NATURE
IS STRANGER THAN
FICTION

by

John Y. Beaty

Illustrated by H. G. Rose

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This book is affectionately dedicated to my wife

ANNA E. BEATY

who has not only encouraged me to make long trips into the tropics, the mountains, the forests, the deserts, the plains, and the oceans in search of fascinating nature truths, but has entered into those expeditions with enthusiasm and has aided my work tremendously both at home and on the many thousands of miles we have travelled together

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INTRODUCTION

We all enjoy learning strange and unusual facts. ' best place to find these is in nature. Nature is only stranger than fiction, but there is no end to number and variety of strange facts to be learned at insects, animals, birds, plants, fish, spiders, and geol

It is easier to remember an astonishing thing t something prosaic. Other facts about an animal wh can walk without either a head or a body are rea recalled because the strange part fixes the whole in minds. When we learn that this same animal liter jumps out of its skeleton five times in its life and gr another skeleton, we know that it is an animal wo of study.

We grow to respect nature when we learn of a that fights its way upstream for one thousand m without any food ; of an insect which uses twenty- instruments ; of a bird which can fly among tree the dark without making a sound ; of one that five hundred miles alone over a strange ocean using than a gramme of fuel ; of an ocean bird which l on fish but cannot swim and would drown if it shc light on the water ; of a spider which easily ma itself invisible ; of plants which live under water at very brink of the Niagara Falls ; of a plant wh comes to life after being dead for five years ; or of which eats one hundred and fifty thousand animals one meal.

We are fired with ambition to study nature when learn of a fly with beautiful eyes ; of an animal t sits on its head and kicks food into its mouth ; another that eats only once a year ; of animals t

never drink ; of a fish that cannot swim ; of an animal that sleeps seven months each year ; of a bird that travels twenty-five thousand miles every year to get more sunshine ; of an animal that eats four times its own weight daily ; of a father fish that carries fifty-five baby fish in his mouth until they can care for themselves ; and of worms twelve feet long.

It is indeed a strange and fascinating world and most of us know little about it. It is to help and encourage those who wish to learn some of the most vital and astonishing things that this book has been written. Every fact on these pages has been carefully authenticated. None of them is based on opinion.

No person who continues to study nature can be lonesome, tired of life, bored with himself, waste much time in loafing—or ever be very unhappy.

There is a very full index at the end of the book.

ILLUSTRATIONS

ADULT ANT WEAVING WITH LARVA

Living Shuttles weave Silk Cloth

If you have seen cloth woven, you know that there are shuttles that move backward and forward between the layers of warp. These shuttles are made of wood. But there is one kind of shuttle that is actually a living animal. It is an ant named *Œcophylla smaragdina.*

Only the larva of the ant can spin silk. Usually it spins a silken cocoon in which it goes through one of its stages of development.

The adults of *Œcophylla* want a nest made of silk in which all of them can live. So they carry the larvæ to the place where the spinning is to be done, and move them backward and forward like shuttles as the larvæ spin silk. Thus they form a fabric which becomes the wall of the nest.

The Mangrove builds itself an Island to live on

The mangrove is an extraordinary tree in many ways. For one thing, it causes its seeds to germinate and send

out roots before it drops them from its branches. The seeds start to grow and the tiny plants which come from them have roots ready to use when they drop into the salt water or on to the wet soil surrounding the mother plant.

The plant is a foot or more long when it drops into the water. When it reaches an anchorage it proceeds to grow and, if it is not too close to the parent plant, it is likely to thrive.

If the new plant fails to reach the bottom of the water it may be washed away to another position where it can start growth, and where a new island may be built.

The mangrove has two kinds of roots—those which grow at the bottom of the trunk and those which grow down from the lower limbs and from the trunk above water. The aerial roots serve as props to stabilize the mother tree.

The grove thus made by one tree soon becomes an impenetrable jungle. But, as the tree is anchoring itself and increasing its progeny, it builds an island. It is easy to understand that silt and rubbish brought by the water soon fill in the spaces between the many roots. Islands are built in this way much more rapidly than might be expected. The mangrove creates soil in which it can grow. Some of the Florida Keys in America were built in this way.

The mangrove is quite common in tropical and semi-tropical salt marshes and in mouths of rivers emptying into the sea. The leaves are evergreen and the flowers are a yellowish colour.

He breaks his Skeleton Five Times

The grasshopper cannot grow unless it breaks its skeleton—not once, but five times. After it is broken it is of no value, so the grasshopper throws it away—

or rather, crawls out of it. He grows a new one and, a little later, breaks this also.

When the grasshopper is hatched out of the egg it looks very much like the adult except that it is very small. The skeleton is the hard shell on the outside of its body, as is the skeleton of all insects.

On the inside of the shell, the muscles are attached to the skeleton. The blood fills the body and does not circulate in veins as ours does. The internal organs float in the grasshopper's blood.

Before it breaks its skeleton the tiny grasshopper starts to grow a new one, and there is enough of the new one, although it is soft, to hold its body and soul together until the new skeleton can expand and harden.

The hardened skeleton will not expand and so it must be the soft one that is enlarged as it hardens. Only in this way can the grasshopper grow.

Murder in the Air

Certain tiny animals known as *Acaridæ* mites must have fresh bees to eat. The tiny little mites are so small that they are no match for the bee and its sting. But the mite has devised a way to get its necessary food. When a bee alights near it the little *Acaridæ* mite climbs on to the bee's back. It waits until the bee is flying through the air; then it kills its living aeroplane. When the bee drops to the ground the mite has food enough and to spare for many days.

Bumble-bees use the Bucket-brigade Idea

Bumble-bees used the bucket-brigade idea as soon as they began to build nests. The queen bee starts a family in the spring, after having hibernated all winter,

by building a few cells out of wax, laying eggs in them, sitting on the top of the cells to keep the eggs warm, and then feeding the young when they are hatched. Before the summer is over the family may have grown to as many as five hundred or, in some cases, to a huge family of one thousand bees.

The queen lays her eggs in a mouse's nest in the ground. But, as the family grows, the nest must be enlarged. After the young have grown large enough to help they arrange themselves in long lines and pass tiny pieces of grass from one to the other until they reach their destination.

No Men Soldiers in this Army

You know of the various women's forces, and that, in some countries, women have been reported as fighting along with the men. There is an army in nature which never contains any males. The soldiers of the ants' armies have always been females.

The male ants are so lazy, so blind, and so stupid, that they are of no use whatever to the ant tribe except to serve as the fathers of future generations. They live only a short time. They are of no value as soldiers. They cannot even feed themselves, and are unable to find their way home if they are lost.

But the females are divided into many castes. One of these in many ant families is especially designed for warfare. Usually the soldier's head is much larger than the heads of others in the family. Its mandibles are bigger and more effective as weapons. In some families the soldier is also provided with a gas tube through which it shoots poison-gases to drive off or destroy the enemy. The armies of ants are always made up exclusively of females.

The Sea-otter is Invisible on the Ocean's Surface

The sea-otter hides in open view right on the surface of the sea, in a collection of seaweed which has come to be known as 'sea-otters' cabbage.' It has heads like balls and about the same size and exactly the same colour as the heads of the sea-otters.

This bulb head of the seaweed rises and falls with the swell of the ocean—and so does the head of the otter. No better method of camouflage is known. There is the protection of colour, size, shape, and motion.

No Fish can swallow Pterophryne

If another fish attempts to swallow the strange ocean-animal known as *Pterophryne*, this peculiar fish protects

PTEROPHRYNE

itself by sucking its body full of water, and expanding its size so much that the swallower coughs it up.

Pterophryne is a salt-water fish which catches its own victims by opening its jaws so suddenly and so widely that the force draws a current of water into its mouth. This happens with such speed that any creature contained in the water enters along with it.

The food goes down a very large throat and, because there is so very much life in the ocean, *Pterophryne* never wants for a good meal. Since it is so easy to obtain food, this fish is lazy. It lives a very quiet life. Whenever it is hungry, it simply opens its mouth—and dinner is ready in the twinkling of an eye.

A Many-headed Monster

It has long been known that, if an earth-worm is cut in two, the head portion will grow a new tail. Its special structure enables it to live with only half its length and to add to its rear extremity until it becomes full length again.

However, until recent experiments were made, it was not known that earth-worms could grow several heads. It was then discovered that the farther forward a cut is made, the easier it is for the worm to grow a new head.

There seems to be a certain part of the front end of the worm which is dominated by the tendency to grow new heads, just as a cut at the rear of the body causes a new tail to grow. If partial cuts are made in the worm's body in the head-dominated area, and the nerve chain is severed at several points, a new head will grow at each incision. So there you have a many-headed monster.

Of course, it is not often that a worm has this sort of treatment. Such a thing probably occurs only in a laboratory.

The earth-worm is very essential to the continuation

of the fertility of our garden soil. There are as many as one hundred thousand earth-worms per acre in fertile soil ; they help to keep it productive, as Charles Darwin discovered many years ago.

A Fly as Fast as a Musket-ball

Although a modern rifle-bullet would probably outdistance the deer-fly, the speed of this insect is greater than that of the old-fashioned musket-ball. The deer-fly, with the scientific name *Cephenomyia*, has been known to fly at eight hundred and eighteen miles per hour.

Of course the deer-fly does not fly continuously for an hour and arrive at a point eight hundred and eighteen miles away, but its speed is eight hundred and eighteen miles an hour when it dashes here and there through the air. This was calculated from a motion-picture film, the speed of which is known.

It is the male *Cephenomyia* which makes the high speed, for the female cannot fly quite as fast. The male will make a dash of four hundred yards in a single second. This is as fast as the shells of ' Big Bertha ' travelled when the German army shot them into Paris during the first World War. If it were possible to drive an aeroplane at this great speed it would encircle the globe in seventeen hours.

The deer-fly travels half as fast as sound.

No Air for Six Months, yet the Little Shrimp continues to live

It is still a question as to how long the living embryos of the little brine-shrimp known as *Artemia* can live

without oxygen. It is known, however, that they will last for six months, for, in experiments conducted with these unusual creatures, they have been kept sealed in a vacuum for half a year and then taken out and put into strong brine. They continued to grow and live.

This is not the only unique characteristic of this odd animal. Its natural home is in unusually salty lakes. The ocean is not salty enough for it. It requires a heavy concentration of salt such as is found in the Dead Sea and in the Great Salt Lake in Utah, U.S.A.

In the hope that the length of time that this queer animal can live without air may be discovered, a number of them have been sealed in glass tubes in a high vacuum, and these tubes are to be opened at five-year intervals, that is, one in five years, another in ten years, another in fifteen years, and so on. This will continue until dead shrimps are found.

A Twenty-four-hundred-mile Flight on Two Ounces of Fuel

Even though we are accustomed to hearing of new and remarkable accomplishments in air flight, the statement that a flight of 2400 miles was made on two ounces of fuel is almost too much to believe. Yet the flight is made by thousands of birds every year.

The golden plover spends its summers along the seacoast of Nova Scotia but, according to one of the world's greatest specialists on bird migration, it prefers to winter in South America. The golden plover flies 2400 miles between its summer and winter homes, apparently without a stop, and it accomplishes the flight in forty-eight hours. This species is a variant of the golden plover which can be seen on moors and mountains in the United Kingdom.

The birds have been weighed at the beginning of their flight, when bands were placed on them, and again at the end of the flight in South America, and it was found that the difference in weight was only two ounces. This also gave the information that the birds made the flight in forty-eight hours.

If the flight is continuous during the whole forty-eight hours, the birds must travel at the rate of fifty miles per hour. But the golden plover's migration is even more remarkable for the small amount of fuel consumed. His flying efficiency far surpasses that of man-made aeroplanes.

Perhaps Some Houses should be built Full of Holes

The hurricane-plant protects itself against destruction from high winds by holes in its leaves. By means of holes, the plant is able to withstand very strong winds, because the air can pass through instead of breaking off the leaves. Perhaps in some countries houses should be built full of holes to prevent their destruction by hurricanes.

