabled, when roosting, to draw the tail up over the back, wherein they differ from all other birds.

The woodpeckers have become more intensely

adapted to an arboreal life than the toucans, since they are enabled to run up and down the trunks of the trees with ease. Further, the beak is of extreme hardness, so that it can be used as a pickaxe to smash away the wood surrounding luscious grubs, or to excavate nurseries for the young. During this work of splintering the body is supported by the tail, which forms, as it were, the third leg of a tripod. And to this end the feathers have come to assume the form of long, pointed spines. But the most remarkable of all the structural peculiarities of the woodpeckers is to be found in the tongue, which is of great length, and worm-like. By a special mechanism it can be thrust far out of the mouth for the purpose of capturing ants and other insects. When thus used, its surface is covered with a sticky kind of saliva, so that whatever touches it adheres. Thus, thrust suddenly into a swarm of ants, it can be drawn back in an instant covered with their writhing bodies! Finally, in the matter of size, and coloration, it will be remarked, the woodpeckers present a truly wonderful variety.

If one were to be asked what is the dominant type of bird-life to-day, the reply would have to be that of the "perching birds" or "passeres," inasmuch as these are to be found the world over. Moreover, in regard to the number of species by which they are represented they exceed all the other groups of birds put together! It is not surprising, then, to find that in the matter of coloration they

present an infinite variety, and include some of the most gorgeously plumaged of all birds, as for instance the birds of Paradise. Having regard to this fact it is obviously impossible to attempt here to survey, even roughly, the various types which so great an assemblage presents. Those who are really fond of birds will find this group irresistibly fascinating. It should be studied as a whole, as one great family breaking up into two or three great branches, and innumerable smaller branches. Scientifically the "passerine" or "song-birds" are split up into two great divisions, according to the structure of the organ of voice; but all agree in having a foot adapted to walking on the ground, though, as the term "perching birds" implies, as a whole they are arboreal types. In this foot three toes are turned forwards, and one behind, as in the majority of birds, wherein it contrasts sharply with the "zygodactyle" and "syndactyle" foot of those birds which are more strictly perching birds, since they seldom or never walk.

As to the nearest relatives of this great host it is impossible to speak with certainty; but they appear to have split off from the stock which gave rise to the nightjars, and those strange birds the "colies" (Case 63), which accordingly should be carefully examined by all who are interested in the fascinating problem of descent.

Here our survey of the Bird Gallery must end, not because we have exhausted its contents —on the contrary, we have but traced in the

barest outline some of the more interesting of the problems it holds out to us—but because it would take a whole volume to do it justice, and this, it must be remembered, is but a chapter of a volume.

CHAPTER VII

THE REPTILE GALLERY

"The toad, ugly and venomous,
Wears yet a precious jewel in its head."

SOMEHOW or another the reptiles have won an evil name among the human race, for probably no creatures are so generally disliked and so universally mistrusted. Tradition has done much to foster this dislike, and the natural dread inspired by such creatures as the snakes has done much to keep alive this ill-feeling.

If, however, it be true that "a fellow-feeling makes us wondrous kind," then surely many of those who now regard the reptiles as Nature's outlaws should be won over to reconsider their hasty verdict; since, like ourselves, these creatures are also called upon to struggle with circumstances for a hold on life.

The story of reptile life is largely the story of a race whose glory has departed. Just as in the study of the human race we are able to follow the histories of nations, their rise, glorious zenith, and decadence; so with the reptiles we may trace a similar course of evolution. The survivors of to-day are but a remnant; a feeble tribe, spurned and despised.

Time was when they were the dominant forms of life upon the earth, so that we speak of the "Age of Reptiles." For millions of years—from the Permian to the end of the Jurassic era—they held sway, but were at last outnumbered, and overpowered by the present reigning type of animal life—the mammalia. But their defeat is without ignominy, since their conquerors are at the same time their descendants.

Lowly in origin, these creatures nevertheless came rapidly to the fore; they spread themselves over the face of the earth, and took possession of the waters thereof, and of the heavens above. Many exceeded in stature all creatures that have ever lived, before or since. Waxing numerous, they branched out into many tribes, each carving a way for itself. What the members of these several tribes were like, and how they have overcome their enemies; what weapons they have employed, what subterfuges they have resorted to, and what their pedigrees disclose, can be traced in this gallery by those who will patiently spell out the lessons which the specimens here exhibited are intended to teach.

But before we proceed further it is essential that a clear idea should be formed of what constitutes a reptile. Save among experienced naturalists, only the vaguest notions seem to exist on this head. Generally a totally distinct group of animals is included in the popular idea of the class reptiles. These alien forms are the frogs, toads, newts, and salamanders. Now between the reptile and these

creatures there is a very wide difference. Both agree in being "cold-blooded," in having a backbone, and four limbs adapted for walking: but they differ in that the young of the frog-tribe—using this term in its widest sense—with certain exceptions, when they leave the egg, do so in the form of "larvæ"—that is to say, they differ from their parents in that they are obliged to live in water, and

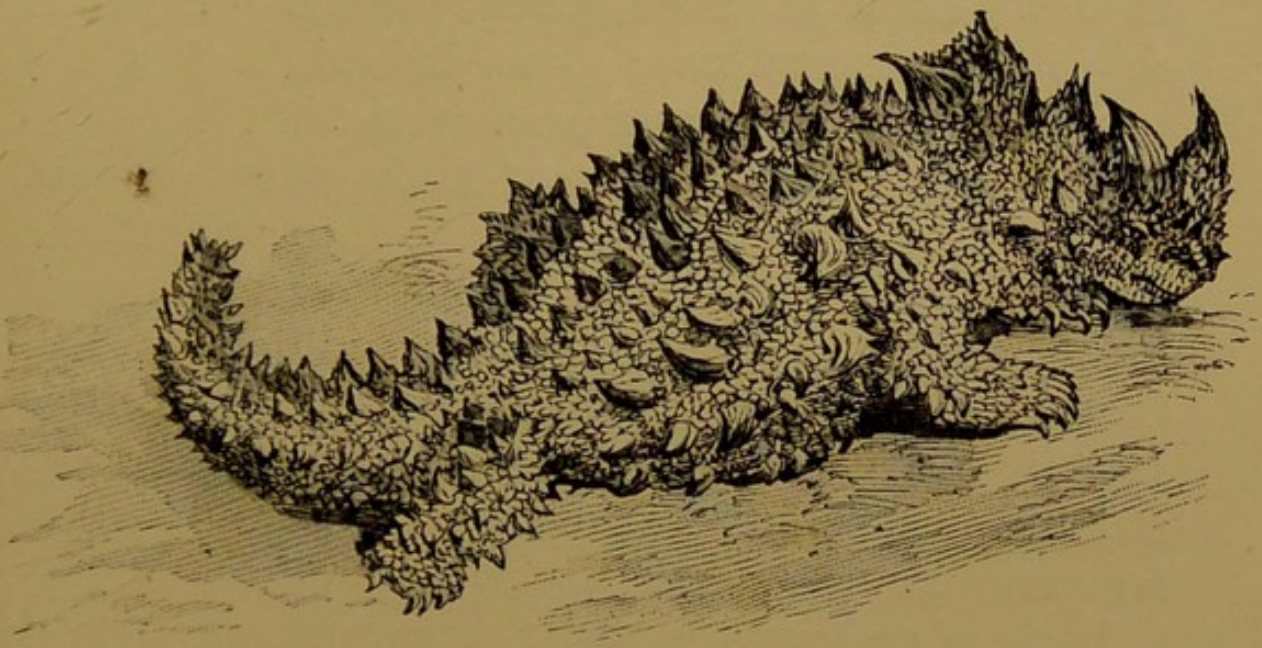


FIG. 29.—Moloch, or Horned Toad.

to breathe by means of gills after the fashion of fishes. Later these gills disappear, and breathing by lungs is substituted. But in this adult stage they still differ from the reptile in that the skin is naked, and richly supplied with glands for the purpose of keeping the skin moist—hence the "sliminess" which makes these creatures so objectionable to many. Among the true reptiles the young leave the egg in the form of the parent—that is to say, they *never* pass through a gill-breathing

stage. Further, the body has a scaly covering, and the skull moves upon the backbone by means of a single bony knob, instead of two such "knobs" or "condyles," as they are called, in the frog and its kin.

A glance round this gallery will show that the reptiles can be divided into several well-marked groups—crocodiles, tortoises and turtles, lizards and snakes. Each of these groups varies greatly in shape, colour, and size; some, indeed, in this last respect attaining colossal proportions.

The essential characters of these groups present some exceedingly interesting facts in regard to the way in which animals become slowly transformed in adapting themselves to new conditions of life. One could point out dozens of instances of this fact in this gallery, but one or two of the more striking must suffice. Take the tortoises and turtles, for example.

If these creatures were less common they would be regarded as amongst the most wonderful animals in creation: for they alone, among the vertebrated or backboned animals, have the skeleton outside the body! And this order of things has come about in a very strange way.

For the familiar shell which encases these animals is nothing less than the skeleton, peculiarly transformed. Closely examined, this shell is found to be composed of an outer layer of horny plates, or shields, on top of a closely fitting series of bony plates, which, like the horny shields, are symmetrically arranged, as specimens here exhibited show.

The zigzag lines represent the interlocking edges of the separate plates, which have a very remarkable history. One set—those which are seen running down the middle line of the back—are formed by table-like expansions of the spines of the vertebræ or backbone, and therefore are parts of the true skeleton. The other set, which run down at right angles to the backbone, and those which form the margin of the shell, are, on the other hand, derived from bones which really have nothing to do with the skeleton, but are derived from the skin! They are this, and something more. But how did this puzzling state of things come to be? Originally, it would seem, these now symmetrical bands of bone were embedded in the skin, either in the form of modules, or of bands, and this skin, as in all other animals, overlaid a thick mass of flesh, or "muscle," as in ourselves, for instance. But as the bony part of the skin increased in thickness, and was gradually welded together, it allowed less and less movement of these muscles, and in proportion as they ceased to be used so they decreased in size, till finally, the outer shell (for such it had now become) rested entirely on the underlying ribs, and finally fused with them—that is to say, the two became welded together, so that to-day, in some tortoises, all that can be traced of these ribs is the "head" or the portion which joins the vertebræ column, and the tip which supports one of the small plates of bone which make up the edge of the shell. This we know because in very young tortoises complete ribs are present, but, as their growth proceeds, all save the

two ends just referred to become absorbed, and replaced by the bones, originally, as we have said, belonging to the skin!

Nor is this all, for the history of the breastplate of the tortoise is no less strange, for here too we have a similar arrangement of horny shields closely attached to an orderly series of bony plates, but the bony elements here belong in part to the "shoulder-girdle," or bony support for the limbs, and in part to the welding together of certain peculiar ribs met with as separate elements in the ancient Tuatera lizard of New Zealand, and in certain fossil reptiles.

The development of this shell has been accompanied by many other profound and remarkable changes. Thus the backbone, between the base of the neck and tail, once a supple, jointed rod, has now become virtually suppressed, its originally separate pieces being greatly reduced in size, and welded one to another, and to the shell. This was the unavoidable result of the growing immobility of the shell.

Yet another remarkable feature is the position of the limb girdles. In all other animals the shoulder-blades lie on the *outside* of the foremost ribs; but here they are found inside the shell, that is to say, underneath the ribs. Similarly, the haunch bones which support the hind-limbs in other animals lie behind the last rib, and near the surface of the body: in the tortoises and turtles they lie, like the shoulder-blades, inside the shell!

The strange position of these bones, however, is only a feature of adult life. In very young

tortoises, where the development of the shell has only just begun, the shoulder-blades lie a little in front of the first rib, whilst the hip bones lie just behind the last rib. The growth of the shield, however, in course of time, gradually creeps over the shoulder-blades in front, and the hip bones behind, so that finally, as we have shown, they come to lie within the shell!

There is another point to which reference may well be made here. If the shells of one of the tortoises exhibited here be carefully examined—shells which have been purposely prepared to show this—it will be noticed that the arrangement of the horny plates is quite different from that of the bones. In all other creatures which have horny plates covering bony plates, the one fits exactly on the other. The crocodiles have this arrangement. The arrangement of the horny shields can easily be traced in the shell of the tortoise, for their overlapping edges leave a faint impression on the bony shell.

In some of the turtles this fusion of the ribs with their overlying bony plates is less complete, and hence what happens in the cases just referred to can be the more easily grasped. And we find a still earlier stage in this marvellous chain of events in the curious "leathery turtle," specimens of which will be found in one or two of the large table-cases. Here the bony shell is made up of a sort of mosaic of bones, overlaid by a leathery skin. And this shell is here quite distinct from the ribs.

This singular form of clothing seems to have been

devised as a protection against enemies, on the part of a somewhat sluggish animal, enabling the creature to resist all attack by drawing in the head and limbs ; for the latter, being studded with bony lumps or nodules, effectually closed the two ends of the shell. The armadillos, and the extinct Glyptodon among the mammalia, it is to be noticed, have adopted a similar device. But the armadillos have no shell on the under surface of the body. They, however, have the great shield of the back hinged so that, the head and tail being armed, they can roll themselves up in a ball, and equally defy attack. The Glyptodon had no such shield, but here the upper case was immovable, as may be seen in the skeleton of this old-time giant in the Fossil Gallery.

Some of the tortoises, however, differ from their fellows, and approach the armadillos, in having a hinged shell which effectually closed the only exposed portions of the body—the head and limbs.

There are yet other features in the history of this strange group which should be noticed. In the typical tortoises, which are land-dwellers, the feet are like those of the elephant, and especially the hind feet. Some tortoises, however, have become aquatic in their habits, and show a series of gradation from walking limbs to swimming feet or paddles, as may be seen by comparing, say, the Grecian tortoise with one of the soft tortoises (*Trionyx*) in Case 9. And from this we pass to the fully-developed paddle seen in the marine turtles.

Of the curious colours which some of the tortoise

tribe present, much could be said; but space forbids. Let it suffice to point out the most remarkable of all, which is furnished by the Matamata tortoise in Case 8, No. 185. The shell of this creature is raised into a series of conical bosses, and these, when covered with confervæ—for it lives at the bottom of streams—gives the whole a wonderful likeness to a piece of a tree trunk. Then, it will be remarked, the head and neck are adorned with loose tags of skin, which wave about in the water and attract small fishes, who perceive therein something good to eat. As they approach nearer and nearer the head, a long, pink, worm-like tongue is thrust out, and wriggled about. This bait proves irresistible—the victims rush to seize the juicy morsel, when the huge mouth is suddenly opened and they are engulfed!

Among these tortoises some are of gigantic size, and have the shell of exceeding thinness, and very open in front, so that it could not possibly be closed. Now all these giants came from islands where there were no enemies, and consequently there was no need to keep to the traditional shape of the shell.

Though less modified than the tortoise tribe, the snakes yet present some remarkably interesting facts in regard to their shape and structure. To begin with, the long, lithe, sinuous body was once lizard-like, and borne upon four legs, as we shall show presently. But by degrees it grew longer, by adding to the number of the vertebræ—the series of bony bodies which make up the backbone. And

as the body grew longer the legs grew shorter, and finally vanished, so that the snake to-day is reduced to walking on its ribs! This it contrives to do by means of a curious mechanism; each pair of ribs is attached above to a vertebra, and below to the edge of one of the horny plates that run across the body from just behind the head to the base of the tail. Thus, as the ribs move forwards the horny plate is set somewhat on edge, and this edge grips the surface of the ground, so that as the ribs are pulled backwards the body is thrust forward—hence that weird, gliding motion, which we know as "snake-like." That these creatures did possess legs we know from the fact that vestiges, at least of the hind-limbs, are to be met with in some snakes to-day. In Case 14 in this room, you will find a part of the flattened skin of an African python, showing a pair of large claws, the last remaining external traces of the once useful hind-legs, and near this is a tablet containing the complete bones of the hind limb of a boa constrictor—an American species—showing even more convincing proof of this, for here a part of the hip-girdle remains, and attached to this is the femur, or thigh bone, ending in a claw, which is all that remains of the shank of the leg and foot.

Snakes are all carnivorous; the large kind kill their prey by constriction—that is to say, by throwing themselves, as it were, upon their victim, and enveloping it between the coils of the body, when death speedily results, so powerful is the crushing power of this terrible embrace. Small deer, for

example, are in this way broken up till they assume a sausage-like form, when the work of swallowing begins. Now this is done in a very curious way. In the first place the jaws are not immovably fixed to the skull as in other animals, but suspended by very elastic ligaments, while the lower jaw is divided at the chin, the two halves being held together by similar elastic tissue. Further, the ribs not being fixed to a bony jointed rod, or sternum, as in their cousins the lizards, for example, the trunk, as well as the head, can be stretched to an enormous extent; and thus it is that the snake is able to swallow larger morsels in proportion to its size than any other living animal. This is not all, however, for the work of swallowing is carried on after a unique fashion. Briefly, the upper jaws of the right and left side of the head can each be moved separately, and the teeth which they bear, sharp as needles, are curved, and point backwards, towards the throat. As the work of swallowing begins, then, the jaw of one side is thrust forward, like a rod armed with hooks, and takes the first grip, when it starts to pull; then the jaw of the other side is thrust forwards, catches hold, and pulls back, and so the work goes on, so that the creature's food is actually pulled into its mouth, and drawn backwards down its throat! The teeth, pointing backwards, offer no resistance, while they render it impossible for any return! Thus two accidents at the gardens of the Zoological Society of London are explained. In one of these the creature made a grab at its blanket and had to swallow it;

in another two snakes seized the same pigeon, and as a consequence, when the larger had swallowed all the exposed portion of the bird, he had to continue until he had swallowed his fellow-captive into the bargain!

So far we have been discussing non-poisonous snakes. The poisonous species are everywhere and justly dreaded, for in many the bite means speedy death. These snakes never reach the huge size of some, say the python or the boa, which may measure as much as thirty feet in length. Nor do they kill their prey after the same fashion, but, inflicting a bite, leave the victim to die and then proceed to swallow it. The poisonous snakes have but few and small teeth, except the poisonous fangs, which are of large size. At their base lies a bag of poison; and the fangs, which, when not in use, lie folded back, out of harm's way, are so fashioned that they are thrust forward on opening the mouth. As soon as they strike their prey the poison from the bag runs down the tooth, which is hollow, or deeply grooved, and so finds entrance into the wound.

But the most remarkable teeth of all are those of the African egg-eating snake (Dasypeltis). This animal has no teeth in the jaws, but certain of the vertebræ over the region of the middle of the gullet have developed curious spines which pierce the walls of this tube—the foodpipe. The reason for this singular contrivance is plain. Eggs are easily broken if touched by hard and pointed bodies, such as form the teeth of typical snakes, and since

the snake has no lips, an egg, taken into a mouth bristling with teeth, would soon break, and the contents would be lost. But with this snake they can readily be seized by the jaws, passed into the mouth, and swallowed. When they reach the region of the gullet underlying the teeth the animal gives its body a sudden jerk. This breaks the shell, allowing the contents to escape and pass down to the stomach, while the shell is presently squeezed up, and forced back out of the mouth. In Case 14 specimens and drawings of this wonderful snake will be seen.

Snakes, like other animals, undergo certain changes of form in accordance with their environment. Thus some species have become burrowers, and in these the head is hardly to be distinguished from the tail, while the scales of the body are very degenerate, as may be seen by the specimens shown here. Some have adopted a wholly aquatic existence, and these may at once be distinguished by the compressed, eel-like form of the tail.

The coloration of snakes is a theme, did space permit, on which much could be written; but this, like many other aspects in the life of these curiously fascinating creatures, must be omitted from these pages.

Let us pass now to the lizards. These, it might be supposed, could at all times be readily distinguished from the snakes, but as we shall presently show, this is not the case. But the hall-marks, so to speak, of the lizards are easily recognised. All lizards have a small hole behind the eye—this is

the entrance to the ear. All lizards have movable eyelids; snakes have none, but the eye is protected instead by a horny case like a watchglass. Most lizards run upon four legs, some with exceeding swiftness; but some are limbless, of which more anon.