This strange plant is often grown in greenhouses in the United States, but it is native to the tropics. It grows, not only in exposed places where hurricanes destroy other plants, but also in the woods.

The plant has another unusual habit in that its fruit ripens only a little at a time. Its scientific name is *Monstera deliciosa.* The fruit, delicious as the name indicates, must be eaten a little at a time as it ripens. .

The hurricane-plant can live as a bush on the ground or it can climb trees and get its food out of the air with aerial roots.

Honey-bees Co-operative Society, Ltd

More like a corporation than an individual businessman is the community of honey-bees. Because a hive of bees is a manufacturing unit, we may logically refer to it as 'Honey-bees Co-operative Society, Ltd.' No one individual has all the benefits and all the profits from the activities.

No one bee completes any part of a manufactured product. Everything is made by the progressive assembly method. When wax is manufactured for combs, a little is made by one bee, a little more by another. One bee carries one piece into place, another bee adds to it. Eventually the comb is formed in perfect size and shape, but no one cell is made entirely by one bee.

Wax is made of honey. The honey-bees eat great quantities of honey and then anchor themselves to a firm foundation and go through a process of muscular exertion which finally results in wax coming out of tiny plates on the underside of the abdomen. Worker-bees remove this wax and carry it to the needed place.

The honey-bees also make a chemical product, brownish, resinous, and waxy, which is called 'propolis.' It is made from a substance gathered from the buds of trees and is used as a cement to close all the cracks in the beehive, and for other similar purposes.

The bees gather nectar from the flowers; this goes through the first process of honey-manufacture in the bee's honey-stomach as the bee flies back to the hive. When it reaches the hive, it delivers its load to one of the cells in the comb. Then it flies away to obtain more nectar.

Other bees add formic acid to the nectar which was brought by the flying bee. This acid helps to keep the honey from fermenting.

Still other bees fan the cells so that water will be evaporated.

No one bee does all of these jobs and no one bee completes the work of any one cell. You may truly refer to a hive of bees as the Honey-bees Co-operative Society.

A Shrub that folds its Leaves and apparently goes to sleep

At night the mimosa plant, like many others, folds its leaves and apparently goes to sleep. The leaves then become stiff and are quite easily broken off. With the rising of the sun, however, the plants awaken and the leaves unfold to get the necessary power from the sunlight.

The mimosa is often called the 'sensitive plant,' because it can be made to go to sleep by a touch. Touch just one leaf, and all the leaves on that stem will fold up, and the stem itself will droop to the ground.

This strange shrub is native to Brazil and is often grown in other countries where it can be kept in a warm, moist atmosphere. Travellers in Brazil, walking through beds of mimosa, have been astonished, on looking back, to discover that their trail appears like a path of desolation. Every sensitive plant that has been touched has closed its leaves and appears to be withered and dead.

These Insects feed through a Layer of Poison

There are some types of fruit-tree pests which are difficult to kill. Even though poison is sprayed on the trunks and branches of trees, these pests may attack the tree and live on its sap without any discomfort whatever. They are insects that do not move about.

When they are once anchored they lose their legs and eyes, for they have no further need to see or move. For that reason they are not always recognized as insects. As a matter of fact they are called ' scales.' One of the most destructive is the ' San José scale-insect.' Another is the ' oyster-shell scale-insect.' It is given that name because its shape and form resemble that of the oyster —but it is very much smaller. In fact it is so small that several thousand can live on one tiny twig.

The scale-insect anchors itself in place and pushes out a proboscis to penetrate through the poison which may have been put on the twig. The proboscis has a permanent ' well casing ' through which the insect pumps its food as desired.

The only way these insects can be destroyed is by means of a chemical which can burn through their shells and thus destroy their bodies.

A Bird can set its own Broken Wing

Broken wings among birds may be more common than most of us realize. Does a bird give up when its wing is broken? Not always. Birds are able to set their own bones by placing their wings in such a position that parts of the bone will knit while the bird sits quietly waiting for the process to be completed. This is only possible when the mate feeds the wounded bird, for birds must have food at frequent intervals.

Snakes fly in Borneo

Martin Johnson had unusual experiences in Borneo, one of which was seeing poisonous snakes flying through the air. The snake, of course, has no wings, so its

flight is not like that of a bird but rather like that of a flying squirrel. It crawls high up into a tree and then projects itself out into the air and glides towards a distant tree. The snake is small and poisonous. Mr Johnson photographed one of the snakes flying through the air.

A Plant that catches Insects for Food

Provided with leaves which contain sensitive hairs, the plant known as ' Venus's fly-trap ' (*Dionæa muscipula*) catches flies and other insects to obtain the nitrogen it needs as food. An insect touching the sensitive hairs causes the leaf-trap to fold quickly. In order to capture the agile insect the trap must close with the speed of a steel trap. The insect is then imprisoned by the sides of the leaf and the entrance is closed by the many tiny hairs or bristles which are so arranged that they interlock.

Thus, instead of getting all of its food through its roots, this strange plant takes in its animal food through its leaves. The insects are digested by juices which are poured into the leaf-trap. These juices are made by glands on the surface of the leaf, and are potent enough to convert the insect's body into plant food.

It commonly requires about a week for a leaf-trap to digest a good-sized insect. When the digestion has been completed, the trap opens. But apparently the plant needs a rest after such an exertion, and for many days insects can walk over the leaves without being caught. Possibly this is a part of the food-trapping operation, for if insects were caught every time they touched the leaves, other insects might observe the danger and avoid the traps.

A peculiar thing about Venus's fly-trap is that rain does not spring the trap ; neither would a piece of dirt

or a little pebble which fell on the leaf. If by any chance the trap does close upon an indigestible object, it opens again quickly. The leaves form a rosette with a trap on the end of each leaf. One trap probably

VENUS'S FLY-TRAP

catches only two or three insects before the leaf dies, but enough food is obtained from one insect to last the plant several days.

'The Male lives inside the Female

One of the strangest of all sea-worms is an animal with a body the size and shape of a walnut and a proboscis about a yard long. It lives only in the Mediterranean Sea and protects its body in a hole in a stone. The proboscis projects out of the hole and moves around, searching for food.

This description applies only to the female. For many years scientists were unable to find the male. Finally it was discovered that inside the female there were tiny animals, shaped like commas. Now naturalists have proved beyond a doubt that these are the male worms.

The name of this interesting animal is *Bonellia viridis*, and, while it seems very peculiar to the layman, it is quite well-known among scientists.

These Plants can drink a Stream dry

When there is a very thick growth of such water-loving plants as bulrushes and willows on the banks of a brook or irrigation ditch, these plants may actually drink the stream dry. They all need to take in a great deal of moisture which contains the plant food. This moisture passes through the stems into the leaves whence it evaporates.

Great quantities of moisture are given off into the air, not only from these water-loving plants, but also from all other plants. This can be clearly demonstrated by placing a tumbler over any growing plant. In a short time the inside of the tumbler will be covered with moisture which has evaporated from the leaves.

I will sacrifice One Leg to save my Life

Apparently the reasoning of many wild animals caught in a trap is, " I will sacrifice one leg to save my life." And very often those animals save their life by biting off the leg that is caught in the trap.

Trappers have often had the experience of finding an animal's leg—but no animal—in a closed steel trap. It is known that the animals hide themselves after biting

off a leg and treat the wound until it has healed. They do actually save their lives by giving up one leg.

It is also known that a mother rabbit, finding one of her babies caught in a steel trap, will bite off the baby's leg to release it.

It is said that a musk-rat will sever its leg when caught in a trap and will cover the wound with hemlock gum. This keeps out the dirt and germs which might infect the musk-rat while it is swimming. If it spent its life on land it would not be necessary to cover the wound with gum, but the musk-rat must go into the water for its food.

She flies through the Air without Wings

A tiny little worm-like larva must have grasshoppers' eggs for food. But the poor little fellow has no wings and no legs. He has no way of travelling here and there to find a nest of grasshoppers' eggs. So he waits patiently until a grasshopper alights near where he may be waiting. He then clings to one leg of the grasshopper and flies through the air with his potential food-producer.

When the grasshopper lays her eggs the little larva drops off and proceeds to eat. As he eats he grows, and eventually turns into a 'blister-beetle.' This same larva is just as well satisfied if a bee alights near it, for he is also fond of the kind of food he finds in a beehive, to which the bee, to whose leg he attaches himself, takes him. In the hive he eats both the larva of the bee and the honey.

Most insect-mothers lay their eggs in places where the young are surrounded by their needed food—but not the blister-beetle.

Animals doctor themselves

A fawn which has been wounded will lie on the ground with the wound exposed to the air and sun. Some instinct apparently tells it that the sun and air are healing elements. But the fawn goes even farther than that. It keeps the wound clean by licking it.

It is also known that many kinds of birds and animals eat certain herbs containing chemicals which their systems need. The herbs are eaten only at certain times, not as foods, but as medicine. Again, we say that 'instinct' tells the animal what to do. Instinct, in our language, describes some controlling force which we cannot explain.

Some observers have seen a wolf, which was bitten by a rattlesnake, chew snake-root.

The wild turkey is known to force her poults to eat the leaves of the spice-bush during a rainy spell when they are especially subject to colds.

The purpose of bathing, either in water or in dust, which most of us have observed among birds and animals, is to rid their bodies of parasites. A horse rolling in the dust is not putting on a show for his friends, but is actually taking a therapeutic treatment. Chickens and wild birds take dust baths.

It is said that old grizzly bears find hot sulphur springs in which to bathe, apparently to ease the pain of age.

Why Cats eat Grass

Both dogs and cats are occasionally seen to eat grass. This is not one of their usual foods, but it is taken by them as a medicine. Somehow the cat knows that, when its stomach is not operating properly, the eating of green grass will bring about a readjustment.

Wild bears are said to eat roots and berries at certain times, just as we take a cathartic.

It is known also that animals induce vomiting by eating certain things. Animals do indeed doctor themselves.

Yellow Warblers keep the Neighbour's Children in the Basement

In an effort to protect her own young the American yellow warbler tries to keep from hatching a cow-bird's egg which has been laid in her nest by building a new nest over the top of it. Sometimes the cow-bird comes back and lays another egg in the new nest. Then the warbler builds another storey above that, to keep the neighbour's children in the basement.

The cow-bird never makes a nest of its own. It lays its large eggs in the nests of birds whose eggs are smaller. If the cow-bird's egg remains in the nest, as is often the case, the baby cow-bird is hatched first. It is larger than the babies of the foster-mother, and so it gets more of the food that the warbler brings.

Very often the baby cow-bird will actually smother the fledgling yellow warblers because it becomes so big that it fills the entire nest. Although she recognizes the strange egg when it is first laid, the female yellow warbler seems unable to distinguish between the young cow-bird and her own babies after they are hatched.

Many of the other birds in whose nests the cow-bird lays its egg sit on it and hatch it out without any objection, though a few, such as the wren and the robin, are able to recognize the strange egg and have learned to throw it out. Sometimes, however, even these birds will accept the young cow-bird as their own. With the possibility of their not all being hatched, the cow-bird lays more eggs than would be needed if she performed her own maternal duties.

The baby cow-bird is not only able to beg food from its foster-parents but, after it leaves the nest develops

YELLOW WARBLER WITH NEW NEST ABOVE THE OLD ONE. THE LARGE EGG IS A COW-BIRD'S

a plaintive call which attracts other birds that are willing to feed it.

Bees make Waterproof Cement

We usually think of bees as in a hive, or hovering over blossoms in search of nectar. But there are many kinds

of bees. One, known as the 'mason bee' with the scientific name *Osmia*, builds cells in burrows in the ground. These cells are first lined with a coating of clay which has a rough surface. Then the bee makes a waterproof cement and covers the inside of this burrow with this cement, smoothing it out and pressing it down with a huge tongue which serves as a trowel. The cement is made from tiny pieces of soil mixed with a special saliva with which nature has supplied the *Osmia*.

Nature's Ploughmen

Without any steel ploughshares, horses, or tractors, nature has a tremendous army of workers ploughing the soil. As Darwin discovered many years ago, because of their habit of ploughing the soil, earth-worms are essential to crops—which possibly could not be raised without them.

They plough the soil by eating it below the surface, and passing the soil through their digestive systems. The earth-worm deposits this digested soil in pellets on the surface of the ground. In that way thousands of earth-worms on each acre of land bring soil up to the surface and place it where it can be used by crops. Furthermore, these long, lean ploughmen dig many holes in the soil through which air can pass. Thus the soil is aerated—a very essential condition for the growth of crops.

Ants are also effective ploughmen, although they are not so universally prevalent on farm lands as are the earth-worms.

Frost does its share by keeping the surface soil loose and friable.

American gophers and ground-squirrels bring up soil from below and desposit it in piles at the top, or scatter

it through the grass, according to their habits. Cicadas and other insects commonly get their food underground and aerate the soil by opening passageways in it, and otherwise preparing it for a useful job of crop production.

Chickens and pigs help to plough the soil. Everyone has seen fields in which pigs have turned over the soil with their snouts. The furrows are not as regular as those made by the farmer's plough, but they serve their purpose. Farmers need the help of nature's ploughmen.

Seven Feet of Jelly

Have you ever seen a jellyfish in the sea? Have you ever picked one up and found that there was nothing in your hand but a little blob of transparent jelly?

The jellyfish is a living animal. It swims, searches for food, and reproduces its kind. There are many kinds of jellyfish, some very tiny, others very large. One of the largest is seven feet in diameter and has tentacles one hundred and twenty feet long.

If a jellyfish is put into a bottle of sea-water and watched, its feeding activities can be observed through a hand magnifying glass. It will be discovered that there are openings along its mantle out of which the refuse from its feeding is discharged—not one, but whole rows of openings.

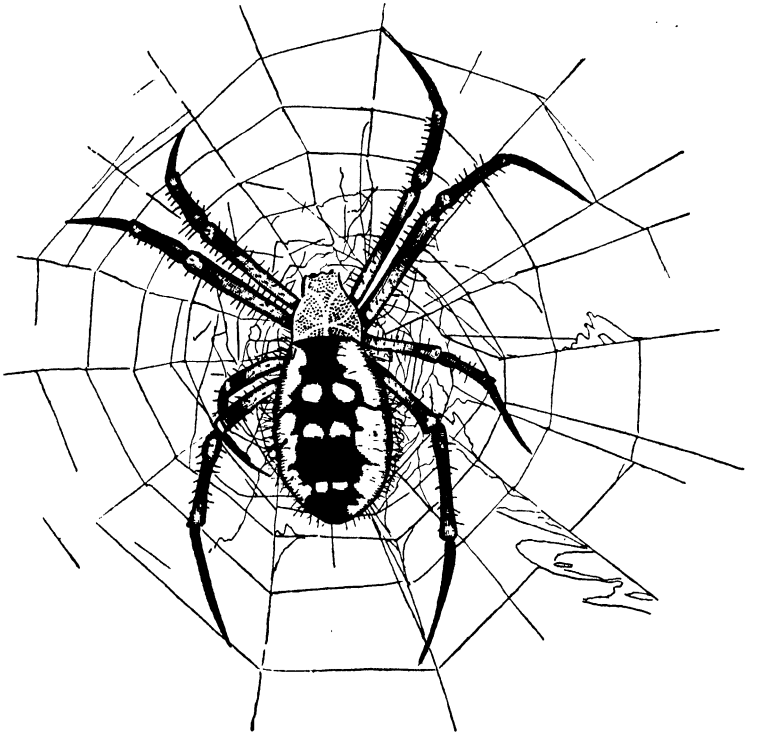
The water and the food it contains are taken into the jellyfish through the underside of its body which is its mouth. The food passes through its transparent digestive system.

The tentacles of the jellyfish are used for swimming and, in some kinds, for the capturing and stinging of prey. Some of the jellyfish have stings strong enough not only to shock but to injure your hand if you pick

them up out of the water. After all, even a jellyfish must protect itself.

Spiders are Effective Manufacturers

Spiders manufacture silk, anæsthetics, glue, and glue-proof oil. They are solitary individuals and are not



THE SPIDER CAN WALK ON THE STICKY THREADS IN HER WEB WITHOUT STICKING TO THEM

insects but arachnids, to which order of life scorpions and mites also belong. They share neither their food nor their silk and they keep their anæsthetics for their

own use. The female will not tolerate another spider —not even a prospective mate—anywhere near. The poor male must live alone, contenting himself with the scraps from his wife's kitchen.

The spider's factory is inside her own body. In one set of glands she makes a white liquid which hardens to form silk as it comes from her body and is twisted by several tiny fingers called spinnerets. In other glands she manufactures an anæsthetic which she injects through her hollow jaws into the body of any animal caught in her web. In other glands she prepares a glue which she puts on certain parts of her web to prevent insects from getting away when they have once hit the web in their flight.

But, to prevent her own feet from becoming entangled in the glue, she manufactures still another chemical product—a glueproof oil. This covers her hairy feet. She then walks, without sticking, over the glue which she has made.

This applies to the 'orb-weaver' spider, and to a number of other varieties. There are some, however, which get along without the silk, the glue, or the glue-proof oil (see *Spiders that capture Birds and Fish*, p. 137).

A Queen who has a Farm

One of the varieties of ants lives primarily on a tiny mushroom-like fungus. The fungus is so small that the average person would not notice it, and certainly, without a magnifying glass, would not recognize it as a fungus. It is carefully planted and tended by the queen ant whose scientific name is *Mycetosoritis hartmani*.

The most fascinating part of the whole operation is that, when a new queen, to found a new colony, flies away from the nest in which she was hatched, she

carries a quantity of fungus-spores in her mouth. In the queen's mouth is a tiny compartment, apparently placed there specially for carrying fungus-spores.

After the queen has been fertilized in her flight through the air, she drops to the ground, bites off her wings, crawls into a crevice under a stone, or into a crack in the ground, where she selects a suitable room for herself, plants the fungus bed, and lays her eggs.

By the time the eggs have hatched into larvæ, the fungus has grown into a food-crop. The queen harvests the crop and feeds her babies until they are large enough to care for themselves. After that they also look after her. When the colony is founded the workers take charge of the farm-work.

Communism succeeds in the Sea

Communism exists in several places in nature, but one of the strangest cases is that of the 'hydroids' known as *Millepores* and found in the warm ocean waters off the Florida Keys, Bermuda, and the West Indies. *Millepores* are sometimes called 'elk-horn corals,' although they are not corals at all. They live in branched houses which they themselves construct and have an appearance similar to some kinds of coral. You can guess, from their nickname, that these houses are branched something like an elk's antlers.

The skeletons—their houses—are pure white when dried. But when the animals occupy them there is a reddish tinge due to the colour of the animals themselves. Out of each little opening in the shell protrude the tiny arms of one of the animals in this communistic colony. When you look at the many arms through a magnifying glass, you might almost think it were a flower.

The various animals have special jobs to do. One

does nothing but sting the food with its tentacles so that some of the others which have mouths may swallow it. The ones with stings have no mouths. Those with mouths cannot sting. So they work together all for one, and one for all. The living mouths would be helpless without the sisters who have stinging apparatus. In the same way, the stingers would be helpless without the mouths. It is perfect communism. All the food belongs to the colony as a whole and not to any one individual. All are fed at a common table. And it is successful—in the sea.

No Strikes among Nature's Dairymen

In nature, the dairymen never go on strike. They are always willing workers. They are not men, but females which milk the cows on the leaves in your garden.

The green, red, or black plant-lice or aphides are the cows which supply delightful milk to several species of ants. So valuable are these cows to the ant family that the female worker-ant not only milks them but cares for them just as affectionately as any farmer cares for his four-legged cows.

The aphis has six legs and a long proboscis which it thrusts into the leaf of the plant on which it feeds. Through this proboscis it draws into its stomach the liquid from the inside of the leaf. There it is digested, part of it being passed out as a sweet liquid known as 'honeydew.' This is what the ants use as food.

One ant will fill her crop with honeydew and then, as she goes back to the nest, she may meet one of her nest mates who is hungry. They both stand on their four hind legs, place their huge tongues together, and the honey-dew passes from the crop of one ant to the stomach of the other.

In the winter herds of plant-lice are taken underground and are protected below the frost-line so that, in the spring, there will be plenty of seed-stock from which a new herd of aphides can be reared.

Not a Shooting Star—a Beetle

Visitors to the West Indies have frequently reported seeing shooting stars hit the ground. On investigation, however, it has been discovered that the light is made, not by a celestial body, but by a flying beetle called 'cucujo.' This insect was described by Spanish writers as early as 1525.

The beetle dashes through the air in such a direction and with such speed that it is easy to mistake it for a falling star. Its light has been measured and it has been found that we see as much light from it as from a star of the first magnitude. The star is of course much stronger, but it is millions of miles away and the amount of light we receive from it is equal to that of a cucujo beetle flying close to us.

It is said that the natives of the Spanish West Indies in early days used these beetles in the place of candles. On festive occasions the beetles were tied on the costumes of young people who danced through the streets at night. The lights gave a weird and fantastic effect. Other accounts state that cucujos were sometimes secured to the natives' feet to light their way along the forest paths at night.

Fireflies shine through a Frog's Body

The tremendous penetrating ability of the light of the firefly was demonstrated when scientists thought they had found a luminous frog. It was discovered that

the light shining from the frog's body came from its stomach and was produced by a quantity of fireflies which the frog had just swallowed as his evening meal.

A Living Fishing-line

The living fishing-line is a worm which can grow to be as long as ninety feet. If you found it under a stone on the seashore, you might think that you were looking at a piece of raw meat. It is rolled up almost as if it were on a reel. If you were to pick up this mass and drop it into a tank of water, such as a very large aquarium, you would discover that it is really a very long fishing-line—and is alive.

Should you ever do that, be sure not to have any fish in the aquarium, because the worm will immediately attack the fish. This fishing-line does not wait for the fish to come to it, but goes after its prey. It unwinds itself and attaches itself firmly to a fish by its mouth, which is a sucking disk. The long slender body then twists and turns as the fish attempts to get away. This is, of course, a drag on the fish which finally tires and gives up. Then the worm (*Nemertinea*) begins to eat its meal.

Nature's Combination Laboratory

In one laboratory nature uses the various instruments of physics, chemistry, and biology in the making of soil. On the island of Newfoundland nature is in the process of creating soil.

The rock-formation was solid until, by a tremendous physical movement of the earth, the rock was moved upward and large cracks were formed. Then the rain

came and moisture flowed into the cracks. With the coming of frost this moisture was frozen into ice. As this expanded, the cracks were widened, and small pieces of rock were broken away.

Then came the snow, and as it melted more water ran into the cracks and into other cracks which had been formed by the rapid change between heat and cold when the sun shone on the rock during the day and the night winds cooled the rock again.

But nature was using chemical processes at the same time. Nature continually employs chemicals, especially acid, to disintegrate rocks. As these break up, portions of them collect in crevices, or at the foot of the rock, and biology begins to operate.

Birds drop seeds into this newly forming soil. Insects crawl into the crevices and die. A man drops in a tiny piece of wood which he has finished using. Mammals add other debris to the combination which is rapidly becoming soil.

The seeds brought by the birds begin to grow and form plants. The wind has brought spores of ferns and fungi, and these have added to the humus which is so essential to a fertile soil.

Thus, by the use of physics, chemistry, and biology, soil is thus made out of rock. Then later on—maybe millions of years later—rock is again made out of soil. Backward and forward the process goes : first rock ; then soil ; then rock again. Nature is always busy in her combination laboratory.

Animals whose Bodies have Stems, Branches, and Leaves

Some day, when wandering along the seashore, you may pick up what you think is a piece of seaweed. You

will see that it has stems, branches, leaves ; in fact, you will probably find the fruit and flowers. The flowers somewhat resemble daisies or single dahlias in miniature.