In Case 18 will be found the first of the series of lizards—these are the geckos, a name obtained from the peculiar cry of the Turkish species, "Geck-ko!" —a cry more noteworthy because most of the reptiles, unlike the frogs and toads, are dumb. But the geckos are remarkable especially on account of the curious suckers on the under surface of the toes, which enable these creatures to crawl up the faces of rocks and walls, and what is more, to run along the ceiling of a room with the same ease as a fly. But this does not complete the tale of the gecko's peculiarities, for some species, in their colour, present a most remarkable likeness to the bark of the trees on which they rest till the shades of night call them forth to feed. In one species in this case, the fringed gecko (No. 359), there runs down each side of the body, limbs, and tail, a fold of skin with a scalloped edge. This, when the creature is at rest, is pressed closely to the bark of the tree, and being, like the body, coloured so as to harmonise with the bark, detection by prowling enemies is next to impossible. In some respects the fimbriated gecko or lichen-bark gecko (No. 365) is even more marvellous in the matter of its hues. This creature haunts the trunks of lichen-covered trees, and it will be noticed the coloration of the

body is so cunningly mottled and blotched with lichen grey and black as to be hardly visible, even at close quarters; and the deception is carried still further by the ragged fringe of skin along the body, and the lobes along the tail, for these, being pressed close to the bark, completely obscure the outline of the animal, so that, even within a foot, it is practically invisible when alive. The pupil of

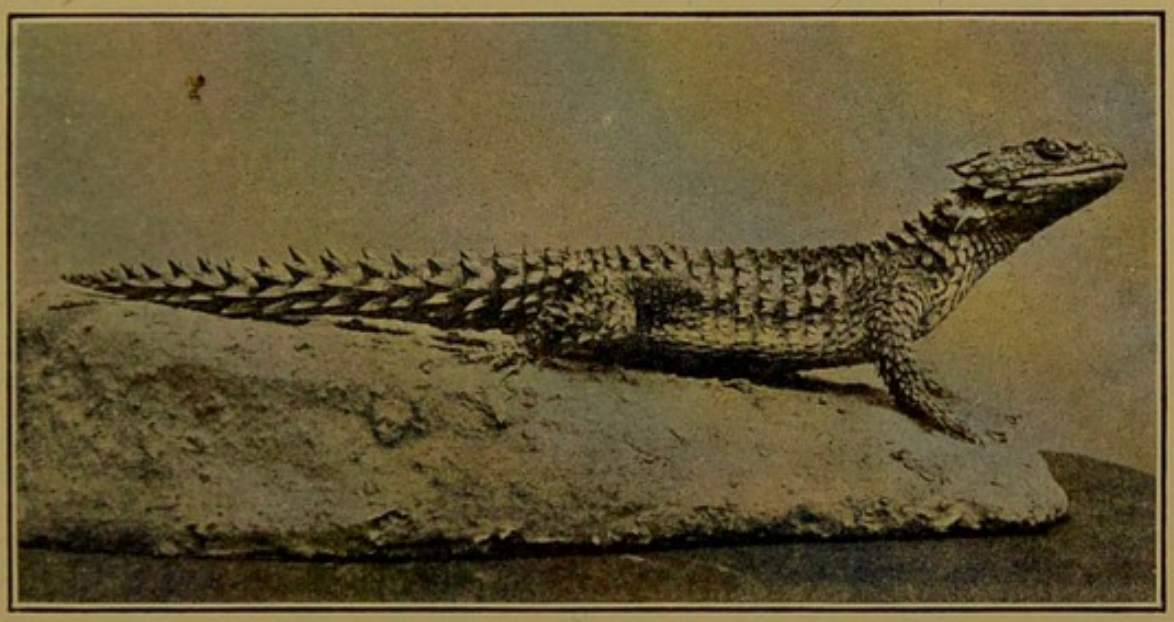


FIG. 30.—Zonure Lizard.

the eye, it will be noted, is a mere slit, surrounded by a disc of gold relieved by irregular, crescent-shaped lines of red. But when night falls this pupil is tremendously enlarged, and assumes a round shape, so as to admit as much light as possible, for with the darkness activity begins. Coloration of this kind is known as "protective," and is assumed by many helpless types of animals of all kinds, since it enables them to escape the notice of prowling enemies.

This strange creature, a native of Madagascar, is much dreaded by the natives, who call it by a name which means "the beast that leaps at the chest," and they believe that if any one approaches the tree on which it is resting it will leap out on to his chest, and cling there so firmly that it can only be removed by shaving away the skin!

That this coloration does serve as a mantle of invisibility is further supported by the fact that, as may be seen here, there are certain geckos which are active by day instead of by night; and these are green, and ornamented with red spots, while the eye is small and also red. These colours harmonise perfectly with the green foliage amid which the creature moves, and similarly, these are protective. The peculiarities of the geckos are what are known as "adaptations" to a life in trees. And a yet more remarkable adaptation of this kind is seen in the "flying dragon" just at hand (No. 366). This creature is a parachutist, being enabled to take flying leaps through the air by means of a fold of skin running along on each side of the body, and expanded, when in use, by means of long, slender, bony rods, which are nothing less than the *ribs* enormously developed! Thus the snakes, as we have shown, use the ribs as legs, the flying dragon as wings!

It was pointed out that the snakes were, once upon a time, four-legged animals, and that as these legs dwindled, so the body lengthened, the hind-legs being the last to vanish. We come now to a precisely similar instance among the lizards. This

is afforded by a small number of species known as the scale-footed lizards. Herein the fore-limbs have been suppressed, while the hind-limbs are reduced to a pair of scale-like flaps (Nos. 385–86). The body, it will be noticed, is snake-like. The same peculiarity of structure turns up again among certain other lizards known as skinks; and at

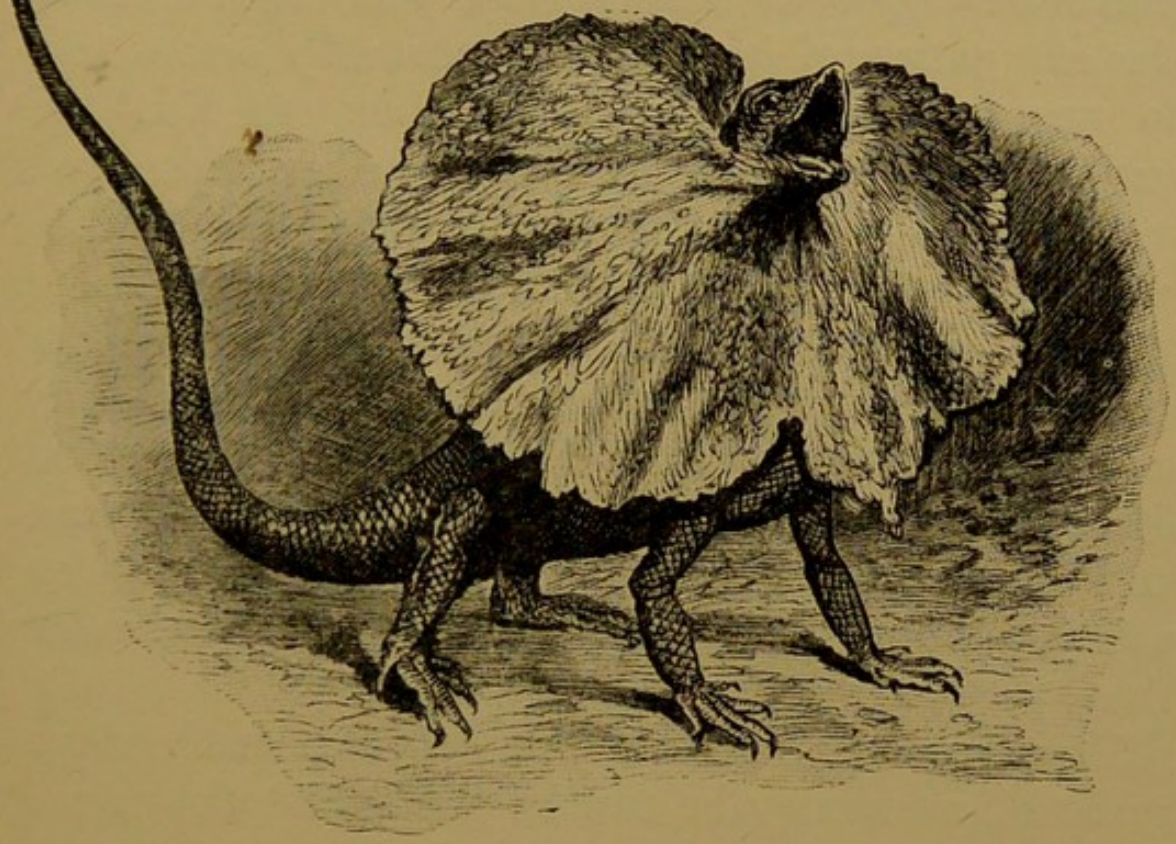


FIG. 31.—The Australian Frilled Lizard.

the other end of this room (Case 20) there will be found a number of species wherein every stage in this diminishing process can be traced, beginning with a leg ending in a five-toed foot, and ending with a mere stump not much larger than a pin's head! But in our British "slow-worm" (No. 429) this process of reduction has gone even further, so that not a vestige remains, externally, of the limbs at all.

Some remarkable examples have been given of protective coloration : if we return now to Case 18, we shall find another device whereby protection from enemies is secured. This is furnished by the odd-looking Australian frilled lizard (No. 379, Fig. 31). This animal, when threatened, rears itself upon its hind limbs, and opening its mouth, expands at the same time a huge frill, stretched by the elongation of bones which normally serve only to support the tongue. Thus they act like the excessively developed ribs of the flying dragon : but this by the way. The opening of the mouth, which is brilliantly coloured, and the erection of the frill, which is done with great suddenness, has a terrifying effect upon creatures bent upon making a meal. But should this " bluff " fail of its purpose the creature promptly closes both mouth and frill, and raising itself upon its hind-legs, bolts for safety. The stuffed specimens here exhibited show these phases.

How varied in form, size, and coloration the more typical lizards may be can be gathered by a glance at the numerous species here exhibited. But a longer pause must be made at the ugly, red-black creature, the heloderm, or gila monster of New Mexico and Arizona (No. 424). For this animal, happily nocturnal in its habits, represents the only known poisonous lizard, its jaws being armed with poison fangs like those of the snakes. It feeds on frogs, centipedes, and iguanas' eggs. Here, too, we have an illustration of a type of coloration known as " warning coloration." Warning colours are always

conspicuous—black and red, and black and yellow—and serve, as their name implies, to warn other animals that to attack is dangerous. Thereby the creature so coloured is saved the risk of attack and death, for predatory animals soon learn to know the meaning of these colours—often by painful experience.

Passing the curious skinks, to which reference has already been made, we come to the weird-looking chameleons. These, like the geckos, are built, so to speak, for a life in trees : but while the geckos are equally at home crawling up the flat faces of rocks, the chameleons have become so completely modified for a life amid the branches of trees and shrubs that they cannot get on without them. These strange reptiles have undergone a very remarkable transformation. Look at the feet, for instance, and compare them with those of the typical lizard. The contrast will prove most striking: for the toes in the chameleon are very short, and arranged in two groups opposed to one another in such a way as to form a most perfect grasping organ. Then the tail is prehensile—it can be used as a fifth limb, since it can be twisted round a branch like the tail of the sea-horse among the fishes, and the spider monkey among the mammalia. The eyes are no less singular. Unlike those of any other living creature, each eye is enclosed in a tightly fitting envelope of skin, and can be moved independently of its fellow, so that one can be looking forward and one backward at the same time. Lastly, but not leastly, mention must be

made of the tongue. This is thick and fleshy, and is used as an instrument for the capture of insects, on which these creatures live. If one be watched as it is about to seize a victim, the mouth will be seen to be very slowly and deliberately opened, when, of a sudden, out flashes a long tongue, and the fly disappears. This feat is accomplished by means of a sticky saliva which covers the tongue, so that whatever touches it sticks and is drawn back into the mouth. The woodpeckers among the birds, and the ant-eaters among the mammals, have similar tongues. But it is on account of its wonderful power of changing colour that the chameleon has acquired fame. Every one knows that these animals have the power of altering their hue to suit that of their surroundings, though these changes are by no means so rapidly made as many suppose. The mechanism by which this is effected is not easy to describe. Briefly, it is done by means of particles of colour enclosed in little bags. Under the stimulus of light, these little bags can be flattened out to form discs; when the stimulus is removed the disc returns to its original globular shape. According to the strength of the light so the colour varies, because these little colour-bags are under the control of the nervous system. A shadow thrown across the body reduces the light in that area and reduces the stimulus on the nerves controlling the colour bags in that region: in consequence, the pull on the bags is reduced, and from discs they become globules, and thereby expose the darker background over which they are placed.

When the shadow passes, the return of the light causes the return of the bag to the disc shape and the consequent formation of a screen of colour drawn over the dark background.

As we remarked at the beginning of this chapter, the reptiles of to-day are a race of pigmies compared

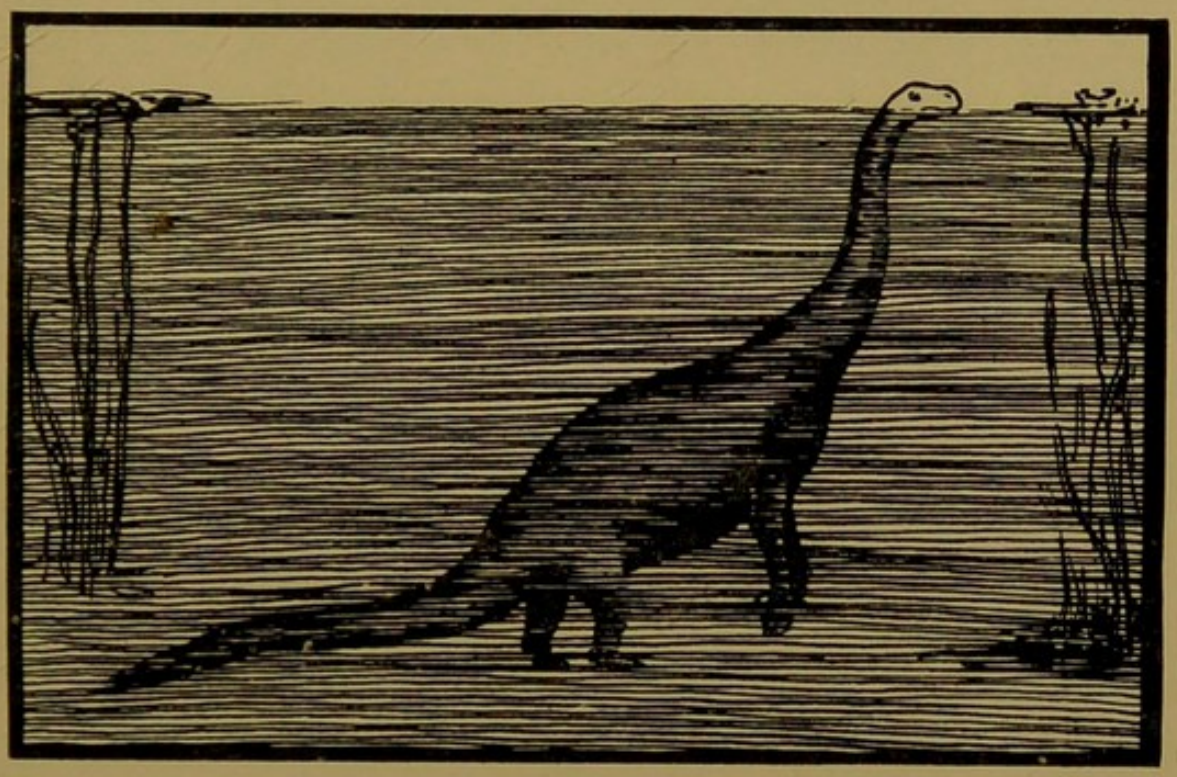


FIG. 32.—Cetiosaurus, an ancient British river dragon.

with some of those of ages ago : and nowhere is this fact more forcibly brought home than in this gallery. Of the giants here gathered together let us first examine that extraordinary creature the Diplodocus, which boasted a length of some eighty-four feet, and stood thirteen feet high over the region of the hips. It would seem, however, to have been at least half-aquatic in its habits, walking and swimming about in rivers after the fashion of the

hippopotamus of to-day. The peculiar position of the nostrils points to this. These, it will be seen, opened at the great cavity which lies, not at the tip of the snout, but above the eyes. This allowed the animal to remain submerged with only the top of the head above water. It was certainly herbivorous, and lived apparently on very succulent vegetation, as may be gathered from the long, rake-like teeth confined to the front of the jaws.

In the Iguanodon, near by, we have another giant, but one which walked upon its hind-legs. The fore-limbs had the digit answering to the thumb modified to form a huge spur, the use of which it is not easy to understand.

It is difficult to imagine animals of this colossal size roaming about over what is now Great Britain, but we know that this was so, for huge thigh-bones, which may be seen in the Fossil Reptile Gallery, have been found near Oxford and Peterborough, and these belonged to an animal related to the Diplodocus: while bones of Iguanodons have been dug up in many parts of England.

The huge three-horned dragon, Triceratops, opposite the Iguanodon, was a land-dweller. The enormous frill which stands out from the back of the head and overarches the neck served as a very effective piece of armour-plating against the attack of carnivorous reptile foes, and doubtless the skin was also studded with bony plates.

The Diplodocus (see Frontispiece) and the Cetiosaurus (Fig. 32), to be seen in the Reptile Gallery,

throve during what is known as the Jurassic era, the one roaming over land where now stands the flourishing state of Wyoming, U.S.A., the other, Cetiosaurus, over the vast marsh lands which formed a part of a great continent out of which Great Britain was later

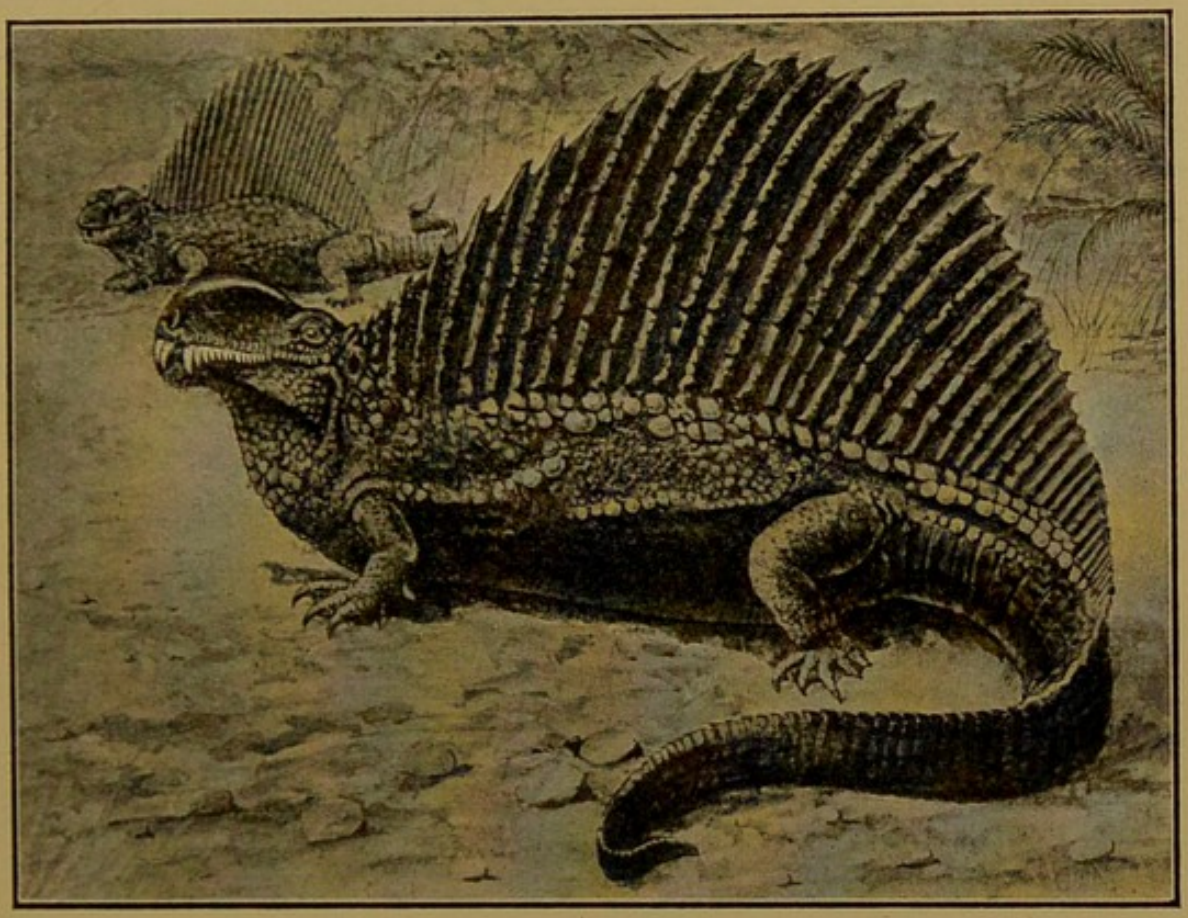


FIG. 33.—The Dimetrodon, an ancient reptile.

on destined to be carved. The Iguanodon and the fearsome Triceratops flourished also during this period, a time so remote as to be beyond expression in terms of years. A dim idea thereof may be formed perhaps by means of the Geological Time Scale to be found on page 265. Each of the periods here recorded represent, probably, millions of years; and the period during which these giants flourished

was near the middle of the Mesozoic or "Secondary" era of the earth's history.