They are, in reality, living animals. And the petals, which are white, rose, blue, purple, yellow, or green, are actually the arms of the animal which reach out into the sea-water to bring food to the mouth.

While each flower is a separate animal, the community of animals is so designed that each one does a special thing for the community. One blossom-animal does

HYDROIDS
(MUCH ENLARGED)

nothing but eat. Another serves as a nursery in which the young are hatched and nurtured. This strange plant-animal is one of the hydroids.

Fish carry Plants as Lanterns

Two kinds of fish (one bearing the scientific name *Photoblepharon*, the other the scientific name *Anomalops*) carry lanterns which are made of luminous plants. The plants are very tiny species of bacteria.

Just below the eyes of the fish are receptacles especially designed for carrying these luminous plants. A rich blood supply goes to these apertures to provide the plants with necessary food. Opaque screens protect

other tissues of the fish from the light, and there is a mechanism in the fish which turns the light on and off.

The Smallest Lamps in the World are Plants

There are tiny plants called bacteria which give off light. The light of an individual plant is so small that it cannot be seen, even with a microscope. This plant, however, never lives alone, but in company with thousands of others. When there are many thousands together, they produce enough light for us to see it. In fact, we can see the light from many millions of these bacteria when we look at meat in the dark.

Plants survive a Temperature of 190 Degrees Centigrade below Zero

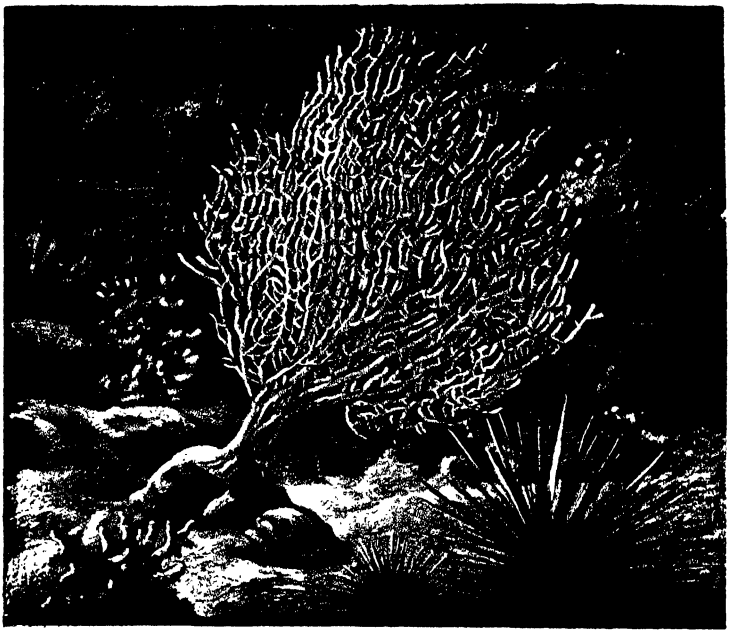
Luminous bacteria, which have the ability to give off light, may be cooled to the temperature at which air becomes a liquid—190 degrees Centigrade below zero. After such cooling, the plants, when warmed again, will live and give off their mystic light. This has been demonstrated by experiment.

Peacocks in the Sea

The peacocks in the sea are not birds, but worms which spread out beautiful many-coloured fans, and seem even more wonderful and more beautiful because they are under water.

Peacock-worms live on sandy areas in shallow water and in little pools left by the tide when it goes out. Their outspread 'feathers,' which serve as gills, are not

only coloured but also have spots on them, like those of a real peacock. These feathers disappear into a burrow



THESE 'PEACOCKS' LIVE IN SHALLOW WATER

if the worm is disturbed. But most of the time they are spread out on the sand in the shallow sea-water.

Rattlesnakes for Bedfellows

Why should any animal want to sleep with a rattlesnake, which eats other animals? The nine-banded armadillo, which lives in southern Texas, must derive some advantage or comfort from having a rattlesnake for a bedfellow. The armadillo shares its burrow willingly with the poisonous snakes which grow to immense size in southern Texas.

The armadillo is protected all over its body, except on the underside, with hard horny shell. It has nine narrow bands of shell over its back. Its head and nose are protected with shell. Even its feet and its long tail are covered with such a hard substance that injury is almost impossible (see illustration on p. 50).

The armadillo's head, however, is long and narrow, and it is difficult to understand why a rattlesnake does not try to swallow the head at least. We must assume, therefore, that the friendship which is so common between these two animals must result in some comfort and benefit to each other. It is very common to find both a rattlesnake and an armadillo in the same burrow.

This odd habit has cost several men their lives. One case is known of a man who was hunting the wild armadillo and mistook the tail of a rattlesnake for that of a harmless, armoured earth-pig. Before he could let go of the rattlesnake's tail he had been bitten and severely poisoned ; he died within three hours.

It breathes through its Knees

All trees breathe through their leaves but this does not provide the oxygen needed by the roots. Therefore roots also must breathe.

Here the bald cypress tree, which grows in swamps where the ground is flooded for at least a large portion of the year, encounters a problem. The roots have no gills as fish have, so they cannot take the oxygen out of the water. To provide breathing organs the bald cypress tree grows ' knees ' from its roots, which project above the surface of the water and absorb oxygen from the air.

The bald cypress is a deciduous tree, although it bears cones. During the winter its leaves fall off. In summer

most people would call it an evergreen. It resembles other coniferous trees, commonly called ' evergreens.' But not all evergreens retain their green needles throughout the year. The larch, another water-loving tree, also sheds its leaves in winter.

Crayfish go into Warm Water to breathe

The crayfish of fresh-water streams does not know that it is necessary to go to the surface of the water to breathe. So nature has provided it with the instinct to move to the warmer waters when it needs air. The colder water in a stream is at the bottom, the warmer water at the top. If the warm water is at the bottom, the crayfish actually goes to the warmer water where it cannot breathe, and stays there until it dies.

The instinct to be in warmer water when it needs air is so strong that it cannot go to the surface if the surface-water is colder. This condition, of course, does not commonly exist in nature, and this strange control of the animal's breathing was discovered only through experiment.

Plant-like Animals with Beaks like Birds

One species of sea-animal which is called a ' sea-mat ' very much resembles seaweed, and is frequently mistaken for it. This species is known as *Bugula*, and is covered with thousands of branches, each branch bearing at its end an appendage which looks for all the world like the head of a bird. The ' beaks,' which open and close, are so small that you must use a hand-lens to see them.

Bugula are found in pools left along the shore when the tide recedes.

The Bird with the Largest Wings

The bird with the largest wing-spread—frequently over eleven feet—is *Diomedea exulans*, commonly called the ' wandering albatross.' One of these birds is known to have travelled 3150 miles in about nine days. Yet when it is observed at sea it appears hardly ever to move its wings.

Of course, it does actually make movements with its wings, but not, as a rule, in a flapping motion. As it glides, there is a slight tilting of one wing or even of a few feathers. The bird changes its course without our being able to see what it has done. It is believed that it stays in the air for many hours at a time, descending only for food, and going ashore only at breeding time.

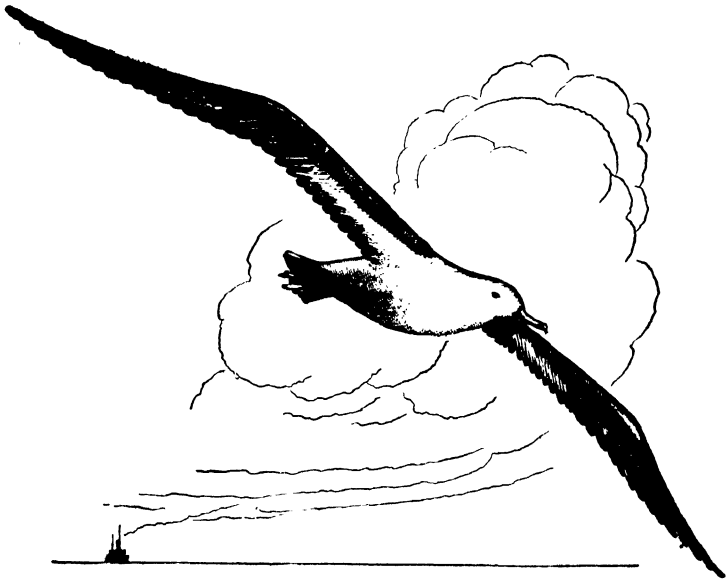
The albatross is a glider *par excellence* and believes in saving its energy until it is necessary to use it. It lets the wind carry its clumsy body for long distances rather than exert its own efforts. Because it depends so much upon the wind it stays in that part of the world where the wind is always blowing.

We call its body clumsy because, when it alights on the ground or on the deck of a ship, it has difficulty in standing up. Its legs seem to be weak and appear to be made for swimming rather than for walking. A bird that is released at the top of a steep cliff falls to the bottom without being able to catch itself and take off in flight.

The males go to the breeding grounds, which are on uninhabited islands, before the females. The females soon arrive, a few at a time. At first there are four or five males to each female. They crowd about the female, making queer sounds and trying to touch her beak with theirs. She encourages them, but very carefully avoids showing more attention to one than the other. If there are too many to crowd about her, those

that cannot attract her attention walk slowly away, their heads hanging toward the ground and swinging from side to side.

After a little while, however, more females come and finally there are enough for each male to have a mate. Together the two build a nest which is in the shape



THE WING-SPREAD OF THE ALBATROSS IS OFTEN OVER ELEVEN FEET

of a mound about two feet high and about four feet in diameter.

At breeding time the legs seem to be stronger and the birds wander about on the rocky island with much more confidence. When they wish to take off they run down a rocky slope into the wind until they gain enough speed. When they cannot get up the necessary speed, they find a steeper slope.

Once they are in the air the wind carries them upward, forward, downward, in most graceful curves.

Leaves completely cover the Branches

We expect to see trees composed of branches and leaves, but there is a tree which is so completely covered with leaves that not a branch can be seen. Furthermore, the leaves are not the kind we are accustomed to recognize as such, but are scales with thorns on the ends.

The tree, whose scientific name is *Araucaria imbricata*, is usually called a 'monkey puzzle' because the monkeys have not found a way to climb it. There is no spot on the entire tree where anything other than a bird or an insect can retain a hold.

It is rather a large tree. One specimen at Santa Rosa, California, was some forty feet high and had a spread of twenty feet or more.

The leaves are evergreen and beautifully symmetrical. The monkey puzzle is a native of Chile but has been imported to the warmer parts of other countries.

Melons that grow on Tree-trunks

We think of melons as growing on vines that run along the ground. But in southern Florida there are trees on the trunks of which great quantities of fifteen-pound melons grow. They do not grow from the branches but in a more or less continuous mass from the sides of the trunk.

This melon-tree has the scientific name *Carica*, but its common name is 'papaya,' and the melon is called the papaya melon. The flowers, which of course come before the melon, are reddish or yellow, and each fruit is on a separate stem which grows directly from the trunk. The fruit has a faint yellowish flesh and a flavour like that of the musk-melon.

The Mystery of the Crooked Pines

It is common for pine trees to grow with straight trunks. Seldom do you see a pine with a distorted trunk. But in the Canadian Rockies, near Jasper, Alberta, is a whole valley of crooked pine trees. Their trunks have assumed most distorted shapes. Each one is different and very few are straight. This valley is known locally as the Valley of Crooked Trees.

The solution of the mystery is most interesting and instructive because it is based upon a principle of tree growth which is not often seen so well illustrated. While the trunk of the pine is inclined to grow straight up, the roots below ground will grow in any and every direction to find moisture and soil.

Close examination of the Valley of Crooked Trees has revealed a sufficient number of large rocks near pines to indicate that they caused the deformity. At one time this was not a valley but a level plain filled with rocks. The pine trees gained a foothold and sent their roots in among the rocks, twisting and turning to find the needed moisture. The roots, as is common, grew into very different shapes.

Then water washed away some of the soil between the rocks and finally the rocks were carried away to be used in road building. Then the exposed roots became trunks and grew bark as would those of any tree if they were exposed.

What appear to be crooked trunks were originally roots. The trunks, above the place where the roots once began to grow, are approximately straight.

Complete New Plants grow on this Leaf

The leaf of the ' life ' plant or ' live-leaf ' plant, with the scientific name *Bryophyllum*, has sharp points along

its edges. At each of these points, and while the leaf is still attached to the plant and functioning as usual, a new plant will grow, complete with stems, leaves, and roots.

After the young plant has a complete set of roots it will drop to the ground. Its roots will take hold and, in time, will grow. If the leaf is broken off, each little plant growing round its edge will send its roots into the soil for moisture and a new family of plants will be started. This plant will also reproduce from seed.

This Bird seemed to prefer a Wooden Egg

Although herring gulls have very keen eyesight and instinctively return to their own nests among hundreds, they do not recognize their own eggs. A wooden egg as large as an ostrich's egg (which is eight times the normal size of the egg laid by the herring gull) has been substituted for the gull's own egg. The gull, after great effort, squatted on the over-sized egg and seemed to prefer it to its own.

A further test has been made by removing the eggs from the gull's nest to a short distance away. The eggs were plainly visible but the gull returned to the nest and tried, without eggs, to hatch young.

An Underground Bush

Those who travel through the desert and see the creosote bush, which is the most prevalent of all the plants in the south-western section of North America, wonder how it can live without rain. But what we see when we look at it is only a small part of the shrub, for most of it is underground. There is far more wood

and tissue in the roots, which extend long distances under the ground, than there is in the stems above ground.

The creosote bush, or greasewood, whose scientific name is *Larrea tridentata*, goes far and deep to get what little moisture may have been preserved in the soil from some previous rain. It is said to have solved, better than any other plant, the problem of living in a desert.

Because it requires so much area in which to spread its roots, other plants are seldom found near it. Travellers in the desert frequently mention that creosote bushes appear to have been planted out like an orchard at equal distances. This is due to the fact that each bush so completely drains the soil under which its roots are spread that other plants cannot find lodgment there.

Room and Board without Charge

Scientists have not been able to determine why it is that some animals live together in peace when there is no apparent benefit to either of them. There are many cases, however, in which one animal is supported entirely by another which might more easily get along without the parasite, so far as we can understand.

The hermit-crab is a crustacean which was not provided by nature with a shell to protect its soft body. So it appropriates the empty shell of a dead snail. Into this it backs so that its body is protected. Then it drags the shell along wherever it goes—hunting for food.

Very often barnacles will have established themselves on the outside of this shell and they, too, benefit from the travels of the hermit. An even stranger parasite than the barnacle is a worm which lives on the inside of the shell. It comes out to feed only when the hermit-crab is feeding. The worm actually takes

its food from between the hermit-crab's jaws. We wonder why the hermit-crab does not make a mistake occasionally, and eat the worm. But it does not. It remains quiet while the worm has its meal. When it

THE HERMIT CRAB APPROPRIATES A SNAIL'S SHELL

has fed, the worm retreats to its perfectly protected home to digest its meal.

The hermit-crab furnishes both room and board without charge, so far as we know. If the worm does perform some useful function for the hermit crab, that function is not yet known to man.

The Jumping Cholla

The 'jumping cholla'—pronounced 'choy-ya'—is a species of jointed desert cactus belonging to the *Opuntia* family.

The cholla is covered with millions of sharp spines which have tiny hooks on their ends. If you touch one of these spines, the whole section on which the spine grows leaves the plant and sticks to you or your clothing. This breaking away is so sudden and easily accomplished that it appears as if the plant has actually jumped at you. The 'jumping cholla' is sometimes called 'teddy-bear cactus' because its thick spines resemble a teddy-bear's fur.

If one of these pieces of the jumping cholla becomes attached to you, you must use special methods to get rid of it. If you hold it with your other hand to pull it away, it sticks to both hands. The only thing to be done if a cholla attaches itself to your hand or clothing is to take hold of it with metal tweezers or push it away with a knife.

No Yucca—No Yucca-moths; No Yucca-moths—No Yucca!

There are a few cases in nature in which a plant and an animal must exist together or not at all. One of the spectacular plants of the desert, the yucca, cannot be perpetuated without the services of a certain insect called the 'yucca-moth.' Furthermore, the yucca-moth cannot be perpetuated without the yucca plant. The one is wholly dependent upon the other.

The foliage of the yucca plant is like a bundle of bayonets spreading out and pointing in all directions. The flowers, which occur in early spring, are a beautiful creamy white and can be pollinated only by the yucca-moth. The flower-stem grows straight up from the centre of the foliage and at night, when the yucca-moth is flying, the bell-shaped blossoms open in great bunches.

The moth crawls over the stamens of a yucca flower, and in doing so, gathers a load of pollen. Then it goes to another flower where it deposits an egg in the ovary, and also some of the pollen previously collected. In this way the moth goes from blossom to blossom, carrying the necessary pollen from one plant to another.

The larva of the yucca-moth must feed upon the yucca seed. It cannot eat any other kind of food. The yucca's seeds cannot develop without the services of the adult yucca-moth. The busy mother, however, pollinates many more blossoms than are necessary to supply seeds for her offspring, and in this way the yucca seed is perpetuated.

Varnish keeps Water in these Leaves

Water is precious in the desert. Plants in temperate and tropical zones evaporate great quantities of water from their leaves. In the desert this evaporation must be prevented.

The desert verbena (*Abronia villosa*) is an annual and must retain all the moisture that it can secure during a spring rain. To make this possible its leaves are varnished so that moisture will not evaporate from them.

The fluid inside the leaves and stems of the desert verbena, as in the case of many other desert plants, is more like mucilage than water. It is a sticky, viscid substance and does not evaporate quickly.

The desert verbena survives for a longer period than do most of the other desert herbs. It produces stems, leaves, and flowers, promptly after a rain. It thrives long enough to mature seeds and so provides for its reproduction.

Mosquitoes are attracted by Light

The instinct in the larvæ of mosquitoes which live in stagnant water is to go towards the light. They must go to the surface to get air to breathe, but apparently the only reason why they go to the surface is that light attracts them.

A light placed at the bottom of a pool of water caused all the mosquito larvæ to go to the bottom and stay there until they were drowned—perhaps 'suffocated' is a better word, because they were killed by suffocation. When they were at the bottom of the water they could not obtain the necessary air.

Tickle me and I'm your Friend

The nine-banded armadillo, which lives in south-west Texas, is covered with a thick hard armour except on the underside.

The armadillo lives in burrows in the ground and has long sharp claws. Those who try to catch one often reach its burrow just about the time its tail is disappearing in the ground. Occasionally they attempt to capture the armadillo by seizing the tail. But the long strong claws dig into the ground and it is almost impossible to pull the little animal from its hole.

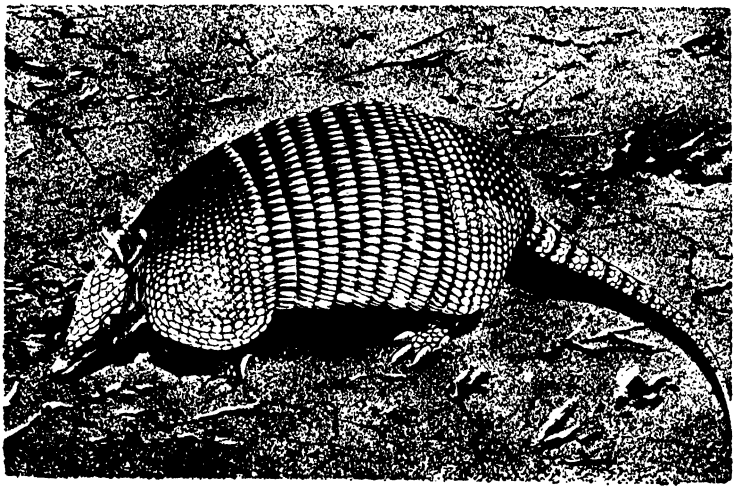
Hunters, however, have learnt that if they tickle the underside of the armadillo's body with a small stick the animal immediately relaxes and can not only be pulled out of the burrow but will be very friendly with its captors (see also pp. 37–38).

The armadillo is very useful because it destroys many worms and harmful insects. It is also a meat-producer and many people consider that its flesh has a delicious flavour. The shell is made into novelty baskets, lamp-

shades, and other interesting things. The oil from its fat is used for medical purposes and for preserving leather.

All Girls together!

The only animal in the world that always produces its entire litter of young of one sex only is the armadillo. The nine-banded armadillo always has four young,



THE ARMADILLO

and the four are either all males, or all females. No case has been found in which the litter was mixed in sex.

The young are reared in a burrow which is often six feet long and are fed on their mother's milk. When they grow older, however, they feed on the same food as their parents. This consists of eggs, worms, insects, and tender roots.

These interesting little animals root in the ground like domestic pigs, hunting for insects and roots. Even

the young are protected by a hard shell which covers the entire body except the underside.

They make very attractive pets and, while they have long, sharp claws with which they protect themselves when necessary, they make friends with man very readily and are easy to care for. They sleep during the day and hunt for food at night. For that reason they are not often seen in the wild state unless they are searched out by some one who has a knowledge of their habits.

Alive Three Years without Water

All plants and animals in the south-western deserts of the United States must learn to live with very little water. The champion of them all is the largest of the cacti, the giant sahuaro (*Cereus giganteus*). It has been known to survive through three years of absolute drought.

It rains occasionally in the desert, and then it rains hard, but usually for a very short time only. That is when the sahuaro (as well as the other desert plants) must be most active.

The sahuaro's roots absorb water rapidly, and transmit it to storage-tanks in the huge stem which sometimes reaches a height of fifty feet. This stem, in which there are cells to hold the water, is held erect by twenty or more ribs of wood, each making a ridge on the cactus stem. As the water inside is used, these ribs go closer together and the cactus shrinks. When it expands, after rain, the ribs spread apart and the cactus seems to grow within an hour. The giant sahuaro is found almost exclusively in Arizona, although there are a few in southern California and in Mexico.

This plant frequents the high rocky slopes rather

than the low, level country and is often found among rocks where the possibility of procuring moisture or a foothold seems to be very remote. But the sahuaro thrusts its roots into crevices which our eyes would not see. It is in no hurry to reach maturity. It is thought that some of the very large ones have lived as long as two hundred years.

Water-tanks in the Leaves

The leaves of plants are the digestive organs and evaporation of water from the leaves is a common process. The leaves of trees give off many gallons of water every day. The leaves of plants that live in the desert, however, must not give off too much water or the plants will die.

One desert plant has leaves so constructed that they actually serve as water-tanks. The leaves are three-sided, thick, and succulent. Each of the three sides is about three-quarters of an inch wide. The sides taper towards the end. These leaves grow so thickly on the stem of the plant that the entire surface of the ground is covered, and thus water cannot evaporate so quickly from the surface of the ground under the plant.

The effectiveness of this type of leaf is due both to its internal structure and to its shape. It has a larger water capacity with less surface from which water can be evaporated than any other type of plant leaf.

The sea-fig is a desert plant, but it is not found on the hot deserts of the interior. It grows in the salt deserts along the Pacific Coast of California, and variations of it may be seen growing on stone walls and cliffs along the south coast of Cornwall.

The sea-fig is an evergreen perennial herb. It continues to be green for many years. It has a structure something like that of the cactus, but it is not a cactus for it has no spines.

The scientists have given the sea-fig a long Greek name, *Mesembryanthemum*. It means ' mid-day flower.' In the middle of the day when the sun is hot the sea-fig sends out its beautiful blossoms, so that the seeds can be produced. These are, in turn, carried by the wind or by birds to some new location.