Another interesting creature was the Dimetrodon, a reptile whose nearest relative now living is the tuatera lizard of New Zealand. The spines of the backbone were produced into long rods—as long as the body—supporting a web of skin, and forming a kind of fin, or sail.

CHAPTER VIII

THE FISH GALLERY

"Master, I marvel how the fishes live in the sea."
"Why—as men do a-land—the great ones eat up the little ones."

THE sea holds many jealously guarded mysteries, both of life and of death: it is a world in itself, which we can never explore except at random, groping blindly. It is Nature's strong-room, which man can never despoil and disfigure as he disfigures and despoils the land. All that she permits him to do is to obtain samples, as it were, of her living treasures—samples which must add not a little to our wonderment at her rule, for the denizens of the deep and the dwellers on the dry land are ruled by the same laws.

We see, indeed, in the fishes, evidence of that same "adaptation to environment" which meets us at every turn in studying the creatures by which we of the upper regions, of the dry land, are surrounded.

Take, for example, the matter of shape. The shape of the fish is decided no less by its environment, the medium in which it lives, than is that of the bird or the beast. Being borne up by the

water, the body has no need of support from limbs. What answer to the limbs of land animals in the fish take the form of fins, which serve not, as is generally supposed, to propel the body, but to balance it; and, as additional aids, the limbs are supplemented by more or fewer fins of variable size and shape, which run down the middle of the back and under surface of the tail, and form the termination of the tail itself. Movement is caused by means of rapid side-to-side movements of the whole body, and especially of the tail and the tail fin. The shape of the body bears a close relation to its method of progression. In swiftly moving fishes, such as the mackerel and the salmon, for example, it is roughly spindle-shaped—conical in front, deepest in the middle, and slightly compressed from side to side, tapering to much more slender proportions at the tail, which ends in a vertically placed fin. Finally, the whole body is cased in an armour of scales, closely fitting, and coated with a layer of mucus or slime, so as to offer the least possible resistance to movement through the water. This is the typical fish, our standard of comparison, by which we may measure the peculiarities of structure of those fishes which, for one reason or another, have departed from this standard.

But besides the matter of shape, there is another aspect of fish-life which should be kept in mind by those who desire to glean from the treasures in this gallery, and this concerns the external covering. The earliest, most primitive types of fishes, the

first to make their appearance in the primeval seas, were those of the shark tribe. These differ—like the modern sharks, their descendants—from fishes such as mackerel and salmon, in that they have a much simpler kind of skeleton, made up, for the most part, of gristle, instead of bone, while the gill openings took, and still take, the form of a number of slits on each side of the head, instead of a single slit as in, say, a salmon. Finally, the skin was covered, as in the sharks of to-day, with closely set, bony, enamel-covered nodules or buttons, instead of horny scales, and these nodules, when they reached the jaws, became transformed into teeth. In this gallery there is displayed a wonderful collection of modern sharks, some being placed in the Wall-cases (1–4), others suspended from the roof of the gallery. Even a cursory glance will show that in the matter of shape these sharks and their kind present a wonderful variety. Of the more typical kind, the obvious sharks, nothing need be said here, save that by the term "shark" the smaller kinds, known generally as "dog-fishes," are also included, and that in these, as everybody knows, the mouth lies on the under surface of the head. The sharks of this type are all "clipper-built"—that is to say, fashioned for a strenuous life, the chase of swiftly moving prey. But certain of the shark tribe seem to have contracted a sluggish habit, discovering, perhaps, that plenty of food could be found on the bottom of the sea, at the cost of little or no trouble, and accordingly this

easily obtained food-supply soon became the normal prey. As a sequel to this we find the body assuming a flattened form, and the fins increasing in size, as, for example, in the angel-fish (Case 3). From this, by a perfectly gradual series of changes, we come speedily to the rays or skates, of which more presently.

Let us take a rapid survey of the shark tribe in Cases 1–4, halting first to glance at that remarkable creature the frilled-shark or chlamydoselache, which, on its first discovery off the coast of Japan in 1884, created quite a stir in scientific circles, because, in many respects, it is one of the most primitive of living sharks—as is shown by the unshark-like position of the mouth, the form of the teeth, the "frills" which protect the gill openings, and the tapering form of the tail. This is, so to speak, the ground-type, the model on which all the sharks have been built, some exaggerating one character, some another. In some, for instance, the snout has grown forwards so as to overhang the mouth; in most, the tail has acquired a quite different form, and in all, save this, the fringes over the gill openings have been discarded. The Port Jackson shark just underneath is another interesting specimen, also of a primitive character. Perhaps the most remarkable feature of this fish is to be found in its teeth, which present a wonderful series of gradation from pointed to cushion-like and beautifully sculptured crushing teeth. The spotted dog-fishes follow, ground-feeders, living mostly

on crustacea and shellfish, and never straying very far from the coast. The eggs of these fishes have a curious pillow-like shape, provided at each corner with tendrils which anchor the egg to weeds, and here, safely stowed away, they remain some six months before the young fish emerges. A specimen of such an egg is shown at the left hand of this case.

The very name of shark always calls up dreadful stories of the perils of those who go down to the sea in ships, and certainly in many parts of the world sharks add a very real terror to those who have to encounter the horrors of shipwreck. One of these formidable creatures, the great blue shark or man-eater, may be seen on Table 25 at the other end of this gallery, and the jaws of a much larger specimen in Wall-case 1. The great blue shark grows to a length of forty feet, but this was a pygmy to some of the fossil sharks, as may be judged from the huge size of the teeth, specimens of which are exhibited here for comparison with those of the great blue shark. The common blue shark, though lacking the imposing size of his larger relative, is yet a source of grave danger to persons bathing in the tropics, and specimens of this and nearly related species will be found in Case 2, Nos. 57–61. In parts of India and China the fins of these fish are used for making soup.

The great blue shark, a native of the Indian and Pacific Oceans, is, however, in point of size surpassed by the whale shark, the largest living creature of its kind, attaining a length of fifty or sixty

feet. Yet in disposition it is to be reckoned among the mildest of fishes, since it feeds on the minute semi-transparent crustacea and molluscs that abound at the surface of the sea, varied by a little seaweed: hence, then, the small size and peculiar arrangement of the teeth. The specimen suspended from the roof of this gallery is only half-grown.

Mention has already been made of the various differences of shape in sharks, and here is a fitting place to draw attention to some of the more extraordinary examples. The thresher and elfin sharks are striking instances. The former, hanging from the rail opposite Case 2, is unique among sharks in the great length of the upper lobe of the tail, while the latter, hanging from the rail opposite Case 19, also enjoys the distinction of being unique in another way—in the extraordinary fashion in which the snout is separated from the jaws: an outline drawing in Case 1 further helps to make this clear. This curious fish was only comparatively recently discovered in the deep seas off Japan. The elfin shark, however, is commonplace compared with that extraordinary creature the hammer-head shark, which might well be called the goblin shark. The specimen on the floor of Wall-case 2, and the larger one that hangs from the rail opposite Case 16 will show at a glance the reason it is called hammer-head. But who would suspect that what answer to the striking faces of the hammer are the receptacles for the eyes? Yet such is the case.

In this matter of shape, of the transformation of the body in relation to the mode of life, the skates or rays in Case 3 are a very striking object-lesson. For these fishes may be regarded as flattened-out sharks, and various stages in this flattening-out can be seen here. Herein, the front fins have assumed a huge size, and the whole body has become depressed, so that both mouth and gills are under the body. This curious form has been gradually assumed as these creatures became more and more committed to seeking their food on the floor of the sea. Now mark the further change which this prone position has demanded in the matter of breathing. The gills, we have remarked, are underneath, next the sea-bottom while the creature is at rest, thence the escape of water in breathing would be difficult. In consequence, this stream is driven out through two holes on the top of the head. These holes, known as the "spiracles" or breathing-pores, are also present in sharks, but are extremely small. In the skates, however, as these specimens show, they are quite large, so as to admit of a stream of water passing into the gills, and being expelled again when fouled by the gases from the blood, a device of the highest importance when the creature is lying flat upon the ground in wait for prey, when, from its colour, it is invisible. Thus its victims approach to within striking distance before suspecting danger. Then, rising quietly, it flaps along ghoul-like, till it is hovering over the victim marked down, when

suddenly, with a flop, the unsuspecting crab or fish finds itself underneath the monster's all-embracing wings. In a few moments, by a shuffling movement difficult to describe, the captive is passed forward to the relentless jaws.

In surveying these creatures the varied shapes which they present will become speedily apparent, the strangest development of all being that of the saw-fish, wherein the snout has been produced into a long blade, armed on either side with a formidable array of "teeth" so as to resemble a double-edged saw. This seems to be used as a deadly weapon of offence in securing its prey. The "saw," which in large specimens may be as much as a foot broad at its base, and six feet long, is used for ripping open its enemies, or such other creature as it may attack for the purpose of feeding on its remains. This fish, as the long, slender shape of the body shows, is not a ground-feeder like its more modified relatives, but swims freely. In addition to the small specimen in Wall-case 3, a much larger one will be found suspended from the ceiling opposite Wall-case 5, and another opposite Case 2.

Two other types of skates demand special mention here on account of the peculiar changes they have undergone. The first of these are the eagle-rays and sting-rays, wherein the tail serves rather as a weapon than a rudder. Drawn out into a long, whip-like form, it bears long and powerful and most poisonous spines, wherewith serious injuries can be inflicted on whatever creature comes within its

range. Some of the eagle-rays or devil-fishes attain a huge size, measuring some fifteen feet across, and weighing over one thousand pounds. A specimen nine feet across is suspended from the roof near Case 6.

The second type here referred to is that of the torpedo (Case 4), a fish which is occasionally found off our coasts. It is remarkable for the fact that it is armed with powerful electric batteries, lodged near the head, and capable of giving a discharge sufficient to disable a man. Shocks from this singular weapon are used by the fish to disable its prey, so that it can be speedily devoured.

Finally, a word as to teeth. Attention has already been called to the teeth of the sharks, and special mention was made of the remarkable character of the teeth in the Port Jackson shark. Now look for a moment at the strange pavement-like teeth of some of the skates, or rays as they are often called, displayed on the floor of this case. These, when compared with those of the shark just above, bring before us, vividly, how structures so hard and apparently unchangeable as teeth can be modified to suit different purposes. The sharks are agile creatures which feed upon swiftly moving prey; many of the rays, however, have adopted a diet of shellfish and crustacea, and food of this kind requires to be crushed before being swallowed: hence the jaws have taken the form of living mill-stones. In some of the ray tribe, however, the teeth differ according to the sex, as, for example, in

the thornback skate of our seas. Herein the teeth of the male differ from those of the female. Is this due to the fact that they each adopt a different diet? So far the question remains without an answer.

I want to pass now to talk of fishes of a very different order, fishes which in some respects approach the air-breathing or land-dwelling vertebrates, inasmuch as they breathe air by means of lungs. All other fishes, you must know, breathe, or bring the life-giving oxygen to the blood, by means of currents of pure water taken in at the mouth and expelled through slits or openings in the sides of the fore-part of the gullet. As it passes through, the fresh water bathes a system of fringes bearing very delicate blood-vessels, vessels with walls so thin that the blood readily draws out the oxygen held in suspension in the water as the stream bathes them. But these lung-fishes live in sluggish streams and swamps where the water is often foul and contains but little oxygen: so that they are compelled to come frequently to the surface and take in air from the world above. The "lungs," it should be mentioned, have been formed by increasing the blood-supply to the air-bladder, thereby converting it into what answers to the lung of, say, the frog, or any other land-dwelling animal, including man himself.

Lung-fishes are no new invention of Nature; they made their first appearance very early in the world's history, and models of these ancient mud-

dwellers are shown in Case 6. To-day they are represented by the ceratodus of Australia, the lepidosiren of South America, and the protopterus of Africa, and of these the most remarkable are the mud-fishes of Africa, because they periodically "æstivate," or fall into a state of torpor to escape the long periods of drought which occur in tropical Africa during many months of the year. Then the streams gradually dwindle, and finally vanish, leaving the river-beds to be parched by the sun. Warned by the diminishing water, the protopterus dives down into the mud, and curls himself up to sleep, turning his tail up over the head to keep in as much moisture as possible. In a very short space of time this mud is baked as hard as a brick, but the sleeping fish knows nothing of it. In due course the rains come, and the floods descend, and the hard earth becomes mud once more, and this is soon covered by a raging torrent; then, and not till then, the protopterus wriggles out of his narrow bed and starts feeding, often after having spent many months in the grave. Specimens coiled up in their mud-beds are exhibited here. Though shrivelled, they yet show us what the nature of this retreat is like. This summer sleep is adopted by many creatures other than fishes, as a means of escape from the droughts, and therein they behave exactly as do animals in cold countries when they "hibernate" to avoid the winter hardships. In both cases escape is sought, not so much from extremes of temperature as from starvation, for with

the drying-up of the streams in tropical, and the descent of snow in cold countries, the life-pulse of the world slows down; so that plants cease to yield their fruits, and myriads of the smaller forms of animal life, on which larger animals often depend for their support, disappear. This period of torpor becomes a necessity to fishes which live in streams that disappear during drought, for otherwise they must surely die, and to many fishes which live in streams subject to the icy grip of winter. These, such as carp and tench, seek salvation by burrowing deep down into the mud, and there, in a dreamless sleep, they rest till awakened by the melting of the ice.

I want now to return for a moment to the subject of fish scales. These, it may be remembered, in the shark tribe present their most primitive form, since they take the shape of bony nodules bearing an enamelled spine. As a rule these nodules are extremely small and packed closely together, forming a kind of mosaic. Time was when the skin of these fishes was highly valued by carpenters and other workers in wood, for, known as "shagreen," it was used as sandpaper is nowadays. We are now to examine a number of fishes, living and extinct, wherein this mosaic of bony scales takes the form of a series of symmetrically arranged plates, almost square in shape, and having the enamel spread evenly over the surface, instead of being raised into spines: or as in the sturgeon, where the scales present two forms, some minute, others

large, and more or less conical in shape, and distributed in rows along the back and sides. Some striking examples of fishes so armoured will be found in Case 6. For the most part these fishes are extinct. Long ages ago such armour was

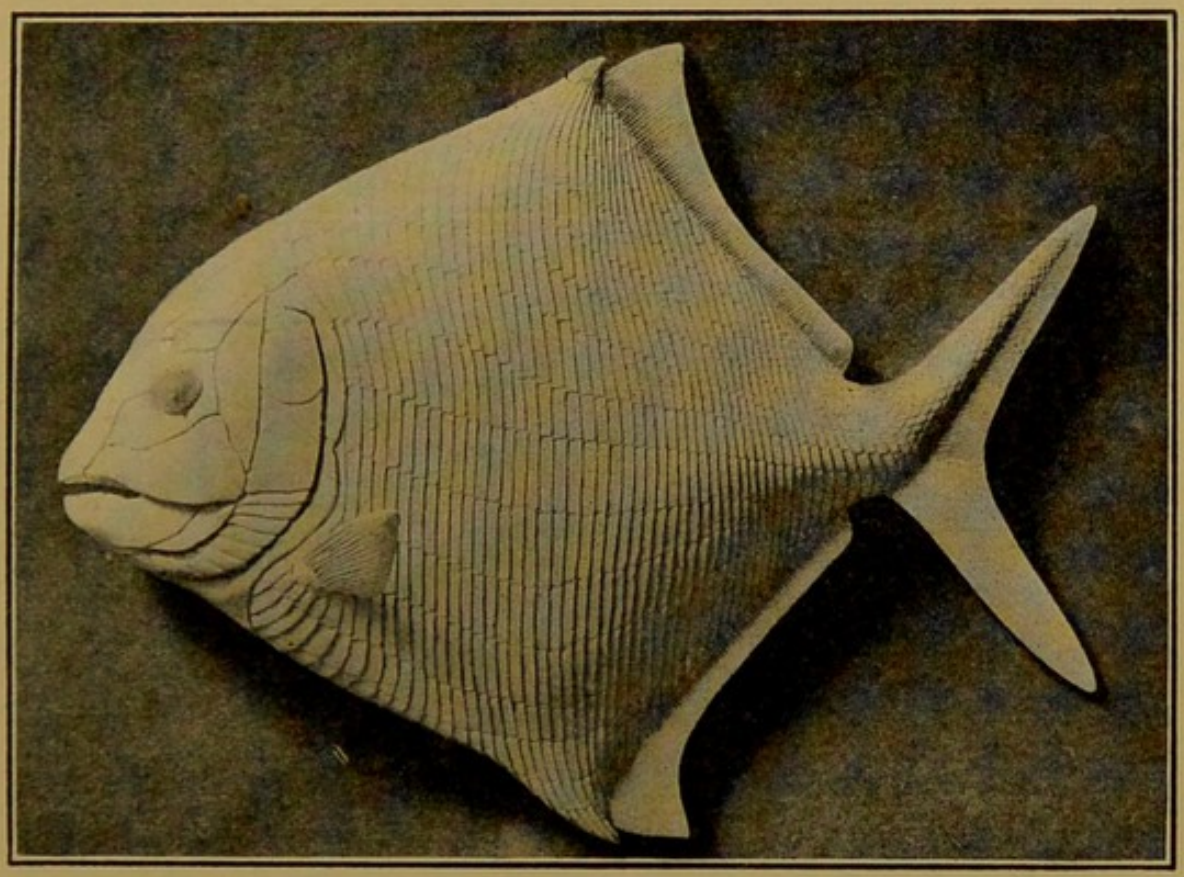


FIG. 34.—A fossil fish from the North of England.

commonly worn just as it was centuries ago by soldiers; to-day, among fishes, only a few of these old-fashioned types survive, while in human society armour has long since been discarded. Of these survivors special mention may be made of the curious polypterus or bichir of the Nile, and of the gar-pikes of the fresh waters of North America. Some casts of fossil forms are also shown here and

in the table-case a little to the left, wherein this remarkable coat of mail is admirably shown. One of these, *Cheirodus granulosis*, is selected for illustration here (Fig. 34). What need could these creatures have had for such strong coats? What purpose do they serve in the survivors of to-day? What advantage do they gain in the struggle for existence with the hosts of other unprotected species among which they now live? These are questions easily asked, but so far they seem to defy solution. The sad-looking sturgeons show many varieties of form and armour. Compare, for instance, the common sturgeon with the naked sword-bill and spoon-bill sturgeons. All show a marked preference for muddy water, and feed upon worms, small fishes, and crustacea, which are obtained by "rooting" more or less pig fashion in the mud at the bottom of the water, and this prey seems to be captured by a sucking action of the mouth, the rim of which can be thrust downwards like the end of a hose, immediately above the victim to be seized. Though many species are found only in fresh water, some, like the salmon, are sea dwellers, but ascend the rivers to spawn, journeying up in vast hordes.