Flowers that grow on Telephone Wires

Instead of growing in the soil, the flowering plant which is erroneously called a moss—either Spanish or Florida moss—can grow just as well on a telephone wire as on the limbs of a tree, for it gets its food entirely out of the air. It is not related to any of the mosses ; as a matter of fact, it is a member of the pineapple family. It has stems, and leaves, and flowers, the same as any flowering plant. Its stems and leaves are so designed as to absorb moisture from the air, and with the moisture it gets food.

Both the stems and leaves are covered with very thin grey scales. The general appearance of the Spanish moss is grey, but the stems and leaves contain green chlorophyl. This helps to feed the plant because it is chlorophyl that takes energy from the sunlight and converts water and carbon dioxide into sugar on which all plants live.

The scientific name of Spanish moss is *Dendropogon*. It is common all through the southern states of America which border on salt water. The inlets of Louisiana are made particularly striking by the *Dendropogon* which hangs from the branches of trees.

More Flowers than Leaves

When the palo-verde tree blossoms in the desert in the middle of March it is covered with beautiful yellow flowers. One would expect that the tree would be covered with leaves. The leaves are not only scanty, but are very small, and stay on the tree only a very short time.

Since leaves are the primary appendages for the digesting of food, it seems extraordinary that the palo-verde tree (*Cercidium torreyanum*) can remain green throughout the season. The greenness, however, is not of the leaves, but of the stems and twigs. They are green because there is chlorophyl near the surface just as there is chlorophyl in the leaves. Thus the tree's food is digested in the bark of the stems and twigs.

This Parasite feeds on a Parasite

A mistletoe plant was growing on one of the acacia shrubs called ' cat's claw ' in the South-western Arboretum at Superior, Arizona, in 1940. To the mistletoe was attached another parasite, the dodder. The mistletoe fastens itself to the tissues of its host from which it takes all its nourishment. When the mistletoe becomes very prevalent on a single plant, as it does sometimes in the desert, it uses all the nutriment that should be used by the plant, and the plant itself dies.

The dodder is somewhat like the mistletoe in that it takes all its food from its host. In the case described, the dodder which was attached to the mistletoe was securing its food from it. It is quite common to find parasites living on parasites in the animal world, but it is not so common to find them in the plant world.

No Eyes, No Ears—but it escapes Enemies

Because we depend so much upon our eyes and ears, it is hard for us to realize that it is possible to get along in this world without either. The earth-worm does so, however, and he knows when an enemy is near, just how near, and from what direction it is approaching.

The earth-worm spends the days underground, but at night it comes out and searches for leaves and other small pieces of vegetation which it can draw into its burrow to be used as food. As it approaches the surface it cannot hear sound because it has no ears. It cannot see anything because it has no eyes. Yet it knows if any other animal, even a small insect, is near to the entrance.

Its skin is so sensitive that it feels the slightest movement in the soil. The earth vibrates at the step of even the smallest insect and the sensitive skin of the earth-worm can instantly interpret that vibration.

The earth-worm does not, of course, escape all its enemies, because there are some, such as birds, that can approach without touching the ground. The robin has become an expert at pulling the earth-worm out of its burrow. The blackbird is not so successful for it is likely to break the worm in two, whereas the robin pulls it out whole.

The Fish with an X-rayed Body

When you look at the glass catfish, *Kryptopterus bicirrhus*, you look right through its body. You see only its skeleton and the scales on its head. Every rib is visible and you can see a leaf in the water on the other side of the fish.

It is as though an X-ray were permanently in front

of little *Kryptopterus*. This fish, whose native habitat is the East Indies, may be seen in many public and private aquaria.

That Cloud of Smoke is a Tree

Many people, travelling through the Colorado and Sonoran Deserts in Arizona and southern California, think they see a cloud of smoke in the distance, but when they approach it, they see that it is a tree. Because it looks so much like smoke, this tiny tree with the scientific name *Parosela spinosa* is called the 'smoke tree.' It has a few tiny leaves in late spring only and produces flowers shaped like pea blossoms and violet-purple in colour. The leaves soon disappear.

The branches are an ash grey in colour, and the twigs are very fine and interlace with one another. It is because of this colour and the interlacing that the tree, at a distance, looks like a cloud of smoke.

The Coralline swims with an Umbrella

The coralline belongs to the hydroid family. When in the larval state it is umbrella-shaped, something like a jellyfish, and swims in a similar manner. When the umbrella is opened, water fills the interior, and when it is closed quickly the water is forced out. This action propels the coralline through the water; it cannot move about in any other way, though it sometimes lets itself drift in the currents under the ocean's surface.

Torpedoes of Fine Thread

How could a torpedo of fine thread be effective against any enemy? The answer is that the thread is provided with stinging cells. A torpedo is produced

and used by the flower-like animal of the sea known as the sea-anemone. Only certain species of the anemone, however, have this method of protection, although all have stinging cells.

The thread, when it leaves the animal, is literally ' on its own.' It is ejected like a torpedo and, in addition, has the ability to swim under its own power. This projectile is stored in special receptacles in the body of the sea-anemone. Not even a magnifying glass will show the location. But when an enemy approaches and touches the sea-anemone in such a way as to frighten it, the flesh opens in an unexpected place and the torpedo rushes out, never to return, but to do its share towards protecting its creator.

As soon as the torpedo-thread leaves the sea-anemone's body, the aperture closes up, leaving no evidence that there has been an opening there.

No other animal in nature is known to have this means of defence. Others use stinging threads, but none of them casts these into the water to travel under their own power.

If the intruder can serve as food—and the sea-anemone is not at all particular as to what it eats—the stunned animal may float near enough for the sea-anemone to get it into its mouth. At the top of the sea-anemone is a great number of arms or tentacles which wave about in order to create currents to draw stunned bodies towards them.

These animal-flowers of the sea are often brightly coloured. Even though they may be growing so deep in the ocean that there is no light whatever, they still have the brightly coloured pigments. Scientists have not agreed as to just what this colour is for. It is assumed that there must be a reason for everything in nature, but there are many things, such as the colour in those sea-anemones which live in the dark, which

no one has yet explained satisfactorily. These unexplained conditions provide objects of research. Nature is so vast and has so many secrets that it seems unlikely that the time will ever come when man has discovered all of them.

This King's Life is in his Crown

The ocotillo might rightfully be called ' the king of the desert.' Ocotillo survives the lack of moisture, the withering heat, and the burning sunshine of the deserts and lives long and vigorously.

The name is pronounced ' O-ko-teel-yo.' There is no other plant like it in the world. It is adapted to desert conditions by a storage space in its root-crown. The plant has a cluster of long, thorny, woody stems. It is not soft like the cactus.

The stems sometimes grow as tall as twenty or twenty-five feet. In the spring, following a heavy rain, large scarlet flowers appear on the very tips of the branches. The seeds will remain buried in the soil (if they are fortunate enough to get buried) for two or three years or more, if there is no rain. When rain comes, they spring to life so quickly and grow so rapidly that they make enough of a start to be able to withstand a drought of several months.

So hardy is this plant that those who live in the desert often cut its long whip-like stems and fasten them together in order to fence round a garden. When the first rains come, each of these stems takes root and starts to grow. The natives thus have a living fence so covered with thorns that it keeps out jackrabbits and other animals which like garden crops better than desert-plants. Thus the crops are saved for human consumption.

Transparent Mud

Mud is a mixture of solid materials with water, yet there is mud through which we can see. It is found on the sea-bed. The solid materials which are mixed with the water to make the mud are tiny organisms with transparent shells which live in the sea-water.

Take a bucketful of water out of the sea. Select it where the water appears to be particularly clear. Allow this water to evaporate in the sun, and when it is nearly gone, so that all that is left is mud, you can scrape up some of the mud, put it on a piece of glass, and see right through it.

Most of the animals whose shells make up this mud are so small that we scarcely see them without a magnifying glass. But there are so many of them in the sea-water that, when they are concentrated in mud, their presence is readily observed.

The mud will contain the young (or larval stages) of some fishes. There will be some crustaceans which are as transparent as glass. There will be fish-eggs and tiny jellyfish. Because the individuals are transparent, the mud which settles to the bottom of a bucket of sea-water is also transparent.

These Sailors meet No Storms

The microscopic animals called *Foraminifera* and *Radiolaria* and plants called ' diatoms ' dwell in the surface water when the sea is calm. But as soon as waves develop they sink down to a lower level. No matter how stormy the surface may be, they are safe from the waves when they go below. The ocean is comparatively still down there, for there are never any storms in the depths.

Water-animals that live in Chimneys

The crayfish is a water-animal. But one variety, which is known as the 'chimney crayfish,' with the scientific name *Cambarus diogenes*, builds a chimney above the ground so that it may safely view the landscape from the top of the chimney and still be able to drop back into its hole and the water it contains.

This crayfish digs a burrow two or three feet deep

THE CRAYFISH BUILDS A CHIMNEY SO THAT IT MAY SAFELY VIEW THE LANDSCAPE

into the ground, usually in the bank of a stream. A chamber is hollowed out in the lower part of this burrow. The chamber fills with water, into which the crayfish retreats. The chimney is built as the tunnel is dug.

When all is quiet in the vicinity of the crayfish's chimney the animal frequently comes to the top and sits quietly looking about with its eyes, which are built on the ends of stalks. The instant there is

danger, however, the crayfish drops down into its retreat.

Animals without Stomachs

Like the amœba, which wraps its body round its food, the sponge is able to live without a stomach. The sponge which we use to wash the car is merely the house in which once lived a great number of individual sponge animals.

The sponge is a community house, each tiny individual doing part of the work for the community. Some of the animals have long tails called cilia with which they pull the water towards them. They absorb the food contained in the water into their own tiny bodies and then share the juice of the body with the other animals in the sponge which do not gather food but are active in some other capacity. The food, however, does not go through a digestive tract, for there is no stomach in the sponge.

We hear the Depth of the Ocean

Until recent years it was necessary to drop a line with a heavy lead on the end of it in order to find out the depth of the ocean. In some places it was possible to take only one ' sounding ' per day. Now the depth of the ocean is determined by ' sound '—literally. A new device known as a ' fathometer ' is commonly used to determine the ocean depths.

With this new meter soundings can be made regardless of the weather. In many places as many soundings can be made now in one day as formerly took weeks. Obviously there are tremendous advantages to ocean transportation coming from this new method of depth determination.

Some of the very large passenger ships, such as the *Queen Mary*, each have one of these fathometers in constant operation. This instrument keeps sending sounds to the bottom of the ocean and recording the time that it takes them to return, so the ship's captain, instead of depending on charts alone, can be sure that the ship is not getting into shallow water.

Sound travels faster through water than it does through air, and careful experiments have determined the exact speed. After this was known it was quite simple for scientists to construct an instrument to send out sounds, record the length of time they take to go to the ocean-bed and back again, and interpret this in fathoms of depth.

This knowledge has been very helpful to scientists in speculating on how whales are able to send and receive messages over long ocean distances. In the Antarctic, whales are numerous. Ships' officers have observed that, when one whale is hit, the others which may be seen as far as five miles away, instantly sound—or dive towards the bottom. It is very evident that a message was sent from the injured whale to all the others and that message was practically instantaneous.

Although whales have no vocal cords and make no sounds that we can hear, we do know that there are many animal-sounds to which our ears are not attuned and many types of sound-waves which might be used by whales. Such waves might be produced in some other way than by the use of vocal cords.

We now have more knowledge of the ocean's deepest place. It is in the Pacific Ocean and is 6·32 miles from the surface of the water to the bottom. Six miles of steel wire with a lead on the end of it is a tremendous load to be handled from the deck of a ship. Such a device is not needed now, except when samples of the ocean bottom are desired for study.

Many Ocean-animals live in Small Worlds

Although there is more water than land on this earth of ours, only a very few animals have the whole ocean as a home. One of these is the sperm whale, which has the habit of travelling round and round the world. Another is the great ocean-bird called the wandering albatross. It, too, travels round the world, living above the water rather than in it, and keeping within certain latitudes (see pp. 40–41).

Most ocean-animals, however, live in small worlds. Some are never found beyond the edges of one tidal pool. Scientists dredging bays along the North Atlantic coast of America have discovered this. Two dredgings made only a short distance apart brought up not more than five kinds of animals common to both places. In one dredge there were fifty-nine kinds of animals and in the other 128 different species. It seems surprising that not more than five of these were found in both places.

Some ocean-fish migrate, spending one season near shore, another season farther away. Usually the reason for this migration is that the favourite food of the animal moves, or becomes depleted in one place but is plentiful in another. Other reasons are changes in temperature and the changes in seasons. Very few of the ocean-animals make use of the entire water area as a home. Most of them live in small worlds.

A Fluid World in which Food rains down from Above

In the fluid world of the ocean food rains down from above instead of being dug out of the ground. In our

land world we have to search for food. In the ocean it is always near for those who need it.

Fish that live near the surface feed largely on tiny plants which grow at the surface. Others feed on minute animals which, either when they die or as they live, sink down conveniently to the mouths which need them for food. Those animals which live in the lower strata of this liquid world never have to wait long for a meal to drop on them. Finding food is easy. That is why the ocean contains so many living things—far more than exist on the ground and in the air.

The most astonishing thing about this fluid world, however, is that nature is able to keep it in balance. When the lobster sends three million wriggling hungry young to the surface, she is sending forth food for ocean life. Only a few of the three million ever get back to the bottom of the sea where they must live their adult lives.

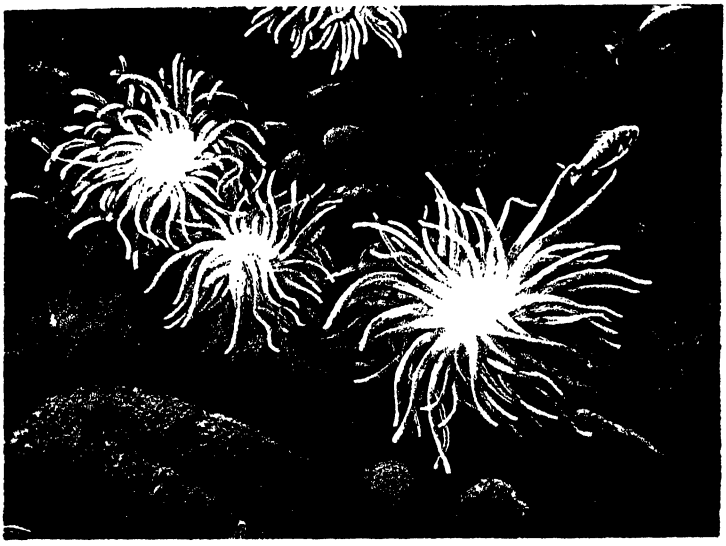
When the oyster sends forth so many eggs that the offspring of only one oyster must be represented by the number 6,600,000,000,000,000,000,000,000,000,000,000, she is not overpopulating the sea with oysters ; she is providing food for many of the ocean animals. If it were not for this fact, the sea would be overpopulated with lobsters and oysters and cod and some of the many other ocean-animals which reproduce so abundantly (see p. 70).

The life of the ocean is held in balance just as life is on land. When too many are produced, the surplus is eaten as food by others. In some years there appear to be more cod-fish than in others, because there is something in nature which temporarily is out of balance. Many thousands of eggs have been laid by each cod, but not enough have been eaten and so more have grown into adults. That makes an over-supply of cod-fish. The balance is restored by other animals which eat

the surplus of cod, or else the temperature or feeding-conditions change in such a way as to destroy the surplus. Life in the fluid world is so complicated that it is difficult to find a satisfactory explanation. But nature seems to bring about all the essential balancing activities.

Animal-flowers that lasso their Food

We call them flowers because they look like delicate, coloured blossoms. But they live attached to rocks in the sea and they are, in reality, animal-flowers. If a



THE SEA-ANEMONE CATCHES FISH

shrimp or fish swims near it, the sea-anemone throws out a lasso and snares its food. Two tentacles are thrust out, one to sting the fish so that it will remain motionless, the other to wrap round it and bring it into the centre of the flower which is the mouth of the sea-anemone.

The body of the anemone is soft and appears to be very

vulnerable. Consequently its need of protection is quite evident. It moves about very little and cannot pursue an enemy—but it has developed a technique by which it can throw stones at any animal that arouses its fear. We might almost say that it 'shoots' the stones, as the effect is not unlike that of a projectile being forced out of the barrel of a gun (see also pp. 56–57).

The cylindrical anemone receives in its mouth a pebble which may have been stirred up by a passing fish. If an enemy approaches it this pebble is forced out by a constriction of the anemone's body.

A Perch that climbs Trees

It is hard enough to believe that fish can walk about on the ground out of water, without trying to visualize

THE TREE-CLIMBING PERCH

a fish climbing a tree. Yet specimens of the climbing perch (*Anabas testudineus*) may be seen in some large aquariums.

They are natives in the East Indies and have the habit of leaving the water at frequent intervals, walking along the ground, and climbing low trees for a few inches.

Aquarium attendants have taken a climbing perch out of the water and placed it on the floor. There they have observed it walk along just as it does in its native country. It has no difficulty in keeping its body upright because its fins are made for use in walking and climbing.

The Sea is Full of Plants that have No Roots

In the shallower water near the shores of all oceans, there are tremendous numbers of many kinds of plants. These plants fall into three groups—seaweeds, one-celled organisms, and bacteria. Complicated plants such as we have on the land have never developed in the sea, or, if they have, we have no record of them.

Many ocean-plants are so tiny that we do not see them unless they are grouped in great numbers. On the other hand, the seaweeds are large enough to be examined individually. They are fastened to the ocean-bottom or to rocks, but the organs with which they anchor themselves are grown only for attachment and not for the attainment of food.

A true root provides food for the plant, but ocean-plants, being immersed in water, take their food by means of mouths in the stems and leaves. The nutriment is absorbed literally through the skin of the plants.

Fifty Sea-shells to the Inch

Along the seashore when the tide is out a white line represents approximately the high-tide mark. This

white line is made up of uncounted millions of shells. Collect a little of this material and carefully place the tiniest pieces under the microscope. Set the microscope to magnify about fifty times and you will see some of the tiniest of sea-shells.

Each one of these shells was formerly the house of a animal. Some of them may still have the animal inside. The great quantities of these shells which gradually collect at the bottom of the ocean are, by pressure of successive layers, ultimately made into limestone rock which, many generations hence, may be pushed above the surface of the sea and become an island or a continent.

The limestone which makes up many of our mountains was formed in this way on the bottom of the sea some of it by the compression of the tiny shells which are so small that it takes fifty of them to make an inch.

King Limulus is like his Prehistoric Ancestors

The examination of fossils of prehistoric animals and plants might make it appear that all modern life is quite different from that which existed many, many generations ago. A few animals living to-day, however, are quite similar to those which formerly existed. A case in point is the king-crab whose scientific name is *Limulus*.

The form of the animal is strange. He has a large thin shell and a long tail like a large bayonet ; and all round his shell and on top of it there are many other bayonets. He cannot be successfully attacked from the rear.

On the underside there appears to be nothing but legs —eight of them. In the centre between the legs there

is an opening which appears to be, and, as a matter of fact is, a mouth. The food which the animal finds on the ocean-floor is masticated by the legs, which are provided with tough spines, moving towards each other.

But where is the animal's body? Behind the legs we see a book of leaves which we soon learn are the lungs or breathing organs—but no body. Yet the animal is able to maintain itself and grow.

King *Limulus* is almost exactly like his prehistoric ancestors. Fossils which have been found in ancient rock show that the king-crab to-day has approximately the same form as it had before the rocks were made.

Perhaps we came from Plants

Man has learned much of the history of life by studying fossils found on mountains. These fossils were once buried below the ground in mud which hardened and became rock. When we break open the rock now, we see the shape of the plant or animal which existed before man knew anything about this earth.

On the side of Going-to-the-Sun Mountain in Glacier National Park, Montana, are fossils of some sea-plants which are recognized by scientists as the oldest fossils ever discovered. These sea-plants are known as 'algæ.'

No animal fossils as old as these plant fossils have been found. Of course it is not certain that there were no animals in existence at the time these plants were thriving in the ocean-water, but there is some basis for speculating as to whether man may possibly have come from plants. We know that some plants have the ability to move about. They have tails with which they propel themselves through ocean-water. Still they are

classified as plants. Possibly they are the link between plant-life and animal-life. No one knows; yet it is interesting to speculate.

(See p. 134 for further mention of Going-to-the-Sun Mountain.)

Prepare to fight the Starfish

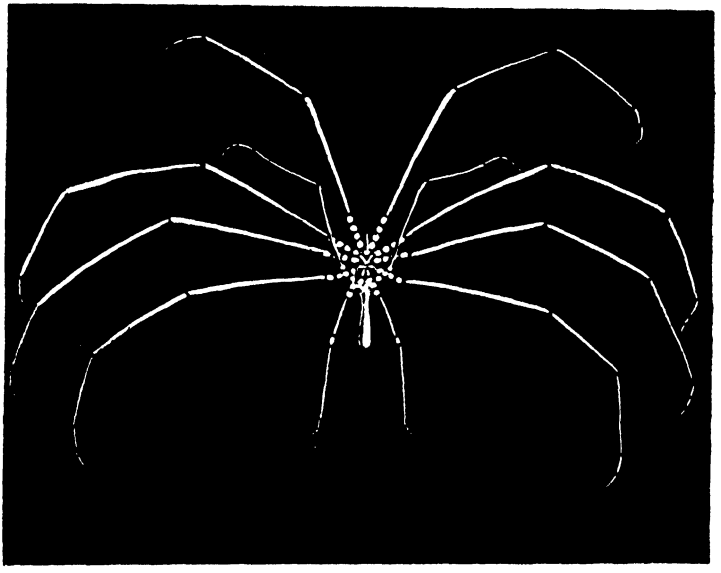
Each female starfish produces over two hundred million eggs a year. We should be overrun with these strange creatures but for the fact that a very few only of these two hundred million offspring ever reach maturity. There are many perils for the eggs of the starfish and for the tiny animals which hatch out of them. The greatest is the thousands of other fishes in the sea which are in search of food. The surplus eggs are provided as food for many other creatures. But, great as is this total, the starfish does not produce as large a number of offspring as some other sea-animals.

The starfish feeds on oysters, among other things, and those who gather oysters from the sea are greatly disturbed by the depredations of the starfish. But oysters are reproduced at such a tremendous rate that there is little danger of their being exterminated. The offspring of one oyster and of her living descendants total six decillions six hundred nonillions. That number is written 6,600,000,000,000,000,000,000,000,000,000,000. Such a tremendous number is beyond our conception.

If it were not for the starfish, the sea would be overrun with oysters, for the starfish eat many oysters. If it were not for the other animals that eat the eggs of the starfish, the ocean would be overrun with starfish. The lobster, the cod, and many other fish lay tremendous surpluses of eggs, but many of the ocean-dwellers feed on the eggs and young of others.

Eight Legs and No Body

It is hard to conceive of an animal without a body. The pycnogonid, however, has no body and no means of breathing. It is difficult to understand how it can live, as it does, without respiration. The eight parts of the stomach of this peculiar animal are in its eight legs in



PYCNOGONID
(MUCH ENLARGED)

the form of tubes, one in each leg. The egg sacs are also contained in the legs.

Perhaps the strangest feature in the pycnogonid is that its four eyes are on the very tip of its nose, more technically called the proboscis, and the long proboscis of the pycnogonid is used as a pump. The pycnogonid, because it has eight legs and lives in the ocean, is called the sea-spider. It is allied to the arachnids.

It steals its food from the sea-anemone, the strange

animal which looks like a plant. As described on p. 65, the anemone is fastened to a rock and opens the top part of its body to receive food. While the food is being digested, along comes little pycnogonid and thrusts its proboscis right into the sea-anemone's stomach. The proboscis, with its four eyes to guide it, then pumps out all the food it needs.