The sturgeons are fishes of great economic importance, for the flesh, though rich and fat, is highly esteemed, while the unshed ova finds its way into the market in the form of "caviare" and the air bladder as isinglass. The collection of this unshed spawn and its conversion into caviare forms an important industry, during the summer months,

near the mouths of many of the great rivers of Eastern Europe. At Rubinsk on the Volga people gather in their thousands in the late spring to await the advent of the fish. As soon as notice is given, by a look-out man, of the arrival of the shoal, the waiting crowd begins the attack with nets and spears. The ovaries, or egg-receptacles, are removed, washed with vinegar, and spread upon boards in the open air. Salt is next rubbed in, and the caviare is then packed in kegs for the market. Various forms of isinglass are shown in this case, from the rough state to the most highly finished preparations.

The great Russian sturgeon which furnishes so much of the caviare and isinglass of commerce is unfortunately not yet represented in the Museum. It is a huge fish, attaining a weight of nearly three tons.

The fishes so far passed in review have all retained more or less striking evidence of their relationship to types of humbler origin. But we come now to that great group known as the "modern" bony fishes, to which the great majority of living fishes, fresh-water and marine, belong. Into the anatomical characters which distinguish them from those which we have so far examined we need not enter here; suffice it to say that these relate mostly to the structure of the fins and the character of the scales, which, when present, take the form of horny discs, overlapping one another and coated with slime. But this scaly covering is,

as we have hinted, by no means universal, and we shall have occasion to refer to some striking examples of this fact.

By way of an introduction to this group let us take an example from two of the most familiar types—the salmon and the herring.

The first-named reminds us that there are fish which can live equally well either in fresh or salt water; for while the salmon enters on life in some clear stream as far from the sea as may be, after a short sojourn it becomes seized with a desire for salt water, and begins thenceforth a long and perilous journey seawards, perilous because every inch of the way is beset by enemies, and among these are the adult members of its own kind. Those that eventually reach the haven of safety in the sea speedily grow under the stimulus of the unlimited and nourishing store of food to be obtained there. In due course the desire to return to its birthplace becomes as strong as the longing to leave had been, and this desire is at length fulfilled, though not without encountering grave difficulties and many dangers. The ascent completed, the eggs are laid, and then the return to the sea again becomes necessary. During the whole of this sojourn in fresh water no food is taken, but with the journey back the appetite slowly returns, and to satisfy this not a few of the young fish making their first journey seawards are ruthlessly devoured. The salmon of our seas is a long-lived fish, and makes many such journeys. But certain American

species have a much less tenacious hold on life. They return to the rivers of their birth but once, and return in vast hosts, in such myriads that the rivers are choked with their numbers, thousands dying by the way in consequence. Of the remnant that reach the head waters and succeed in laying eggs not one returns. Having paid their debt to Nature they die. Some members of the salmon tribe, however, have become "land-locked." Such are the lake trout, near relatives of the salmon, which, long since, became cut off from the sea, and have contrived to thrive permanently in fresh water. The vendace, gwyniad, and pollan—the first-named of the Lake District, the second of Lake Bala in Wales, and the last of the lakes of Ireland—are also land-locked relatives of the salmon, and specimens of these will be found in the British Saloon at the end of the long Bird Gallery.

That some fishes should be able to pass from salt to fresh water and from fresh to salt, while others are speedily killed by such a change, is a curious fact which so far has not been explained.

Of the marvellous feats of leaping which the salmon is called on to perform in its ascent of the rivers, of the fierce fights which ensue between rival males when the journey's end is reached, of the strange fasting periods of this fish, of the many enemies with which they have to contend during this ascent, and of the interesting phases of growth and colour-change which young salmon present, we can say nothing here, for we are concerned rather

with the broad general outlines of the history of fishes as represented in this gallery than with the life-histories of particular species. But there is one other fish which, on account of its strange life-history, nothing would justify us in omitting here —and this is the eel. Commonplace as the eel is generally thought, yet until a year or so ago no man knew whence young eels came. To supply this mystery the most extraordinary tales passed current for fact. But the true story of the eel can soon be told, and this fact takes nothing from its strangeness.

Briefly, the story is as follows. The eel, having reached maturity, becomes possessed by some strange call seaward, and with all speed, whenever escape is possible, makes its way down-stream and finally gains the open sea. But the journey does not end till the profoundest depths have been reached. There, in utter darkness, the eggs are laid, and then comes the reaper Death. In due course the young eels, orphaned before they were born, make their appearance, but in a guise as unlike the parent eels as could well be imagined. As if to harmonise with their gloomy surroundings, they assume ghostly forms, being transparent as glass: even their very blood is as colourless as water. As yet the breast-fins are wanting, as also are those representing the hind-limbs, while in the matter of shape they almost seem to have been passed beneath a roller. At the time they leave the egg, it must be remembered, these poor frail things

are immersed at a depth so great that an ordinary glass bottle lowered down to such a level, if empty, would be crushed to powder by the pressure on its outer surface, as has been proved by experiment. The light of the sun can never reach them. Slowly, however, they rise nearer and nearer to the surface, and nearer and nearer to the light of day, waxing in size and strength as they rise. But soon a strange change takes place—they cease to grow. More than this, they actually begin to decrease in size daily, becoming at the same time rounder. Meanwhile they have acquired red blood, and the skin has begun to darken. Then they begin once more to grow, and growing, become more and more eel-like daily. By this time, impelled by some mysterious guiding force, they have travelled shore-wards, and have reached shallow water; and this journey is continued till they reach the mouth of some river, up which they ascend in myriads, in the form of tiny eels, scarcely bigger than darning-needles. Up and up they go, overcoming all obstacles, climbing weirs and locks, and even leaving the river and travelling overland, by night, in the dewy grass, making their way even to distant ponds, till at last the journey is ended and they settle down, remaining snugly ensconced in mud, or coming out to bask in the sunlight amid the reeds during the grateful summer-time. Here, in con tentment, they remain for many years; but sooner or later comes the call they cannot resist, and hurrying forth, they hasten to the sea—the nursery

for their young, the grave for themselves, for no eel ever returns.

On the Severn these young eels, or "elvers" as they were called, used to ascend in vast hordes, and were caught by the cartload, when their frail bodies were pressed into "cakes" and sold as food.

The eel recalls another aspect of fish-life—that of shape in relation to habits. The long cylindrical body, which has given us the simile "eel-shaped," has been developed in relation to its burrowing habits. But we cannot always establish this relation between habit and structure so readily. And nowhere is this more clear than in the case of the "pipe-fishes" and sea-horses," to which we now pass. These fishes have exchanged the usual scaly covering for a bony armour of considerable strength, though for what reason is not clear. The pipe-fish, it will be remarked, offers no other very striking features save its shape, which is cylindrical. But out of this model Nature has fashioned the "sea-horse," of all fishes one of the most strange, and the only fish which uses its tail as a hand. The resemblance of the head to that of a horse, if fanciful, is certainly close enough to justify the name, and the carriage of this head still further helps the likeness. When these creatures swim they do so after a very strange fashion, for they move through the water in an upright position, and are propelled, not as are other fish, by the wavy movements of the body, but by the rapid vibration of the back fin. A near relative of the sea-horse, however, has gone

still further in this extravagance of shape. This is a tropical species, the "dragon-fish" (*Phyllopteryx*) (No. 439). Herein the "tubercles" which stud the bony armour of the more familiar sea-horse are produced into long streamers of soft skin, which float outwards like a tangle of seaweed, and therein lies the reason for their being, since by this likeness they enable the fish so closely to resemble its surroundings as to be absolutely invisible to its enemies.

There is no more fascinating study than that of the shapes of animals; but to appreciate their significance fully they must be studied in relation to habits and in comparison with less specialised and related forms: thus, by comparing the pipe-fish with the sea-horse, a very real insight is gained into the steps by which the one may have evolved into the other. An animal is said to be "specialised," when, either as a whole or in regard to certain parts, it shows some striking change of form not met with in its near allies. The sea-horse is a highly specialised form, for in shape it differs not only from its relatives the pipe-fishes, but from all other fishes. Specialisation in regard to certain parts is well illustrated by the flying-fishes. Two quite distinct groups of fishes have produced fliers, or more correctly parachutists, and in both the sail area is formed by an enormous development of the breast-fins. One of these, which will be found in Case 11, belongs to the mullet tribe, and is on rare occasions taken off our shores. The other

is one of the gurnard tribe, and will be found in Wall-case 19. Herein the fins are of enormous size, and might be supposed therefore to serve even more effectually as parachutes; yet it is said these fishes do not travel so far as the species which we have just described: perchance this is a case of over-development. The great size of these fins is not difficult to account for, since all the gurnards have very large breast-fins. Though commonly called flying-fishes, these creatures do not fly, for the fins are incapable of the complicated movements necessary for flight. The fish leaps out of the water, and just as the tail reaches the surface it is used as a spring to jerk the body into the air, the surface of the sea being used as a spring-board. Once launched in the air, several yards are traversed before the sea is reached again. By this power of travelling through the air, recalling that of the "flying-lizard" described in Chapter VII., the flying-fish are enabled to escape the onslaughts of enemies, such as porpoises and larger fishes.

The fins of fishes have yet other strange functions, and two or three striking instances must be mentioned here. In the remora, or sucking-fish, for example, which will be found in Wall-case 15, the foremost back-fin has been changed into a large oval disc bearing a number of laminæ or plates, which adhere to any surface to which the disc is applied. Therewith the fish is enabled to attach itself to sharks, whales, and turtles, and thus gets carried about from place to place without effort, leaving its host

from time to time in search of food, which consists of other small fishes. Sucking-fishes occur in all tropical seas. One species in the Torres Strait is used by the natives for catching turtles. The fish is kept alive in water in the bottom of the canoe, a thin string being fastened round its tail. When a

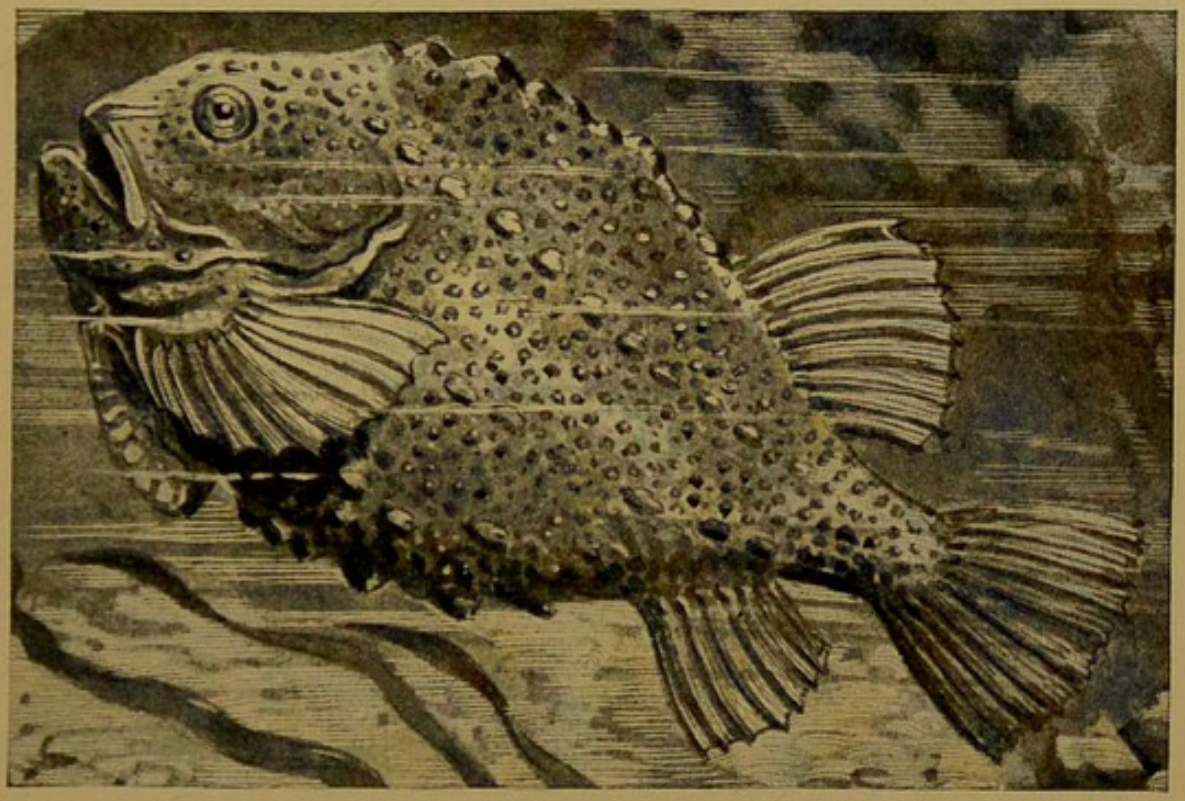


FIG. 35.—The "Lump-sucker."

turtle is sighted, the "Gapu," as the sucking-fish is called, is thrown towards it, and in a few moments the sucker is fast on the prize. If the turtle is a small one it is hauled in by the line attached to the fish, for the sucker takes a most tenacious hold; but if it be a large one a native jumps overboard with a stronger line, and following the course of the fine line arrives at the turtle and secures it by the

stronger rope, returns to the canoe and tows his captive ashore.

The "lump-sucker" (Fig. 35), a fish which is common in our own seas, has a similar disc on the under surface of the throat, formed by a pair of fins representing the hind-limbs of land-animals: an example will be found in Wall-case 19. Therewith the fish fastens itself securely to rocks, and after the same fashion the young fasten themselves to the body of the male parent, who acts as their guardian till they are big enough to fend for themselves.

Another remarkable instance of fin development is that of one of the sword-fish, known as the "sail-fish," a huge creature which will be found in one of the separate cases in the middle of the room (Floor-case 24). Herein it will be noticed the upper jaw is produced into a long spear, which can be used with deadly effect. Sword-fishes frequently attack whales, and occasionally, apparently by mistake, it will charge into a ship. On the floor of this case will be seen a thick piece of oak timber containing the remains of one of these "swords" driven in by such a charge, and this will give one an idea of the tremendous power of the thrust. The skeleton of the sword-fish is remarkable for the way in which the bones of the vertebral column are interlocked, or braced up, as it were, to withstand the shock of charges such as we have indicated, and specimens of these interlocking bones will be found in Wall-case 17. It is possible that the huge

dorsal fin is used to steady the body when a charge is contemplated, but it is also said to be thrust up through the water so as to serve the purpose of a sail.

A yet more remarkable use of fins is that illustrated by the angler-fish (in Wall-case 20), wherein the back-fins have been re-constructed, so to speak, to serve the purpose of a lure. By way of supplement the sides of head and body are provided with ragged fringes of skin, which are kept in constant motion, thereby attracting the attention of small fishes on the prowl in search of food. Attracted by these tempting-looking morsels they hover round, and finally attempt to taste, when a huge mouth suddenly opens, and the victims are instantly engulfed. The head of this fish is enormous, and the body much flattened and dull-coloured. Thereby it harmonises perfectly with the muddy sea-bottom in which the creature lies half buried, and it owes not a little of the success of its cunning to this shape and coloration.

Many of the fishes in this gallery display the most brilliant, and even garish hues, and it might be supposed that they would be most conspicuous objects when at large. But though this is actually the case in certain species, it is by no means always so. In Wall-case 15 will be found some of the most brilliantly coloured of all fishes, and these are dwellers amid coral reefs — scenes of fairy-like beauty, to which they themselves in their splendid raiment contribute not a little. Here, where

colour is everywhere, these fish do but form a part of a great whole—a gorgeous world the like of which is hardly to be met with on land. But the colours of some of these fish at any rate are meant to be conspicuous and to attract attention. No more extraordinary proof of this is to be found than that furnished by the little amphiprion in this case (No. 662). By no means pass without looking well at it, for its home is even stranger than its colour ; it lives inside certain huge species of sea-anemones which thrive in the warm Australian seas. But the strangest part of this history is yet to come. The sea-anemones, you must know, like the jelly-fish (their cousins), lodge within the body most formidable batteries of stinging threads, which are shot out on the slightest touch : thereby whatsoever living thing collides with their bodies is at once paralysed, and in due course of time is seized and eaten. Being blind and more or less stationary, the sea-anemones cannot hunt for food, and thus they kill at random, eating the victim if hungry. Now the amphiprion alone appears to be not only exempt, in the case of this giant species, but actually to be a welcome guest within the very vitals of its host. But this hospitality is not quite unselfish, for the fish is a paying guest. Whenever it is hungry, it wanders forth, flaunting its flaming colours defiantly. Suddenly some other hungry fish gives chase, as was intended, and at once a wild dash is made for its living home. The pursuing enemy speedily crashes against the soft and

portly sides of the anemone, and at once is paralysed by the stinging threads. Then the amphiprions creep out, and begin to feed upon their would-be captors. In the course of breaking up the body fragments are scattered around, and many of these fall to the share of the anemone : and it is for the sake of such scraps that it affords free lodgings to the amphiprion within its stomach !

In the survey of this gallery many and various forms of fishes have been examined : we have gleaned the last words, as it were, in the evolution of many very different groups : that is to say, we have selected types which display more or fewer peculiar modifications of structure developed in answer to peculiar and special needs, and enabling the creatures so modified to seize upon unoccupied niches in Nature's world. Let us, in conclusion, take a survey of a group of nearly related species, which is remarkable for the striking differences of structure which its several members display. These are the file-fishes and sun-fishes, which will be found in Wall-case 20.

The flesh of most of these is poisonous, and if eaten produces a disease of the nervous system known as "Ciguatera." The file-fish, or balistes, may serve as the standard of comparison by which we may measure the various strange departures from the type. There are numerous species of file-fishes, and all are more or less strikingly coloured. They feed on coral, the stony branches of which

are easily broken off by the strong teeth : they also feed largely on the "pearl-oyster," and at one time were held in detestation on this account, until it was found that they actually contributed largely towards the pearl-fisher's harvest, in a very singular way ; the parasite which is the cause of the formation of pearls passes a part of its existence within the file-fish ; but that is another story ! Anyhow, if there were no file-fish there would be no pearls. But as to this theme my readers must turn to page 247.

Now turn to the "coffer-fishes," so called because of the "coffer" or box-like shell in which the body is encased, leaving only the tail and fins free. This case is formed by the fusion of a number of six-sided bony plates, which are really highly modified scales. There are several species of coffer or trunk fishes, all of which live in tropical seas, in shallow water.

A more remarkable illustration of the transformation of scales, and of the modification of the body, is furnished by the globe-fishes (Fig. 36).

First of all as to the scales. These have, as with all the fishes of this group, became transformed into bone, and in the species now under consideration this change has gone further still, giving rise to a bristling array of spines, which are made to play a very important part in resisting the attacks of enemies. The globe-fishes, you must know, in their quiet moments, look much like other fishes ; but when threatened by attack they make a wild rush

to the surface of the sea, and there take in deep

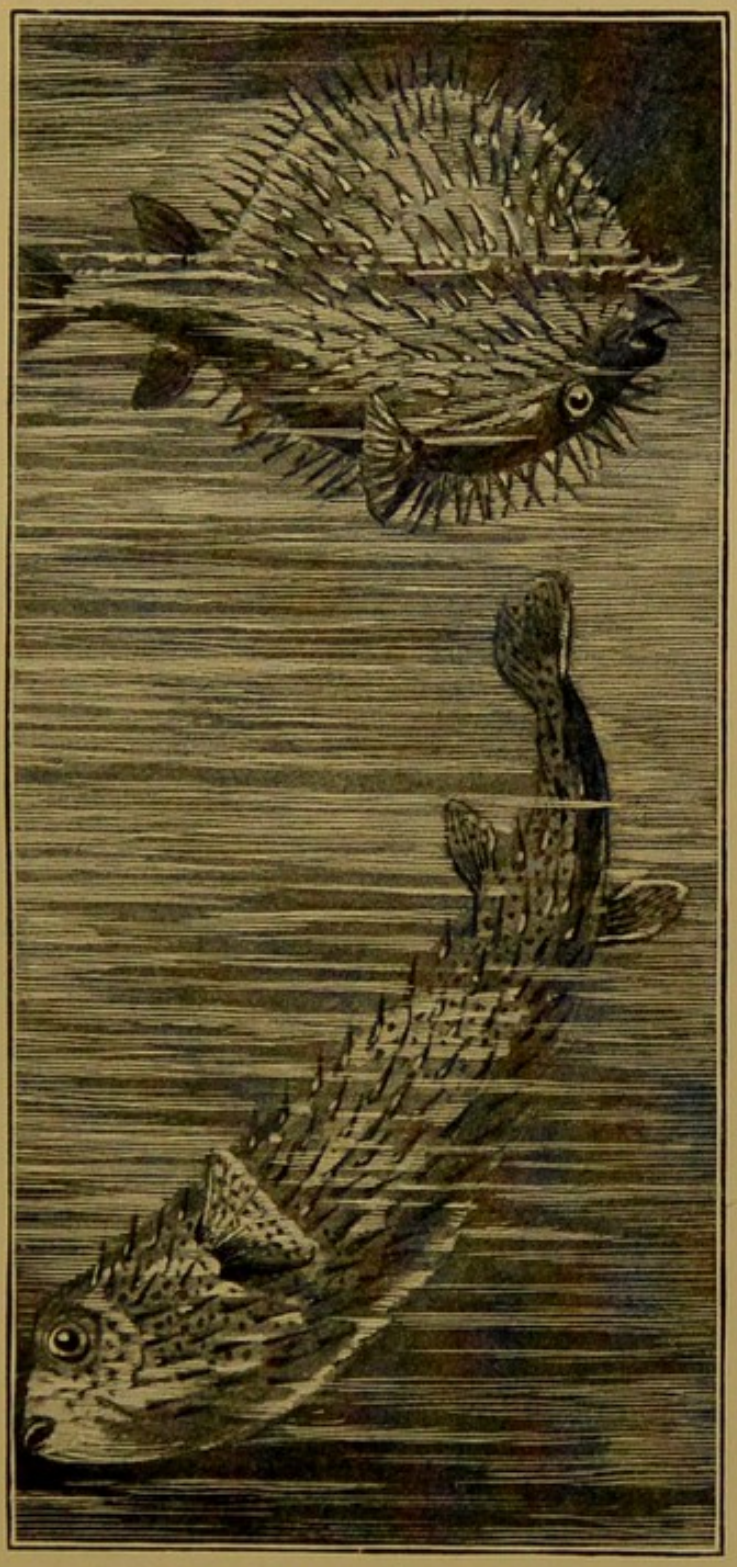


FIG. 36.—Globe Fish, inflated and deflated.

draughts of air, which speedily inflate the body till it assumes the extraordinary globular shape which

has become a subject for the wonder of the curious the world over. When thus inflated the body floats back-downwards, with the belly projecting above the surface of the water, where, caught by the wind, the fish is blown along to safety; for even if the eager enemy should pursue his victim to the surface he cannot inflict harm, being kept at bay by the spines.

Last of all, we come to the sun-fishes, of which there are several species. These all have the appearance of fish which have been chopped in two, just behind the long back-fin! Of all fish they are surely the strangest, and one would imagine the least capable of vigorous movement. Yet this is far from the truth. The sun-fish are the most expert divers of all the fishes! Most of their food is obtained by descending to enormous depths; much of it, indeed, in some localities, is furnished by the larval eels described earlier in this chapter; at one time, in fact, most of the specimens known to us were secured from the stomachs of sun-fish. The descent and ascent is apparently made by the long fins so curiously placed at the end of the body. These, by their rapid vibration, act as propellers; steering, it must be supposed, is done by means of the breast-fins, at any rate to a certain extent.

Some species of sun-fish grow to a great size: a fairly large specimen will be found hanging

from the ceiling at the northern end of this

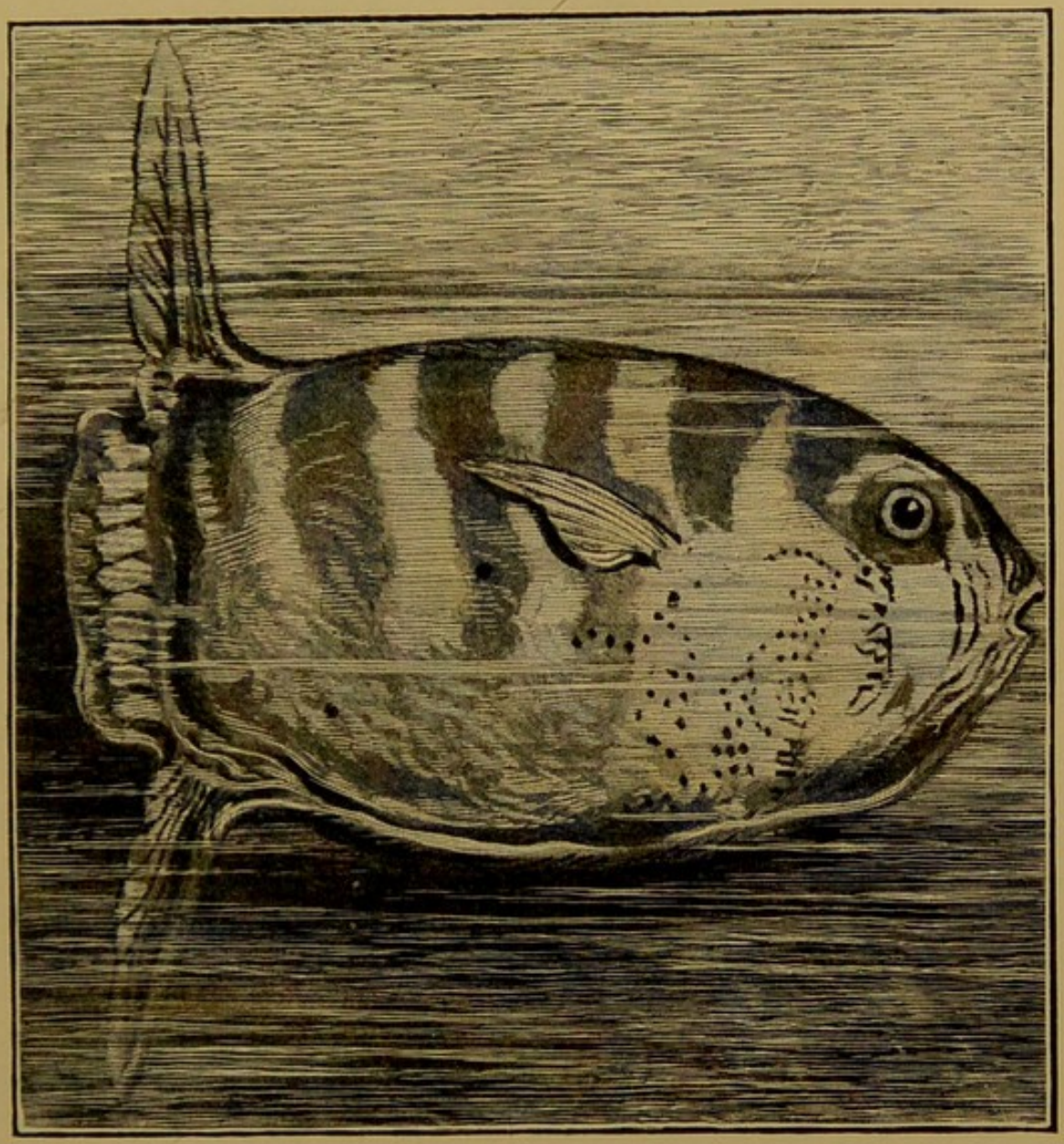


FIG. 37.—The Oblong Sun-fish.

gallery, and another from the rail opposite Case 8.

CHAPTER IX

THE INSECT AND CRUSTACEAN GALLERY

" . . . The jocund voice
Of insects—chirping out their careless lives
On the soft beds of thyme-besprinkled turf."

So far the creatures we have been discussing, though infinitely varied in shape and size and mode of life, have yet had this much in common –the body has been traversed from end to end by a solid rod, or backbone. Along the top of this ran the spinal marrow, which proceeds from the brain, and forms the on'y medium of communication between the outer world and the brain; while along its under surface ran the great blood-vessel supplying the limbs and head, whereby the flickering light of life is maintained.

The creatures now to be considered are built after a very different plan. They have no backbone, and the nerve-cord which answers to the spinal marrow runs along the belly, and the great blood-vessel along the back. At least this is so in the more perfectly constructed; but in the more lowly forms there is no nerve-cord, there are no nerves, and no blood-vessels, for there is no blood! Why this should be cannot be told in these pages;

indeed it will be impossible to do more than select a few of the more remarkable of these "invertebrate" (or backboneless) types, as they are called, for comment: and this because of the vast numbers of different kinds of animals which belong to this branch or division of the animal kingdom. You will realise the force of this when I tell you that there are, in the British Museum, more than 155,700 different kinds or "species" of insects alone, and this does not represent every known species, for altogether some 250,000 have been described! The mollusca, or "shell-fish," again, number something like 30,000 species at the present day; double that number if fossil forms are included! These huge numbers concern two groups of invertebrates only. The whole of the known species belonging to this great division of the animal kingdom are as the sand of the sea-shore in number. We can but take a few samples, then, of the more interesting types belonging to the more important groups.

By way of a beginning let us start with the Insect Room, and in order that a real grip may be obtained of the nature of the many and profound changes of form which insects present, let us briefly survey the essential features of their structure. In the first place, then, the body is made up of a series of rings or "segments" of a horny material known as chitin; there is no internal skeleton, this hard outer surface taking its place. The limbs are numerous—not restricted to four as in vertebrate (or backboned) animals—and are many-jointed. In

the more lowly creatures from which the insects are descended the body is formed of a series of rings throughout its whole length; and each ring bears a pair of limbs. More or fewer of these, near the head, become transformed into jaws; the rest serve as legs. In the insects the jaws have lost their likeness to limbs, while several segments behind the head become welded together to form a short tube —the "thorax"—bearing the limbs; behind the thorax come a series of rings forming the abdomen, and these are limbless. Many insects, in addition, have two pairs of wings attached to the thorax. Breathing is performed by taking air into an elaborate system of tubes or "tracheæ" opening by a number of holes or "spiracles" running down each side of the body. The sense of touch and smell is commonly conveyed by long, jointed rods or "antennæ" attached to the head, while the sense of sound or "hearing" is often conveyed through a special organ in one of the legs! The mouth parts present great variation in structure according to their use, some being very elaborately made for sucking up honey, others being fashioned like stilettos for piercing the bodies of animals for the purpose of sucking up blood. The eyes are most complicated, being formed of a number of prism-like bodies crowded closely together, and forming what are known as compound eyes, thousands of these "eyelets" going to form an eye. In many insects there is a third eye in the middle of the head.

Many insects during their growth from the egg

to the adult state pass through strange transformations, appearing and reappearing in guises as unlike one another as imagination could devise. We might cite a dozen examples, but one must suffice, and that shall be furnished by the butterfly.

Now the several stages, or chapters, in the life history of the butterfly are, in their broad outline, so generally well known, that they have become, as it were, commonplace, and cease to excite either comment or interest. In our love of novelty, we cast about for something new to excite our interest. This is a pity, for in the study of the early stages of the life-history alone—the egg, the caterpillar, and the chrysalis—there are to be found incidents and changes of form as wonderful as anything to be found in a book of fairy-tales! To give anything like a complete idea of such transformations would more than fill this book. It must suffice to draw attention here to the delights that await those who will venture to explore this little corner of Nature's kingdom. The study of the caterpillars and chrysalises of our own butterflies and moths is sufficient to afford interest for a lifetime, when once the why and the wherefore of the meaning of the shapes, colours, and other peculiarities is inquired into. In a series of cabinets along one side of this gallery will be found a marvellous collection of British caterpillars, and these should be carefully examined. Mark the weird-looking caterpillars of the lobster and puss-moths, the odd stick-like "loopers," the "woolly-bears," the curiously

marked swallow-tailed caterpillars, and a score of others.

Then think for a moment on the profoundness of the change between the caterpillar and the butterfly. The one is a chewer of green leaves, the other feeding daintily on sippets of honey; one phase of life lived in seclusion, passed as a worm-like creature creeping on short, stumpy legs, in a world measured by inches, the other passed in a very riot of luxury. The gross, heavy caterpillar body is now exchanged for a delicate framework borne on gorgeously coloured pinions. But between these two lives there is that other strange period of rest, a life as it were in the grave, during which, by some mysterious agency, that tremendous change between the two phases of active life takes place. Contemplate for a moment or two, the chrysalis of the caterpillar, the cocoon of the moth. Note the strange shapes and colours of the former, and the wonderful winding-sheets of silk wherein many of the latter are wrapped. Think of the mystery surrounding all this. The caterpillar has no instructor, no model to imitate. Yet, at the appointed time, it performs the most complicated acts. Many of the butterfly tribe secure the shell, wherein they are to lie through the long winter months, with a girdle of silk to prevent it falling, and this they do before the shell itself has come into being! Among the moths, many construct the most complicated barricades against invaders, so that to escape themselves, they have to soften the walls of their cells

with a powerful acid! Once again remember, these things are done but once in a lifetime, without previous instruction, without rehearsal. More than this, in these pages, I cannot say, but I have surely said enough to show that some of the commonest objects of our gardens and fields are also some of the most marvellous. And what is true, remember, of the butterfly and moth, is true of the early stages of life of other insects. But the incidents differ, some remarkably so.

And now we must pass on to survey the adult stages of insect life.

In Table-case 30 will be found a series of insects showing examples of the different orders and their principal structural characters, and those who desire to see a little beneath the surface of things should carefully examine these.

The examples here displayed are what is called "typical" of their kind. One can say in a moment, "This is a butterfly," "That is a beetle," and so on. But more or fewer members of each of these great groups have taken quite extravagant shapes, and these strange transformations all have a direct relation to the needs of the creature in its struggle to maintain a hold on life. Let me illustrate this. Everybody recognises an earwig, a cockroach, or "black-beetle" (as it is erroneously called—for it is not black, and is not a beetle), and a grasshopper. But near relatives of the last-named have achieved wonders in the direction of fantastic shapes, as a glance at Table-case 32 will show.

Take, for example, the strange "praying mantis" (1128), which derives its name from its habit of standing on its four hind-legs, with the front pair held up and close together. In this attitude they remain till some fly comes within reach, when lo, the front legs are darted out with lightning swiftness, and the fly is caught between a special arrangement of spines! But you will notice some of these creatures have assumed yet more extraordinary forms, in many cases so extraordinary as to lose all likeness to living things at all. Take, for instance, the "stick-insects," which have bodies so slender that they can hardly be recognised. Others have the legs and bodies strangely flattened and scalloped, and often highly coloured, so as to be hardly distinguishable from leaves and flowers. These wonderful shapes (for they are wonderful) have come into being to enable the creatures to capture prey without hunting for it. They are instances of what is known as "aggressive mimicry": that is to say, they mimic the surrounding vegetation in order that unsuspecting insects may approach near enough to be captured, the victims being unable to distinguish the animal from the plant on which it rests. Note especially the *Acanthops* (No. 1137), which is hardly distinguishable from a piece of bark, while a fine example of a flower-like species will be found in the African *Idiolum diabolum* (1143). Though these strange creatures possess wings, as may be seen here, they are rarely used.

By way of contrast let us turn now to a

group of nearly related insects, the crickets and locusts.

Most of the crickets burrow in the ground, or live under stones: and hence it is not surprising to find that some have lost the faculty of coming

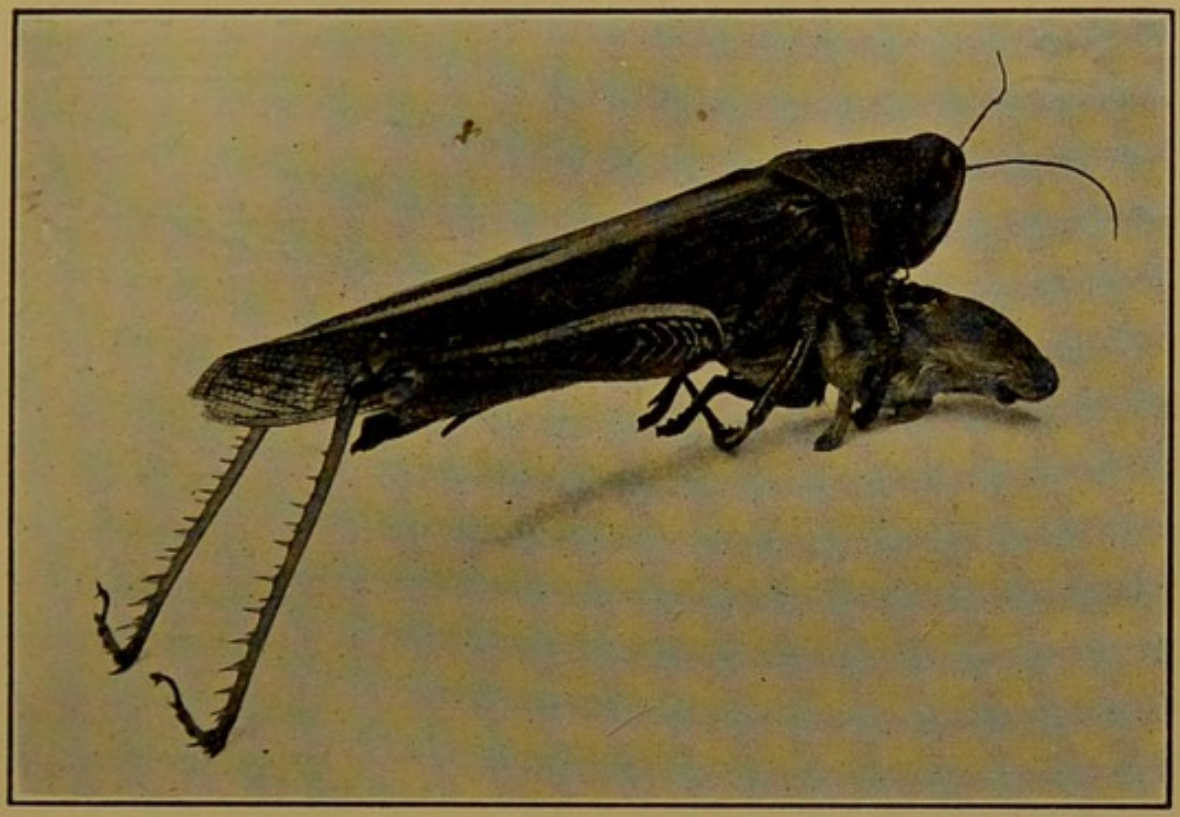


FIG. 38.—A Locust (*Cyrtacanthacris*) from the Congo which was caught in the act of eating a mouse! Others were found eating large spiders, and cockroaches. This furnishes a good illustration of the way in which animals forsake the normal diet of their tribe for new kinds of food.

out into the world to feed, and instead spend their whole life, mole like, underground; and to this end they have undergone profound changes of bodily structure. The mole-cricket (*Gryllotalpa*, 1201) is an instance of this.

The long-horned locusts in Case 34 are no less

interesting. They live in trees and shrubs, and the wings in their shape and colour have come to bear a most wonderful likeness to leaves; often this coloration extends to the imitation of blotches caused by fungi, while the edges look as if they had been nibbled by caterpillars, as for instance in *Pterochroa* (1252). A curious Indian species in this case (1243) is especially worth notice, since the wings, when at rest, are coiled up like a watch-spring! It is a burrower, passing the day underground, and flying by night.

The true locusts, which follow next, present many strange forms, but these insects are chiefly remarkable for the damage they cause. Travelling in vast hordes, beyond the power of man to count, they often convert a thriving country into a desolate waste, devouring every green thing that comes in their path. Photographs exhibited here give an idea of the disaster which they bring wherever they alight.

The crickets and locusts are the kangaroos among insects, for by means of a pair of enormously long legs they are enabled to take huge leaps. Having, however, no balancing organ in the shape of a tail, they cannot stand upright.

Crickets and the smaller locusts, as is well known, make strident sounds. These are produced by a very curious "musical" instrument formed by the bases of the wings. One wing bears a drum-like arrangement, the other a kind of file which is drawn across its surface to produce the sound. Specimens of

this and other modifications of this organ will be found in this case.

Flight, among the insects, at least during the adult stage, is the rule rather than the exception. All the insects so far examined are fliers, of more or less excellence. But let us turn now to some more striking examples of flight.

The wings of insects, it must be remembered, differ from the wings of bats and birds in that they are formed of broad sheets or plates of delicate membrane, supported by a system of branching tubes. Further, there are two pairs of wings: though in some cases, as we shall see, the hinder pair may be reduced to mere vestiges, or be absent altogether. Again, in the wings of beetles the front pair are never used during flight, but serve only as covers for the hind wings when closed. Finally, the wings of insects do not answer to the wings of bats and birds, which are modified legs, but are organs of a totally different kind.

Those near relations of the alder flies and scorpion flies, known as the *Nemopteridæ*, illustrate the curious way in which the hind wings may be changed, as for instance in the West Indian species (*Halter imperatrix*, 1353), wherein the hind wings are drawn out into long threads, with narrow blades at the ends, and in the *Chasmatoptera* (1357) wherein these wings terminate in scallop-shaped expansions.

Often the wings are very beautifully coloured, and this is especially the case with the wings of the butterflies and moths; the colours are arranged to

form complex patterns, often of great beauty. A selection of these insects will be found in Table-case 38. These patterns, it should be remarked, are formed by a wonderful arrangement of little scales, overlapping one another like fish-scales: and to add to the wonderment, these scales, when placed under the microscope, are found to present an infinite variety in shape, and to be beautifully sculptured.

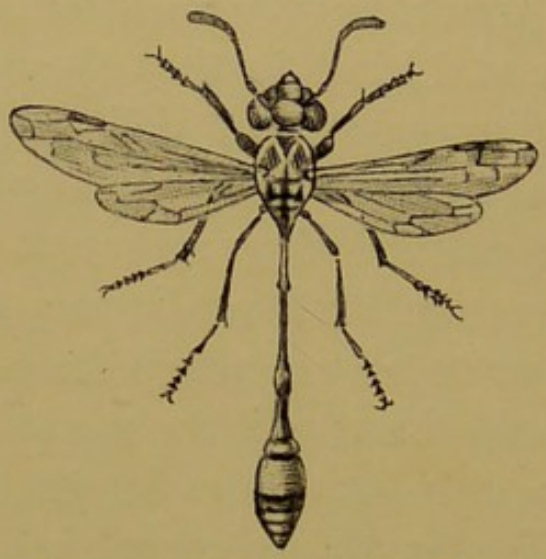


FIG. 39.—Ischnogaster Wasp.

I have found it difficult not to speak of the variety which insects present in the matter of bodily shape, but I dare not. The theme would require a work by itself. I do not mean, by "difference of shape," such as distinguish the beetle from the butterfly, the dragon-fly from the bee, the gnat from the ear-wig, and so on: but the amazing variations of structure in a given pattern, which one meets with in any group of insects. A survey of the mantises and leaf-insects and the beetles will show at a glance what extraordinary shapes the body may assume.

The eyes of insects are generally placed flush with the head, but in some of the flies, they are borne on long, slender stalks. The abdomen and thorax are normally attached one to the other by a stalk so short as to make these two regions of the body seem almost continuous, but in some wasps

this stalk is excessively long, so that the abdomen seems a mere blob at the end of a rod (Fig. 39). The number and variety of these eccentricities of Nature are bewildering; and fascinating though they be, I dare not begin to select. Those, however, who are fortunate enough to live within reach of a museum—or better still, who can study the living

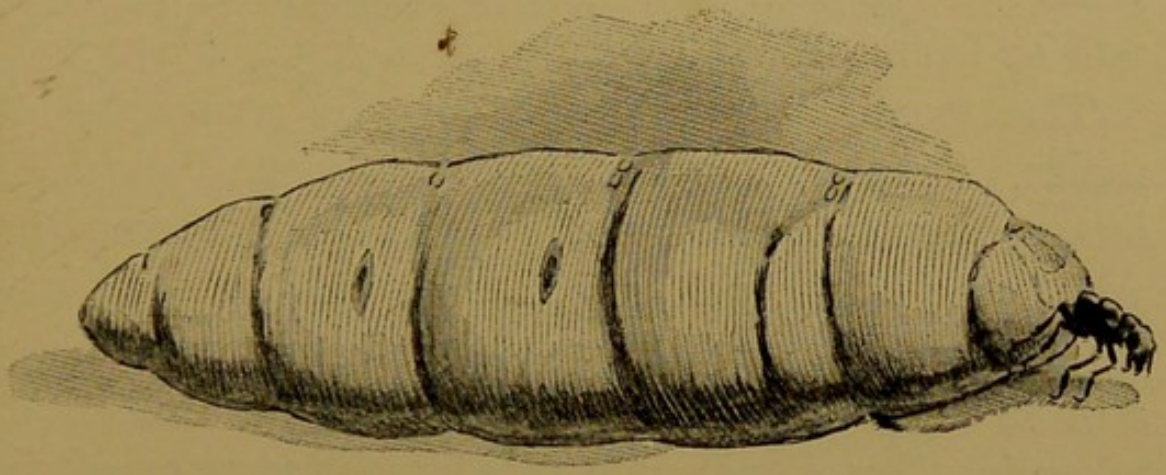


FIG. 40.—Queen White Ant.

creatures—would find in this theme a pursuit of enthralling interest.

Space must be found here for a few words on the more important points of what we may call the home-life of insects, though a whole volume would be needed to do justice to the subject.

Upon every living thing is laid the duty of reproducing its kind: sometimes the fulfilment of this duty entails the most astounding personal sacrifices. As a case in point let us take the "white ants" or termites of Africa. The "queen," upon whom the existence of the colony depends, lives in a specially constructed chamber or cell, which

she never leaves. Her sole duty is to provide eggs, which, as soon as laid, are carried away by the workers of the colony to be reared. So completely is she given over to this task that her body becomes swollen with eggs till it assumes an almost colossal size, so that the head and fore part of the body look as though they were emerging from some huge vegetable growth (Fig. 40). Examples of such martyrs will be found in Wall-Case 9, Nos. 203 and 1307.

The termites form huge colonies made up of males, females, workers, and "soldiers," each of whom have definite duties to perform to secure the well-being of the colony. Some would-be social reformers of human society point to such colonies, and to those of bees, as ideals for human imitation, wherein they display an appalling ignorance of all the horrors that such "communal" life would mean!

The huge and marvellous nests which termites build are of many kinds, and examples thereof are shown in Wall-cases 9 and 10. Some, it will be noted, are built of mud, and rise as much as ten feet from the ground, affording, in Africa, convenient eminences from which to survey the surrounding country, and for this purpose they are used by many of the larger game animals. Many bore into trees, and the woodwork of houses. The latter cause thereby immense destruction, for the diligent workers contrive to give no external mark of their industry. Door-posts and other woodwork tunnelled by termites are shown here.

No less wonderful, and far more beautiful, are

the nests of wasps (Fig. 41) and bees ; and this is specially true of such as are made of wax, and papier mâché, as may be seen in this gallery. A "nest" is generally understood to mean a recep-

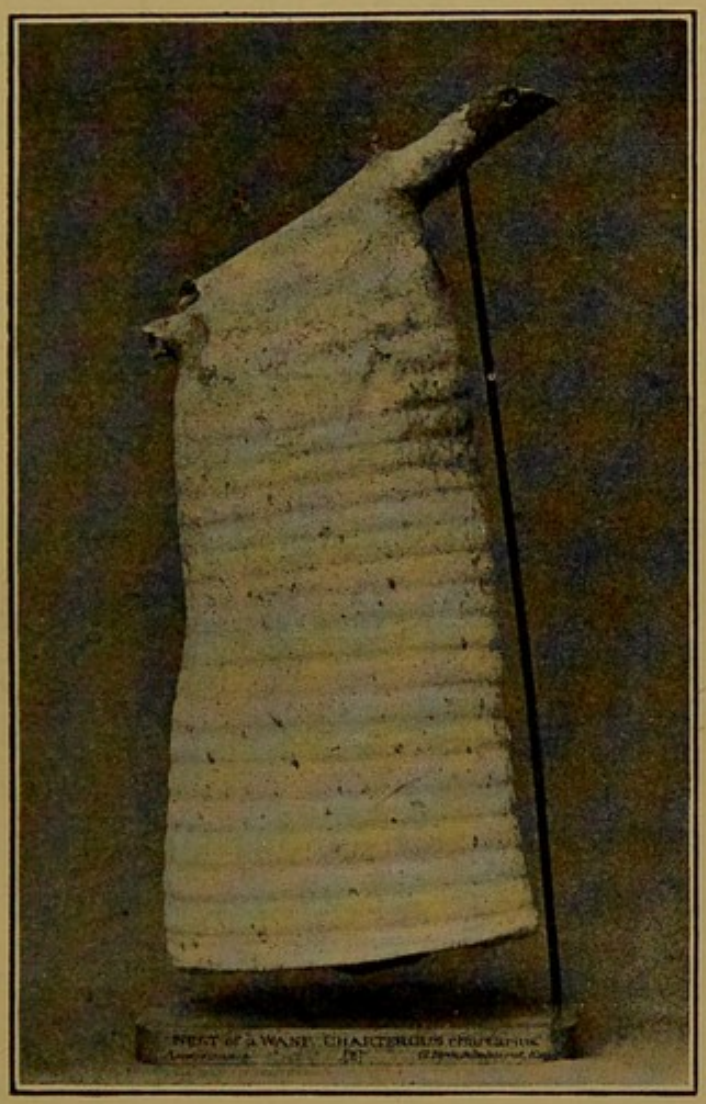


FIG. 41.—Nest of Card-making Wasp.

tacle for eggs, and later on a nursery for the young. As a rule such structures are formed by a single pair of adults, but in the cases here indicated this nest-building is carried out by a vast army of individuals which can never produce offspring, and these builders later become the nurses, the parents

of the callow young taking no part in their up-bringing. But besides these nests, there are to be considered nest-like structures built by young animals themselves to serve as a shelter either during the period of active life, or during that long sleep wherein is effected a strange transformation —as, for instance, is undergone by the caterpillar in its transition to the butterfly. Some caterpillars live in great colonies, under cover of a nest of some sort, spun by the individuals of the colony: later they spin their cocoons therein. What such strange colonies are like may be seen in the case of *Anaphe panda*, a species of African moth (Wall-Case 8, Nos. 263–265).

Every now and then it is well to remind ourselves that the "specimens" in this gallery, as in the rest of this great Museum, were living things—evading enemies, combating with rivals, satisfying the pangs of hunger, basking in the summer sun, or cosily slumbering through the dark days of winter. And no less is the need to remember that, as Longfellow tells us—

> "All things must change
> To something new, to something strange;
> Nothing that is can pause or stay."

That is to say, living things, though they seem to possess, in an eminent degree, the property of stability, or of reproducing members exactly like themselves, are yet, when closely examined, found to be very variable. No two individuals are ever

alike. These points of unlikeness, now in one direction, now in another, slowly increasing, give rise to new forms and new types. The nature of these changes is admirably brought out in this gallery.

Mention has already been made of the two great divisions of the animal kingdom—vertebrates and invertebrates. These last, as we know, in course of this process of change, gave rise to the vertebrates, which in turn branched out into the different kinds of vertebrates. The branching of the invertebrate group has been no less marvellous. The creatures which we have been considering in this chapter represent one of such branches, and have, as we have remarked, a common plan of structure. They are, essentially, in short, jointed animals—creatures made up of a series of rings made of a hard substance known as chitin, each ring bearing a pair of jointed limbs. In the higher types more or fewer of these limbs have undergone more or less marked changes. Some have been transformed into jaws, some have disappeared altogether : while new organs in the shape of wings have been developed by all the higher types.

I want now to conduct you to the opposite end of this gallery—the south end. Here are placed the crustacea—crabs and lobsters, crayfish, prawns, shrimps, wood-lice, barnacles, water-fleas, and a host of forms which are nameless in common speech, and for the most part microscopic in size. Into the peculiarities of their structure it is impossible to enter here, nor is this the place for such a discussion.

My purpose is rather to show the general underlying characters, and to draw attention to the strange diversity of type which has arisen ; more particularly in regard to such well-known creatures as crabs and lobsters.

A word as to the microscopic forms. Large drawings in the wall-cases show that these present a strange diversity of form, and are often of great beauty ; sometimes, on the other hand, they can only be described as odd. While many of these tiny creatures are fully matured animals, others represent early stages in the growth of crabs and lobsters, and their kind.

The gradual evolution, as this series of successive stages from simple to more complex forms is called, is one of the most fascinating chapters in natural history.

Crustacea, like the higher groups, such as crickets, butterflies, moths, and so on, can only grow at certain stated intervals. The hard case which forms the outer wall of the body cannot grow as other forms of external coverings grow. Consequently, at certain definite periods the creature has to get out of its shell much as a snake sheds its skin. When this is done the creature emerges perfectly soft-skinned and at once expands, or swells, as it were, to a size larger, when the new skin slowly hardens, and no further growth is possible till the next "moult," as it is called. Many of my readers must have seen caterpillars changing their skin.

In the wall-case by the doorway of this end of the room will be found a most striking illustration of this process of moulting, illustrated by a crab. Every one of its cast-off suits has been preserved and arranged in order, from the time when the creature was of about the size of a pea till it had attained almost full size, when it died.

Now let us consider some of the more striking changes in the body of the crabs, for further than this it would, perhaps, in this book, be unwise to go.

Let us begin by comparing a crab with a lobster, for the latter represents an earlier and more primitive type of crustacea. In the first place, you will notice, in the lobster—a shrimp will do as well—that the fore-part of the body is covered by a great shield produced in front with a spine, at the base of which are the eyes. Behind this shield come a series of rings, which end in a fan-like tail. Next as to the legs. The foremost, in the lobster, take the form of great pincers, behind these follow the walking legs, and behind these, beneath the rings, smaller legs or "swimmerets." Now turn to the crab. Here the great head shield, instead of being long and tubular, is wide and flat, while the rings behind this shield seem to be wanting. As a matter of fact these rings have shrunk to quite tiny proportions, and are carried doubled underneath the head shield!

From this let us pass to the strange modifications of this shape which the crabs present. Look, for example, at the huge Japanese crab on the wall at

the end of this room. The giant from Tasmania to the right of this, having shorter legs, is almost a dwarf by comparison. In the wall-case beneath will be found crabs that have contrived to forsake the sea for a life on land; and here they have developed such a passion for cocoa-nuts that they actually climb the trees to get them! The more active do the climbing, and tearing the nut from its stalk send it crashing to the ground, where it is speedily devoured. One of these most remarkable crabs is shown attached to a portion of a tree, while from a photograph an idea may be gained of the numbers which congregate to the feast. These crabs came from Christmas Island in the Indian Ocean. A little to the left of these, on the floor of the case, will be found some curious "calling crabs," shown as in life, half buried in mud. From this soft and secure retreat they emerge to spend their spare time, apparently, in waving messages one to another, semaphore fashion, using the big claw for this purpose!

In the small table-cases down the middle of the room you will find yet other and no less curious kinds of crabs. Here, for instance, are the hermit crabs, one of them a huge fellow, snugly ensconced in an enormous shell big enough to hold a hundred of hermit crabs such as we meet with on English beaches. This habit of using the empty shells of molluscs, such as whelks and so on, as a house is due to the fact that the hinder part of the bodies of these crabs is quite soft, not protected as in, say,

a lobster, by a hard tube of movable rings. Hence they thrust this tender portion of their bodies into a case big enough to enclose the whole body, protecting the mouth of the shell with a pair of pincers.

Working towards the middle of the room again we find, in the next case, some queer forms wherein the eyes are borne upon the ends of long stalks; and here, too, you will find two crabs which have taken to evil habits, for they are parasites, or at any rate are in a fair way to become so. One of these is the curious hairy-looking creature, *Pilumnus pulcher*, from Torres Straits, which was found embedded in the middle of a sponge! The other, *Pinnaxodes*, takes up its quarters within the bodies of the sea-urchins. What it lives on is not certainly known. In some other undoubtedly parasitic forms, which live within the bodies of other crabs, all likeness to its crab-like shape is entirely lost, for in its adult stage it is nothing more than a bag of eggs. Indeed, but for the fact that in the course of its life-history it passes through a free-swimming "larval" stage, wherein it resembles other crab-larvæ, the identity of this creature would never have been discovered.

Table-cases 17 and 18 contain some exceptionally interesting types, long since extinct. There are the curious-looking Trilobites, and the equally strange Eurypterids. They are interesting not only because they represent creatures belonging to an extremely remote past, but also because they are of a very primitive plan of structure, and may be regarded

as standing at the parting of the ways between the gill-breathing crustacea and the lung-breathing scorpions and spiders, to which we now pass. The scorpions and spiders, I need hardly remark, are land-dwellers, but they have a very curious relative in the king-crab, which will be found in Table-case 18. The enormous shield covering the fore part of the body has a strangely crustacean look, but we know from their anatomy that this resemblance is not to be taken as a sign of relationship.

The scorpions (Cases 19 and 20) are worth more than a passing glance. From time immemorial they have borne an evil reputation, and not without cause. Besides the formidable pincers, and jaws, the tail is armed with a very powerful sting, inflicting most painful wounds on all who come within its stab. If the scorpions are really more wonderful creatures than most of us realise, this is doubly true of their near relations, the Amblypygi or "whip-scorpions," placed in this case. Herein it will be noticed the body ends in a long filament, instead of a series of thickened joints bearing a sting: while the nippers are replaced by a pair of long legs ending in claws. Behind these the next pair of legs will be noticed, but they have lost all likeness to legs, taking the form of jointed threads of great length. These act as "feelers," that is to say, like the antennæ of butterflies. In the tailed whip-scorpions these feelers reach their greatest development.

From the scorpions to the spiders is a shorter

journey than some would suppose. And here again we find the typical spider body capable of undergoing some really extraordinary changes of form. Some species depart from what we may call the conventional spider chiefly in the matter of size, attaining gigantic proportions, with a mantle of hair that adds much to their uncanny appearance (Case 22). Others, however, casting aside the

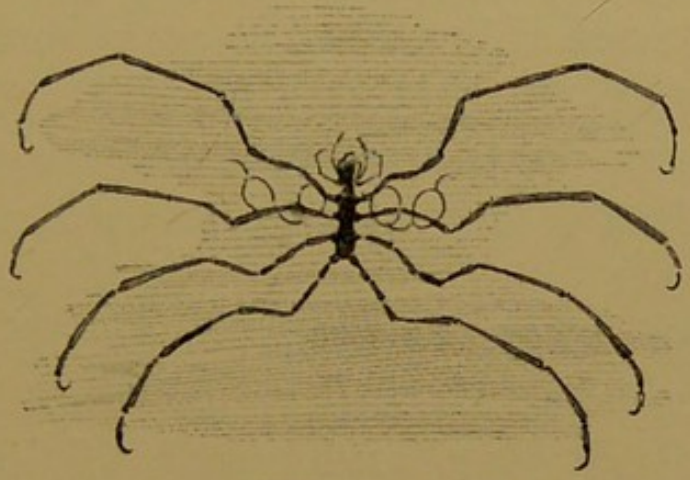


FIG. 42.—The Sea Spider.

traditions of their race, in the matter of shape, have assumed the guise of beetles, as in *Nephila*, or of crabs, as in *Aranæthra*, or of ants! The meaning of this "mimicry," as it is called, and how it is brought about, are so far unsolved problems.

That marvel of beauty and workmanship, a spider's web, has so far proved impossible to preserve satisfactorily, but the homes of some other spiders are shown here, and perhaps the most remarkable of all is that furnished by the trap-door spider, of which some fine examples will be found in the wall-case opposite.

Finally we come to some strange-looking creatures, which, in their way, are as wonderful as anything in this gallery. These are the sea spiders (Fig. 42): by some regarded as relatives of the true spiders, by others as a group by themselves. Be this as it may, they are indeed extraordinary, for they seem to consist entirely of legs, to the exclusion of anything which can be called a body. Nevertheless a small trunk is present, and owing to its restricted size the stomach is branched so as to run down the middle of each leg nearly as far as its tip! They are all marine in their habits, the largest species being obtainable only at very great depths of the ocean.

Of Nature's power of variation on a given theme the creatures in this gallery afford a wonderful illustration. Dry land and aquatic; flying, leaping, crawling, swimming, burrowing, climbing; carnivores, vegetivorous, parasitic; dull hued, and flaunting all the colours of the rainbow; every possible phase of life, and every possible variant thereon, have been brought out of a common ground-type, so to speak—a creature made up of a series of horny rings, each ring bearing a pair of limbs. By suppressing here, and transforming there, the most astounding feats have been achieved, of which only the merest sketch has been possible here.

CHAPTER X

THE SHELL GALLERY

"I have seen
A curious child . . . applying to his ear
The convolutions of a smooth-lipped shell;
To which, in silence hushed, his very soul
Listened intently . . . for murmurings from within
Were heard, sonorous cadences. . . ."

To the uninitiated the Shell Gallery contains a confusing array of shells of many shapes and hues, among which, here and there, a few attract attention. Yet, slowly, they become fascinating. For here, one soon realises, are gathered together the spoils of the great, wide, hungry sea and the burning desert, the silent forest, the running stream, the heath and the sweet-smelling meadow, and country lane. These empty shells represent some of Nature's lowliest creatures, which nevertheless, during life, silently though surely played no uncertain part in the world's history and in the welfare of mankind. The wrecker of ships, and the terror of the diver, the cunning artificer of the pearl, and the distillers of the most precious dyes, have their place here. The very ground on which we stand was in no small part made by the dead bodies of these humble creatures, as a visit to the Fossil Shell Gallery will show, while

savage man in past ages, and in many parts of the world to-day, depends largely for subsistence on the luscious meat they furnish. In commerce and in art they have held, and hold, a distinguished place. Finally, they afford, to those who can interpret, a wonderful insight into that great mystery we call life.

Soft-bodied and defenceless creatures, the mollusca, as the shell-fish are called by naturalists, have for the most part acquired the power of protecting their bodies with a stony armour, some forming a spirally coiled chamber into which they can withdraw, closing up the mouth with a lid. These are the "univalves." Others have fashioned as it were a cradle with a roof, which may be raised or pulled down at will. These are the bivalves. In some, again, the armour is composed of a coat of mail formed by overlapping plates; in others the shell may be tubular, or cup-shaped: while finally, in some the armour has become a species of backbone, and is entirely concealed within the body.

This armour, or shell, is formed by the edges of a fleshy fold of the body known as the "mantle." In the oyster and the mussel, for example, this mantle is double, enclosing the body between it as in a cloak, while in the snail it becomes more closely attached to the body, and in such a way as to form an air-chamber, and serve as a lung.

The under surface of the body is commonly fashioned to form a "foot," wherewith the creature may crawl, or swim, or even leap; while in the

dreaded octopus and his kin, the foot is modified to form in part a series of "arms," provided with powerful suckers, and in part a funnel wherewith to draw in water for breathing purposes, and expel it for the purpose of locomotion.

All the mollusca except the bivalves, which are headless, have a very remarkable tongue. This takes the form of a long band, closely beset with curiously shaped teeth, arranged in the most beautiful patterns. Examples of such "teeth-ribbons," as they are called, will be seen, in the form of greatly enlarged drawings, on the east wall of this gallery. They form a rasp which may be compared to the tongue of the lion.

Sight, hearing, and taste are possessed in varying degrees among these creatures, and reach their highest development in the octopus and squid, and their kind. As everybody knows, the eyes of the snail are borne on the tips of a pair of "horns," which can be protruded and drawn in at will. But in some, as in the chitons, the eyes are very degenerate, and very numerous, as many as 10,000 being arranged along the margin of the shell.

All the mollusca lay eggs. In some these are excessively small, and are retained within the protecting shell till hatched. Others deposit their treasures in capsules, often of wonderful and complicated forms. In the cuttles and their allies these take the shape of a bunch of grapes, each grape containing a single young one; in the nearly-related squids, on the other hand, each capsule

contains from thirty to two hundred eggs, and the cluster of capsules some forty thousand eggs! Every one knows the spawn-cases of the whelks, great rounded bunches of capsules, each containing several hundred eggs, of which only thirty or forty become whelks, these, like cannibals, having devoured their fellows! Some of the snails lay eggs hardly distinguishable from those of pigeons. The number of eggs produced by the bivalves is enormous. The common oyster lays a million or more. its American cousin ten times as many. Some of the river mussels are nearly as prolific, laying some two million or so. But a peep into the Table-case *C*, at the side of this gallery, will convey more than pages of description, for some of the egg-cases shown here are really wonderful objects.

These broad outlines of the main features of the mollusca will, I hope, be borne in mind while a survey is being made of the vast array of shells spread out in this great room. One must look at them not as so many "shells," but must try and conjure up the creatures which lived beneath their shelter, endeavouring to pierce the why and the wherefore of the bewildering variety of shape and colour.

Any attempt to describe the contents of these cases in detail would end in failure. It would require a big volume, and in the end would not prove very exciting reading, perhaps. Rather I propose to point out some of the more remarkable specimens, leaving my readers to fill in the gaps for themselves.

Let me begin, then, with Case No. 1 to the right of the main entrance to the gallery. This contains the lowliest members of the molluscan order—the "sea wood-lice" or chitons, creatures which differ from all the rest of their kind in having their shell made up of a number of overlapping plates. On this account, as well as because of their habit of rolling themselves up like a ball, the chitons have received the popular name of sea wood-lice. They are to be found in all parts of the world, but the largest species live in tropical seas, haunting, as is their wont, rocks and stones in places left bare at low tide, or at most in shallow water. Some, however, have taken to living at great depths. The giant of the tribe comes from Kamtschatka. As there are exceptions in the matter of dwelling-place, so there are in the matter of armour; there will be found in this case some curiously slug-like forms, wherein the plates are quite small, and set far apart, a fact which seems to show that their use for armour has passed, perhaps because they have discovered a new way of evading enemies, or a dwelling-place where, for other reasons, a weighty shell is not wanted.

In Case No. 4 are the limpets, with which many, if not most, of my readers must be familiar; and they will have discovered, too, how difficult it is to remove them from their resting-places on the rocks, where, when the tide is out, they are to be seen in hundreds. But it may not be so generally known that these creatures have the power of dissolving

the rock on which they rest so as to hollow out an area exactly fitting the rim of the shell, and further, that blind though they be, they possess the most extraordinary "homing" instinct. Test the matter for yourselves: put a dab of red paint on a shell, and a ring of the same colour on the rock round its edge. Then come back when the tide has risen. The marked limpet will be found far from home in search of food, but with low tide, lo, his place is filled again as though he had never moved. How does he find his way? And why so particular to return to the *exact* spot?

Let us pass on now to Case 9, which contains the curious "ear-shells" or "ormers," known scientifically as the *Haliotidæ*. In habits they resemble limpets, but they far surpass them in the beauty of their shelly armour. Externally this is beautifully sculptured, and pierced with a row of holes through which slender feelers are thrust, and though which also water passes to the gills. But the inside of this shell is even more beautiful, on account of the gorgeous lining of mother-of-pearl. Unfortunately it is not found nearer our shores than the Channel Islands, but it is abundant in many parts of the world, China, Japan, and West Africa possessing many species; and these furnish welcome food to the natives. As ornaments, throughout the world, these shells are highly prized.

The meaning of the gorgeous colours of some shells is something of a puzzle, since the soft bodies which they protect are the bodies of creatures to

all intents and purposes blind. Take the cowries, for instance, in Cases 32–35. Here will be seen a wonderful variety of colours, some exceedingly beautiful. Yet during life these wonderful patterns are kept zealously concealed by the soft, fleshy margins of the "mantle," which meet over the back. But the mantle is often even more brilliantly coloured than the shells! Among savage and civilised people alike the cowries have always been highly prized as ornaments. The orange cowry is worn by the chiefs of the Friendly Islands, and is considered their highest order of dignity. The negroes in parts of Africa use cowry shells as current coin. One species (*Trivia europæa*) is found on our own shores. One of the most valuable of the cowries in this collection is the *Cyprea leucodon*, the only specimen yet discovered.

In the matter of colour the beautiful "violet snails" in Case 38 must be specially noticed, not only because of the exquisite hue of the shell, but also because of the fact that they carry their eggs beneath a sort of gelatinous raft, filled with air-bubbles to keep it afloat—an unique device, and apparently very effective. These wonderful snails live out in the open ocean and feed upon jelly-fish.

And now from colour we turn to shape once more, passing to Case 46 to inspect the "worm-shells," which look rather like the tubes of those curious marine worms known as serpulas. During early life these shells are free and spirally coiled, but on reaching their full growth they become dis-

torted and attached to stones and rocks. Still more curious are the "carrier-shells" (Case 49). These tell a strange tale. Their owners, apparently for the purpose of disguise, and therefore of concealment from their enemies, contrive to cement to their shells pieces of rock, coral, and fragments of other shells, and hence are known among collectors as "conchologists" and "mineralogists," according to the nature of the material selected. Finally, they do not glide along the sea-bottom after the fashion of molluscs, but scramble along, apparently because of the rough nature of the ground over which they have to move. But in this peculiarity they are surpassed by the neighbouring "wing-shells" which *hop!*

In the matter of ornament, it will have been remarked, shells present a bewildering variety, but surely the most striking of all are the "rock-shells" of the genus *Murex*, ranged in Cases 70–76. There are so many, and they are so varied, that all one can do here is to call attention to the two types—between which every possible gradation can be seen. In the one the shell is covered with great, broad, almost ribbon-like expansions, rather like the fronds of sea-weed; in the other these spines are fine as needles. And to all this is added the beauty of colour. But this beauty is merely "skin deep," for by nature these creatures are extremely greedy, feeding upon other shell-fish, whose shells they pierce with their spiny tongues, then devour their victims at leisure!

In the next case (75) is one of the most extraordinary of shells. This is of the magilus. Early in life it seems to take up its quarters in some sunny nook in a coral reef. Now this is always growing, and in a very little while the magilus finds itself a prisoner, and to avoid being smothered has to keep adding to the mouth of its shell till it assumes the shape of a tunnel of quite surprising length.

By way of contrast we pass to shell-fish wherein the shell is quite a secondary matter, and no longer serves to protect the body. Take the beautiful "glassy nautilus," for instance. This is a large, semi-transparent animal with a compressed, fin-like foot which is used in swimming, the animal moving back-downwards. The shell, which resembles a "cap of liberty," is placed near the middle of the back, and serves to protect the gills. These creatures, like the violet snails, also feed on jelly-fish. The shell is extremely beautiful, and at one time was a great rarity, fetching as much as £100.

The "sea butterflies," "sea hares," and "dorises" in Case 94–97 are very interesting creatures, wherein the shell is reduced to a minimum. The "sea butterflies" swim by means of the flapping of a pair of wing-like expansions, developed from the sides of the neck. Some have small, glassy shells, some have none. They swarm in millions in some parts of the open ocean, discolouring the water for miles, and thereon baleen whales very largely feed.

The doris tribe (Case 97) are remarkable for their

beautiful colours, and strange appearance, for they have no likeness to "shell-fish." The curious branch-like growths along the back are the creature's gills. Of shell, in the adult, there is none, but in the early stages of life the creature dwells in a little shell like that of the nautilus; later on this is discarded. They are carnivorous, feeding on other molluscs and anemones. Though apparently unprotected, these creatures contrive to avoid injury, because they so closely resemble the sea-weed amid which they crawl.

Of the "snails" a vast array will be found here, some of huge size, laying eggs as big as those of a pigeon (Case 120). Many of these snails can live for an enormous period—as long as five years—without food. One specimen—the desert snail (*Helix desertorum*)—was fastened down to a tablet in this Museum under the belief that the shell was empty—and after three years it was found to contain a living animal!

We must turn now to that other great division of the mollusca, the bivalves—creatures that live within a double shell, headless, eyeless, tongueless, depending for food on currents of water brought in by means of the rapid vibration of delicate filaments, Hence that food consists of microscopic particles of animal and vegetable matter. Thus all are aquatic and most live in the sea. How marvellously complicated are their gills, and much else in regard to their anatomy, will be found illustrated here.

Without the wide variety in form and colour

displayed in the shells already surveyed, this group yet has some very remarkable members, both in the matter of form and colour: while some make up in usefulness what they lack in beauty. The mussel-tribe are good examples of this fact. To this group belong the strange "hammer oysters" and the "pearl oysters" (Cases 145–147). They are not, as might be imagined, true oysters. The "hammer oyster" is so called on account of its supposed likeness to a hammer, but to me it rather looks like an old door-hinge! The pearl oyster is one of the most highly prized of all the mollusca, because of the exquisite gems which are formed within its shell—or, more correctly, within the "mantle" which envelops the creature's body, and forms the shell.

It is popularly supposed that every pearl contains a grain of sand. But as a matter of fact this is never the case. On the contrary, every pearl is a coffin, enclosing the body of a small parasitic worm. This parasite has a curious history, for a part of its development is passed within the bodies of fishes. The adult stage is so spent, and when in due time, eggs are produced, the young escape from their host's body in myriads. If they have the good fortune to make their escape when in the neighbourhood of a bed of oysters, all is well. The swarm at once proceed to settle down within the defenceless shell-fish. Some reach the internal organs, and immediately begin to grow, but one or two are almost sure to pierce the creature's mantle, and their career

is at once ended, for the irritation set up causes the mantle to form around it layer upon layer of mother-of-pearl—which is the material wherewith the inner side of the shell is coated. The longer the oyster lives, the bigger the pearl grows. But the oysters are greedily devoured by file-fishes, and other fish with powerful jaws. When this happens the oyster's fate is sealed, but freedom comes for the parasites within, which had the good fortune to select the right place to bury themselves in, for the parasite, on the digestion of its former host, escapes into the fish, and there develops a stage further. Sooner or later the file-fish is eaten by a shark. And again freedom comes for the parasite: which now takes up its abode inside the shark, and soon produces eggs, when the story begins afresh!

At one time the fish that preyed upon the precious pearl oysters were, as may be supposed, hated by the owners of pearl fisheries. Now that this complicated story has been discovered they are given the freedom of the beds, for it is realised that if there were no fish to infect the oysters there would be no pearls. The pearls of whelks and mussels are formed in the same way, for, as most of my readers know, a large proportion of our common mussels contain small "seed-pearls." The Chinese obtain pearls by stealth, as it were, from a species of fresh-water mussel which they keep in tanks, after inserting between the shell and the animal either a small shot, or a round piece of mother-of-pearl, which soon receives regular coatings of "nacre,"

as the pearl material is called, and assumes the appearance of natural pearls. They also insert images of Buddha, which soon become cemented to the shell and covered with a pearly layer: they palm them off among the simple folk as a supernatural witness of the truth of Buddhism! A shell treated in this way will be found in Wall-case E, and here, too, will be found a shell containing a small fish similarly encrusted in pearl.

But we must hurry on, pausing at Cases 150–153 to look at the scallops or fan-shells, so beautiful in their coloration and sculpture, and such delicious morsels on the dinner table! The creature uses its foot, not for walking, but to spin threads to serve as an anchor! Young scallops are excellent swimmers, darting gaily through the water, like a child skipping, by the simple device of suddenly opening and closing the shell.

Our next halt shall be made at the cockles (Cases 192–194). Among the poorer people of this country the cockle is held in high favour, and the fashion of digging them up at low tide must be a familiar sight to all who visit the seaside during the summer. But the cockle is not a hermit, for with the return of the tide the burrows are forsaken, and the cockles emerge to leap about on a long worm-like foot. But the most interesting feature of the cockle is to be seen from a comparison of the species we know so well, with its near and remote relations, when a most interesting series of changes of form will be met with, ending in the beautiful cardissa, in Case

194, wherein the outline of the shell is heart-shaped and compressed along the opening of the valves—that is to say, at right angles to the aperture of the shell; whereas in the common cockle the reverse is the case. A little further along, in Case 196, we come to the clams, conspicuous among which is the giant clam, whose shell is so large that it has to be placed in a separate case, and will be seen in one of the upright cases in the entrance to the gallery. This is the largest of the bivalved molluscs, and may attain a weight of over five hundred pounds. The specimen here exhibited weighs three hundred pounds. A large pair bordered with gilt copper are used as holy-water vessels in the Church of St. Sulpice in Paris. Clams are met with in huge numbers in coral reefs in the Eastern and Pacific seas, and are described as presenting during life a beautiful iridescent glow of blue, violet, and yellow, variegated with fantastic markings.

We have now nearly completed our survey of the bivalves, but the few that remain to be noticed are among the most remarkable of their kind, on account of the amazing capacity for boring which some of them display, greatly to man's discomfort.

The first of these are known as the "gapers," on account of the fact that the valves of the shell are open at one or both ends. From one end the foot is thrust, from the other a long tube divided down the middle, like the double barrel of a gun. Down one barrel the water is drawn for breathing purposes, carrying food with it, and from the other the

foul water and waste products are ejected – a method of breathing and feeding, it may be mentioned, common to all the bivalves. The razor shells are nearly related to the "gapers," and most of my readers must have met with them on the seashore. They are remarkable for the enormous size of the foot, which can be pointed, or contracted, as may be required, for boring into sand; and so powerful is this organ that if the creature is disturbed it bores so quickly and to such a depth, that capture is well-nigh impossible. But they not only burrow, for by means of this foot they have the power of darting through the water like scallops. Once on a time "solens," as these molluscs were called, were regarded as a dainty dish by the ancient Greeks, and they are still eaten by the fisher-folk of the coast population of this country and abroad.

Now we come to the great engineers among the mollusca. These are the piddocks (Cases 201, 202). The shells of these animals are white and thin, but very strong, and are armed with prickles, which act like a file during boring operations, aided by an acid formed by the foot. Thus armed, these creatures bore equally easily into peat, wood, chalk, or the hardest rock. Nearly related to the piddocks are the teredos or ship-worms. They have a long, worm-like body encased in a tubular shell, but at one end (the buried end) will be found the pair of tiny valves disclosing the creature's true nature. From the mouth of the valves the boring work is done, and destructive work it is, for these apparently

helpless animals wrought terrible havoc to piers and ships' bottoming in the days before iron was used. Many a ship has foundered through their agency, while piers could only be saved from destruction by sheathing them with an armour-plating of nails. Specimens of their work are shown here. The watering-pot shell is another of the molluscan marvels. These have a tubular shape ornamented with a series of frills for nearly half their length, and ending in a sort of rose like that of a watering-pot. Hence the name. Now no one would suppose this creature to be a mollusc of the same class as, say, a mussel or an oyster, but, if the end of the shell near the rose be examined, there will be found embedded in the shell-wall two tiny valves—these represent the shell of the young animal ; only in later life is the disguise assumed.

The last of the mollusca to be discussed are the octopuses, cuttle-fish, and squids, and their kin, creatures that bear little likeness to the rest of the mollusca, at least on the surface. Few of them have any claim to beauty, yet most display, on occasion, a wonderful and vivid series of colour changes. To gain a mental image of the octopus on the one hand, and the squid on the other, an inspection should be made of the huge specimens suspended from the roof of this gallery. Note, in the squid, the great cigar-shaped body, and the head surrounded by a circle of sucker-bearing arms. The eyes are enormous, and in the centre of the bases of the arms will be seen a great parrot-like

beak. Woe betide the creature that comes within range of those awful arms, for speedily it is drawn backwards to the cruel beak and torn to pieces. In the octopus the body is more nearly globe-shaped, and is placed, as it were, on top of the arms. In both there will be seen projecting from beneath the head a tube. This is the siphon down which water is drawn to the gills, and from which it can be expelled with tremendous force, driving the body backwards with lightning speed. When the creature is alarmed its retreat is covered by the squirting out of an inky fluid, forming a thick curtain which renders pursuit almost hopeless. From this fluid or "ink" the paint known as "sepia" is made. Giants such as those suspended from the ceiling of this room are rare, but they may be found even on our coasts. In 1875, for example, one was stranded off the Irish coast whose shorter arms were eight feet long, while the longest pair measured no less than thirty feet.

As a very brief glance at the collection here displayed will show, the octopus and cuttle-fish tribe present a great variety in the matter of size and shape, and by reason of little blobs of colour just under the skin, which can be spread out or concentrated at will, a marvellously varied and vivid play of colour, shimmering the whole body, can be produced.

Many of the cuttle-fish have a hard, oblong, internal supporting shell, but in some, as in the extremely rare spirula, this shell is hollow and

divided into chambers. Such shells are to be obtained in thousands on the beaches of New Zealand and the islands of the Pacific Ocean, along the coasts of the Indian and Atlantic, and even occasionally on the beaches of Devon and Cornwall ; yet for all this, the animal itself is excessively rare.

There remain two other members of this tribe to be mentioned. One of these is the argonaut, whose beautiful shell, known as the shell of the "paper nautilus," is always highly prized. This shell, which is not fixed to the animal as in other mollusca, but is held in position by a pair of arms, is really a very exquisitely wrought cradle, for it is carried only by the female, and contains the eggs. By the older naturalists it was supposed that the arms, which we now know serve to hold the cradle in position, were used instead as sails, being thrust out of the water to catch the wind, and more than one poet has written of these supposed powers.

Byron, for example, refers to—

> "The tender nautilus who steers his prow,
> The sea-born sailor of his shell canoe."

All that now remains is to take a peep at the nautilus, or as it is often called, the pearly nautilus (Fig. 43). It is curious that alone among its kind, it should be a shell-dweller, and thereby it loses all likeness to its cousins the octopuses. The shell is remarkable in many ways. In the first place,

as will be seen in the beautiful sections exhibited here, the interior is divided into a series of chambers, though the centre of which runs a long tube, or siphon. The creature occupies only the last chamber, and adds a new one annually, or at any

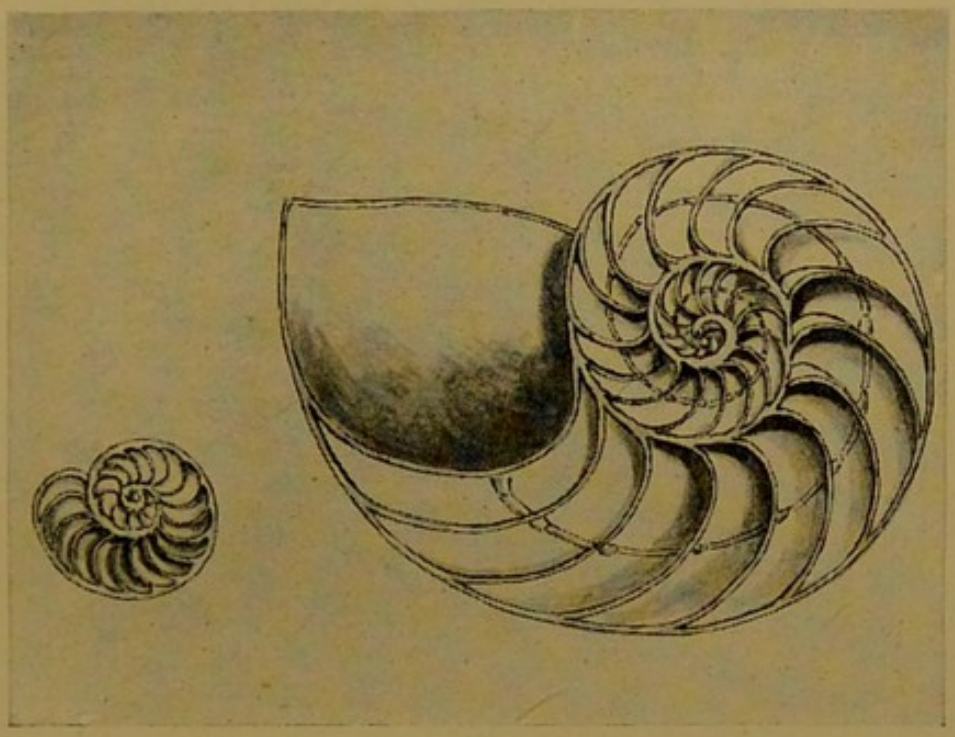


FIG. 43.—One of the Foraminifera and the Pearly Nautilus Shell.

rate periodically. Not the least interesting feature about the pearly nautilus is the fact that it is directly related to the old ammonites which swarmed in the seas millions of years ago, leaving their shells in myriads in the form of fossils (Chapter II.). And I would suggest that all who have a liking for comparing the animal life of past times with our own should make a point, after leaving this gallery, of visiting the Fossil Gallery containing the ammonites, so as to compare the nautilus of to-day

with the nautilus of the past. During life these creatures swim at the surface of the sea, shell-downwards, but most of their time is spent at the bottom, crawling about in search of food by means of their arms.

CHAPTER XI

CONCLUSION

"And the first Morning of Creation wrote
What the Last Dawn of Reckoning shall read."

OUR survey of the animal world is now almost ended: a few small groups have been omitted because they present little of interest save to the man of science: those that remain are creatures which, as a rule, appeal but little to most people, yet they possess features of quite remarkable interest, and hence they will be briefly discussed in this final chapter.

Take the creatures known as the "Polyzoa," for instance. Most people have never even heard of them: yet there are few who have not, unknowingly, derived great pleasure in gathering them, and pressing them out between sheets of paper when spending a week at the sea-side. Children, at any rate, find great delight in making such collections. The Polyzoa are supposed, to come to the point, to be "sea weeds." Now some of the specimens thus collected *are* sea-weeds—that is to say, are plants; but some, strange though it may appear, are *animals!* Such are the "sea-mats"

and "sea-firs." If pieces of such "sea-weed" be plucked when growing, placed in a glass jar, and examined with a lens, they will be found to be alive, studded with little waving tentacles, all busy catching food to thrust down an invisible mouth! The horny skeleton of the "sea-mat" or "sea-fir," as the case may be, has been slowly built up by these tiny creatures. If a dead branch of one of these plant-like specimens be examined, or a piece picked up off the beach, the surface will be found studded with holes: these are the chambers which once lodged the living animal. Specimens of such "sea-weed," and of the animals which built it up, will be found in Cases A and B, at the south end of the Shell Gallery. Why they have assumed this very vegetable-like appearance no man can say. But they are not alone in this, for yet another and much lowlier group of animals has a precisely similar habit of growth, so the "sea-weed" collected may contain examples of both groups. Now this lowlier group, belonging to what are known as the Hydrozoa, are in their way even more remarkable, for periodically they produce buds which grow into—jelly-fish! The plant-like stage in the life history is made up of a colony of individuals, some of which are engaged solely in procuring and digesting food for the benefit of other individuals, whose task is the production of bud-like growths which, sooner or later, break off from the family tree and unfolding float away as jelly-fish! These, in course of time, produce eggs,

which in turn give rise to minute bodies, which swim through the sea by means of the rapid vibrations of minute, hair-like threads. Finding a suitable locality, these little bodies settle down, and in due course grow and produce again a plant-like colony. Thus we have what is called an "alternation of generations." Some jelly-fish, however, have, as it were, grown out of the earlier tree-like stage, and give rise at once to other jelly-fish, but their ancestors, we know, passed a part of their lives on a tree-like colony.

The sea-anemones, the corals, and the little fresh-water hydra, are nearly related to these little jelly-fish-producing communities.

As to the various forms to which these jelly-fish-forming "sea-weeds" give rise, of corals, and sea-anemones, a really marvellous story could be told, but the limits of this little book forbid more than this hint of what a world of mystery they represent. Those who will, however, may learn much from the specimens displayed in the Coral Gallery and the guide thereto sold in the Museum.

But a word as to the corals, which are housed in the long gallery running at right angles to the Shell, Reptile, and Fish Galleries, and giving entrance to these. The marvellously varied shapes of these corals, some huge masses, some quite small, all carved, as it were, by some cunning hand in glistening stone, are supposed, by many, to be made by an "insect." As a matter of fact, these stony masses, whether large or small, represent the

internal skeletons of tiny creatures nearly related to and closely resembling sea-anemones. Some live in solitude, but some in huge communities, joining skeleton to skeleton to form enormous masses of stone known as "coral reefs." Off the coast of Australia is such a reef thousands of miles long, and woe to the ship tossed thereon during the storms which sometimes rage in these regions. How reefs, and lagoons, and coral islands are formed would make a story too long to tell here. But could one look down into the clear, cool waters of a coral reef a wondrous scene would be revealed—a true fairyland garden, a riot of gorgeous colour, made up in part by the bodies of the coral creatures themselves, and in part by fishes, and other creatures of no less brilliant hues. Coloured drawings on the walls of this gallery give some idea of the marvellous beauty of the coral-forming animals during life, and I hope that my readers, after inspecting these, will spend a minute or two in carefully comparing the various forms which the dead coral takes. Here are pieces like stony mushrooms, and there masses like some strange flower carved in stone. But more curious still, some pieces look like nothing so much as petrified sponges! What mysterious laws of growth are at work to bring about this likeness the wisest of us cannot even guess at. Yet it is just these puzzles which make the study of animal life so fascinating. And again, in this series, will be found relatives of the corals which in their mode of growth bear a most marvel-

lous likeness to plants; so much so that their animal nature by the earlier naturalists was quite unsuspected. Thus, then, we have three distinct groups of animals assuming branched, tree-like forms—the Polyzoa, the jelly-fish-bearing Hydrozoa, and the coral-forming Anthozoa. Here is a riddle which is yet to be read.

Most of us, probably, as we walk along the galleries of this wonderful Museum, look at the specimens displayed as so many "objects," curious or beautiful, according to our fancy, or capacity for analysis. But they are far more than this. They were once alive; they represent a world of mystery and beauty that the most imaginative and most learned among us can only dimly realise.

So far we have surveyed what is left to us of the records of the rocks, and among living animals have passed in review a great host, each more humble in the scale of life than the last. It now remains for us to take a peep at the humblest of all—the Protozoa or "first animals," which will be found at the east end of the Coral Gallery. These creatures are most of them so minute that it requires a microscope to reveal their presence. Yet, lowly as is their station in life, their influence on the world has been, and is, profound, while among them are to be found creatures of the most exquisite beauty.

That these are no exaggerations will be evident when it is realised that much of the solid earth on which we tread is made up of the hard parts of their dead bodies. The white cliffs of Dover, for

instance, are made up of the dead shells of Foraminifera, of which some beautiful models are shown here. Thousands of miles of the ocean floor are covered thickly with shells visible only under high powers of the microscope, but in delicacy and sculpturing far surpassing anything in the animal world which can be seen with the naked eye. Space forbids my mentioning particluar specimens, but a few minutes here will soon awaken an interest that will never wane. During life, it should be remembered, these skeletons were embedded in an almost colourless jelly, incessantly sending forth feelers, as it were, into the surrounding water in search of food, and drawing them in again with the captured particles, there to be digested and converted into new jelly, taking the place of that lost by the wear and tear of life.

Surely it is almost staggering to think that creatures so minute should play so important a part in world-building: but this is only one side of the part they play. Unseen and unsuspected, these tiny creatures have branched out along many paths, have adopted many modes of life: some, like the ocean-dwelling radiolarians, have developed skeletons of glassy consistence and exquisite beauty, others are mere specks of jelly with no skeleton, and among these some have developed the most deadly powers, infecting even man himself with disease and death. The dreaded sleeping-sickness of Africa, the cattle scourge of that great continent, fevers and agues innumerable, are due entirely to their malignant powers. The ants are a little people and accomplish

much, but the Protozoa are smaller still, and they accomplish more. Verily the battle is not to the strong, nor the race to the swift, alone.

But even among these, the lowliest of created creatures, there are degrees of lowliness; and the lowliest of all, in a sense, enjoy the pride of place in the world of living things, and this because they represent the living matter out of which all else living has arisen.

The little blob of jelly to which the name "amœba" has been given, that crawls all unconsciously on the mud of some silent and uninviting pool, so tiny that we must needs hunt it with a microscope, represents the primæval matter from which all things living derive their origin! In the dim and distant past, so distant that we can form no conception in terms of years, only such creatures as amœba lived. Therefrom, in course of ages, have sprung all the animal and plant life of the world! How this evolution has come about we can only surmise in part, but of a truth we know that it is so.

From the models displayed here the indescribable marvels of the radiolaria and other lowly forms will become apparent, and no less obvious will be the primitive simplicity of the amœba—a blob of jelly without definite structure or parts, possessing neither mouth nor digestive organs, and only the rudiments of the senses of sight, touch, and taste. As it crawls aimlessly along, particles of food are picked up by whatever portion of the body is

touched thereby. When the living jelly has extracted all nourishment from the particles ingested, the husks are just dropped as the creature glides along. Like all living things, the amœba grows, and after attaining a certain maximum splits into two, each half going its own way. Thus there is neither birth nor death in this weird method of increase. What turned the tide of events, and started the growth and development of new types of Protozoa, and in an ever-widening series, of new types of higher grades, no man can tell.

If those who have used this book as a companion to their wanderings about this Museum would only, having come to this last chapter, start their pilgrimage of these galleries over again, beginning instead of ending with amœba, and working upwards to man himself, marking at each step of the way the gradually increasing complexity of the creatures examined, then an insight into Nature and the mysteries of life would be gained such as would increase our reverence for the world in which we live, and lend a sense of mystery and poetry which else we can never feel.

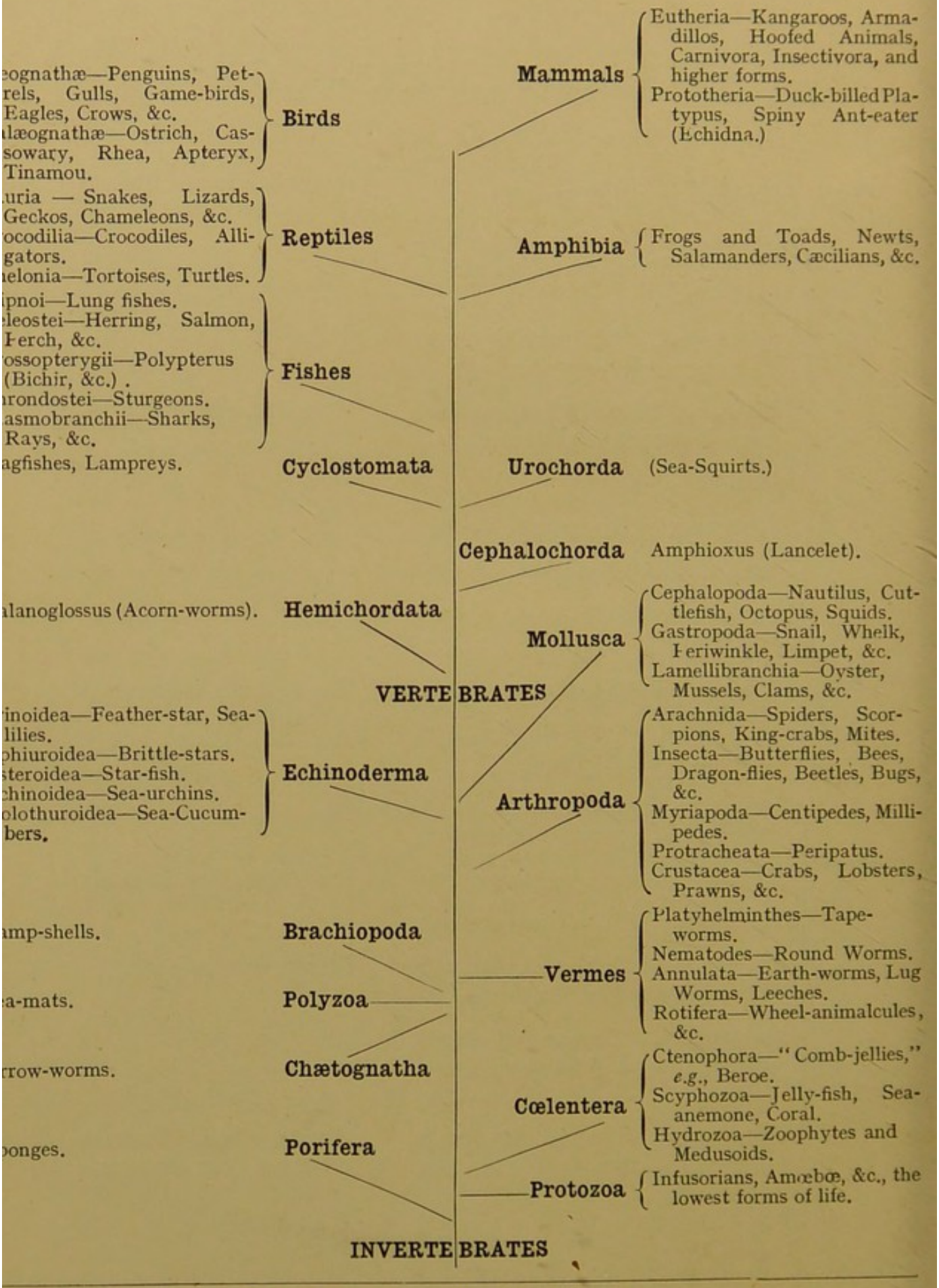
"He prayeth best who loveth best
Both man and bird and beast."

GEOLOGICAL TIME-SCALE

See page 181

Eras.	Epochs.	Examples.	Range in Time of Animals and Plants
Cainozoic or Tertiary.	Holocene.	Present-day conditions. Historic and Neolithic periods.	
	Pleistocene.	Palæolithic and Glacial or Ice-age periods.	
	Pliocene.	Norfolk forest-beds and Norwich and red crags.	Man first appears.
	Miocene.		
	Oligocene.	Hampstead beds.	
	Eocene.	London clay.	
Mesozoic or Secondary.	Cretaceous (Chalk Age).	Chalk in Norfolk.	
	Jurassic.	Portland stone. Oxford clay.	Birds and mammals first appear.
	Triassic.	White lias.	
Palæozoic or Primary.	Permian.	Red marls and sandstone. Magnesian limestone.	
	Carboniferous.	Coal measures.	Amphibia first appear.
	Devonian.	Old red sandstone.	
	Silurian.	Shales and grits, and limestones, Ludlow beds.	Fishes first appear.
	Ordovician.	Limestone, slates, and grits of Bala and Llandrilo.	
	Cambrian.	Tremadoc beds, Lingula flags.	Plants and invertebrates first appear.
	Pre-Cambrian.		No fossils yet discovered.

PEDIGREE OF THE ANIMAL KINGDOM *



* Fossil forms are omitted from this scheme.

GLOSSARY

ARTHROPODA.—Jointed animals with a hard chitinous external skeleton or case.

CEPHALOCHORDA.—Small, fish-like, degenerate vertebrates, represented by the lancelet or *Amphioxus*, without brain, skull, or limbs, and with liver, kidneys, and vertebral column of an extremely primitive type.

CYCLOSTOMATA.—Primitive fish-like animals with sucker-like mouths, armed with horny teeth, no distinct jaws, without paired fins, and with a cartilaginous skeleton.

EUTHERIA.—Mammalia with a completely closed four-chambered heart; includes all mammalia from kangaroos to man. (See PROTOTHERIA.)

HEMICHORDA.—The most primitive vertebrate-type, represented by the "Acorn-worms" (Balanoglossus). Worm-like animals, but with a rudimentary vertebral column, and breathing by gills.

INVERTEBRATA.—With the nerve-cord, when present, running along the ventral surface of the body, and *having no axial supporting rod.*

NEOGNATHÆ.—Birds in which the vomer and pterygoid bones become more or less completely separated in adult life. The vomer is always small, and may be absent. Includes all living birds except the ostrich-tribe.

PALÆOGNATHÆ.—Birds in which the vomer—which is large—and pterygoid bones of the palate are intimately connected.

PROTOTHERIA.—Egg-laying mammalia with the chambers of the right side of the heart imperfectly shut off, including only the duck-billed platypus (*Ornithorhynchus*) and spiny ant-eater (*Echidna*).

UROCHORDA.—Degenerate vertebrates, only the larva giving evidence of vertebrate structure. This larva bears a close resemblance to a frog tadpole; later it becomes fixed by a sucker-like mouth, and rapidly degenerates, losing all trace of the brain, eyes, and vertebral column, and becoming transformed into the familiar "Sea-squirts." Some members of this group are, however, free-swimming, semi-transparent animals, and have a very complex life-history. The term Tunicata is often used instead of "Urochorda."

VERTEBRATA.—With a nerve-cord running along the back immediately above an axial supporting rod or backbone.

INDEX

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