The sea-spider is frequently found in the little pools along the seashore after the tide goes out. In addition to its many bizarre anatomical structures, it seems to have mystical power over the sea-anemone, which catches for food other animals that come near it. Yet the sea-spider approaches the sea-anemone without hindrance.

Ten Days Alive without a Head

Because it has eleven 'brains' located in different parts of the body, the silkworm-moth can, if necessary, go through its brief life-routine without a head. Experiments have shown that a moth whose head has been removed will live as long and perform the activities of breeding and egg-laying in exactly the same way as if it had a head.

In addition to having a brain in the head, this moth has five pairs of ganglia which are nerve centres corresponding to brains. Each ganglion controls certain actions and those which govern the activities of the adult life are located in the thorax and abdomen rather than in the head. While a ganglion is not a brain in a technical sense, it serves almost the same purpose.

If the adult moth were a glutton for food it would be necessary for it to have a head, but as a rule it eats nothing. It did its eating when it was a larva or caterpillar. Then it ate more and grew faster than almost

any other kind of animal. The adult form has only the two tasks of breeding and laying eggs.

Like other insects, it breathes through spiracles on the sides of its abdomen, so the absence of the head does not impair the breathing.

Seaweeds that swim

It is very easy to start an interesting argument as to what is the difference between a plant and an animal. If you try to settle it on the basis that a plant stays in one place and an animal has the power of locomotion, you may then learn with dismay that some plants have the power of locomotion and some animals always stay in one place. For example, some of the seaweeds swim about, looking for a new location (see p. 69).

All seaweeds belong to the family called algæ. One is called the blue-green alga (*Cyanophyceæ*). This kind has a quantity of thin threads which look like gelatin. At certain times these threads break in two. Each one swims away to a fresh location and starts life as a new blue-green alga. Of course, it does not swim with the speed of a fish ; nevertheless, it actually moves itself through the water by its own efforts.

(See p. 190 for animals that stay in one place.)

Six Good Legs—but a Dragonfly cannot walk

A dragonfly has six perfectly good legs, yet it cannot walk. The six legs are formed into a basket to capture insects while the dragonfly is cruising through the air.

The dragonfly is provided with exceptionally powerful wings and is one of the strongest flyers of all the

insects. Therefore it does not need to walk. Every time it moves, even for a very short distance, it uses its wings.

Fishing-lines grow in the Sea

Some fishing-lines are made of silk and some of cotton. But it is not commonly known that some fishing lines actually grow. While they are growing in the ocean they are called seaweeds.

One, which is found near the island of Vancouver, is known as the great kelp (*Macrocystis*). It has leaves which are thirty to forty feet long. The stem, however, often grows to a length of three hundred feet. Fishermen collect these long stems and dry them. They are then strong enough to be used as fishing-lines.

No Food but its own Hide

The carpet-beetle has been known to live in a corked bottle for two years with nothing to eat but its own hide. Periodically the skin was shed. The beetle calmly ate this skin, for there was nothing else to eat.

Of course, this tiny insect did not grow while it was depending entirely on its own body for nourishment, but it did continue to live. This is one of the fascinating examples found in nature of persistence of life.

Six Balloons carry this Animal Aviator

If t[illegible]sect called the phantom cranefly is one of the be neces[illegible]hich nature has provided with balloons. nothing. [illegible]v on the cranefly's legs. Near the end of pillar. T[illegible]ix legs there are sacs and tubes containing

air which buoy up the fly as it drifts in the air, moved about by the ever-present wind currents. When it wishes to travel, it inflates its six balloons with air.

This Bride is always a Widow

All queen bees in charge of hives of honey-makers are widows. They were widows the very day they became brides. The drones, their husbands, died after their heroic efforts to provide the queen with enough sperm cells to enable her to lay as many as 300,000 fertile eggs. They have no other purpose in life and are not allowed to return to the hive after their flight with the queen. They cannot gather food for themselves, so they soon die.

The queen bee is fertilized only once in her life. She stores the sperm cells in a special receptacle in her body and uses them as eggs are laid. The egg is fertilized as it passes a tiny tube in the neck of the ovipositor.

One Mother's Offspring would cover the Earth

The tiny aphis (often called the plant-louse) multiplies so fast that if only one female were allowed to reproduce without any check, and if its offspring all lived and reproduced in the normal way, in only one summer enough plant-lice would be born to cover the earth completely with their bodies. This is all the more startling when we consider that one individual aphis weighs only about one-sixtieth as much as a grain of wheat.

Because plant-lice have almost no way to defend themselves against their enemies, nature has provided

them with unusual fertility. They reproduce so fast that their voracious enemies cannot eat all that are born. It is not even necessary for the aphis to mate. All summer virgin females give birth to live babies. Only when it is necessary to preserve the race over a period of cold weather or drought are fertile eggs laid.

During the summer there are no males. All of those born during the summer are females. Only in the autumn are males born. The aphides mate, the eggs are laid, and the insects rest through the winter.

When these aphides live in a greenhouse which is kept warm throughout the year, no males at all are born. As many as ninety-four generations of female aphides have been recorded without the appearance of a single male.

This Cricket is a Living Thermometer

The temperature - cricket has the scientific name *Œcanthus niveus*. The number of chirps uttered varies definitely with the temperature. If you will count the number per minute, divide this by four, and add forty, you will have the exact temperature in degrees Fahrenheit. Many tests have been made and the cricket has proved to be an accurate announcer of the weather. The *Œcanthus* lives in trees and is sometimes called the snowy-tree cricket.

Astounding Growth

The larva of the polyphemus moth eats unbelievable amounts of food during the first two days after it hatches from the egg. During that period each of these tiny worms eats food 86,000 times its own weight.

Within forty-eight hours this larva has grown to weigh 4140 times as much as it did when it was hatched. That is not easy to believe, but it has been proved by careful observation.

Slavery has not been abolished

There may be some justification for slavery in the ant kingdom, for there are some species of ants which cannot feed themselves. Their only function is fighting. Their fighting mandibles have grown so long that they cannot secure their own food. Neither can they care for their own young. Consequently, they must keep slaves if the race is to be perpetuated.

The Amazon ants, for example, have grown helpless and must capture another variety known as *Formica argentata*. As a matter of fact, they do not capture their slaves, but rather raise them. They go to the nest of the *Formica*, kill some of the adults, and carry away the cocoons containing the *Formica* larvæ. When these babies hatch, they are a part of the family of the Amazon and serve faithfully as slaves. They hunt food and care for the offspring of the Amazon queen.

No Eyes needed

Ants, beetles, and many other insects could go through life just about as well without eyes as with them. They depend almost entirely upon the sense of smell. Many tests have been made to prove this.

Their eyes have been covered with opaque liquids or glue and the insects have not been at all confused. Yet, when the antennæ are removed, the insects are lost. It is in the antennæ that the sense of smell is

located. They find their way easily without eyes but they cannot travel without smelling-organs.

Ants have Aeroplane Weddings

Ants with wings are not often seen, yet every year some virgin females and some males are born with wings. At an appointed time in the autumn these winged ants fly into the air.

The males have almost no brains at all. They do not know how to feed themselves and cannot find their way home. After their flight they drop to the ground and starve to death. Yet they have some kind of an instinct or sense which enables them to follow and find one of the virgin queens.

The wedding takes place in the air. It is an aeroplane wedding. After it is over the queen descends to the ground, bites off her wings, and starts a new colony —alone. For the males, life is over. Their tomb is the great out-of-doors.

Mother hangs her Babies on Poles

So vicious are the young of the lacewing fly that each egg must be placed at the top of a tall pole to keep the young larvæ from eating one another. The lacewing fly is a beautiful insect with wings that are transparent and so veined that they look like exquisite lace.

When the female is ready to lay eggs, she puts a drop of liquid on a leaf. This liquid hardens immediately and, as the mother flies into the air a short distance, a thread is spun which, in effect, is a tall pole. This pole, to the top of which an egg is attached, waves in the breeze until the egg hatches.

The larva then crawls down the pole and hunts for plant-lice or aphides on which it feeds ravenously. If it can find enough aphides, it will eat them at the rate of about one a minute. Its appetite seems never to be satisfied.

It punctures a hole in the aphis' body with its two hollow mandibles. It then lifts the aphis into the air and lets the juice run down through the mandibles into its body.

In about two weeks it has grown sufficiently and encases itself in a ball made of silk. The cocoon is about the size of a small pea. In sixteen days it cuts open a circular lid in this cocoon, comes out, and is then known as the golden-eyed lacewing fly. (See also p. 109 for the lacewing fly.)

They skate on Water

' Pond-skaters ' or ' water-striders ' have six legs just as all insects have, but four are much longer than the others. The two front ones are shorter and are used only for seizing food or for attaching the pond-skater to objects. The four hind legs are so made that they will easily carry the light body of the insect over the surface film of the water.

The part of the leg that is used as a skate is very long in proportion to the size of the body. It does not sink except when the pond-skater wants to dive into the pond or slowly moving river where it lives.

When it dives, the pond-skater must take a supply of air down with it, because it cannot take oxygen out of the water as fish do. The body is covered with a thick coat of hairs. While it is skating round on the surface, the spaces between the hairs are filled with air and it takes this down under the water with it. While it is

below it breathes this air and is thus able to stay under the water for quite a long time. (See also p. 172.)

Snakes and Peanuts for Dinner

There is a friendly little animal which really should grow larger because he never lacks food. He is the collared peccary or musk-hog. His scientific name is

THE COLLARED PECCARY

Pecari angulatus. Young musk-hogs are often caught and kept in pens. They make splendid pets for they are very friendly. They like to have their necks scratched and they enjoy eating anything given to them.

If visitors throw peanuts into the pen, and later a snake crawls through the wire, the little peccary may have snakes and peanuts for dinner. He likes them

both. He will eat anything : berries, vegetables, meat of any kind, scraps from the table, insects, worms.

In spite of their omnivorous appetites, the peccaries seldom grow to weigh more than seventy-five pounds each. They commonly live in bands of thirty or less, and, while they can fight to defend themselves, they are not vicious.

Fathers are not Necessary

Drone bees and male ants are hatched from infertile eggs. These males have no fathers, but they have grandfathers because the queens, their mothers, had fathers.

Females in the insect world are hatched only from fertilized eggs. The tiny mechanism that enables the queen bee or the queen ant to control the fertilizing of her eggs as she lays them is so minute as to be almost imperceptible.

The queen is fertilized for life on her wedding-flight. She stores up the huge quantity of sperm cells in a tiny sac within her body. The tube that leads from this sac to the egg duct is controlled by microscopic muscles. When the queen is to lay an egg that will hatch into a female, she releases these muscles and lets one of the sperm cells join with the egg. When she wishes to lay drone eggs, the muscles tighten and do not allow sperm cells to unite with the eggs.

Fathers, therefore, are not necessary in the ant and bee families to produce males.

Food is digested outside the Body

Instead of taking its food into its stomach for digestion, the glow-worm digests its food first and swallows it afterwards. The glow-worm likes to dine on snail

breathe. They cannot take the oxygen out of the water as a fish does.

The Cicada calls his Mate a Mile away

Not only does the cicada make sounds which carry long distances but his mate has special ears for receiving those sounds. Tests have been made that show that the mate can hear a call at least a mile distant.

The sound-instrument is a special body cavity which is divided into chambers with filmy walls. A muscle attached to a drumhead sets up a vibration which is repeated by the other films and finally by the two shields which cover the outside opening.

The males can call their mates a mile away but the female has no voice. An old philosopher, learning of this for the first time, wrote :

> Happy are cicadas' lives,
> Because they all have voiceless wives !

A Bride breaks her Lover's Fiddle so that he can woo No Other

The female of the European field-cricket will not allow her mate to woo another maiden. The wooing is done by use of a fiddle which is a part of the male's wings. After a female has accepted him, she tears the wings of her lover and breaks his fiddle so that never again can he play for the enticement of another female cricket.

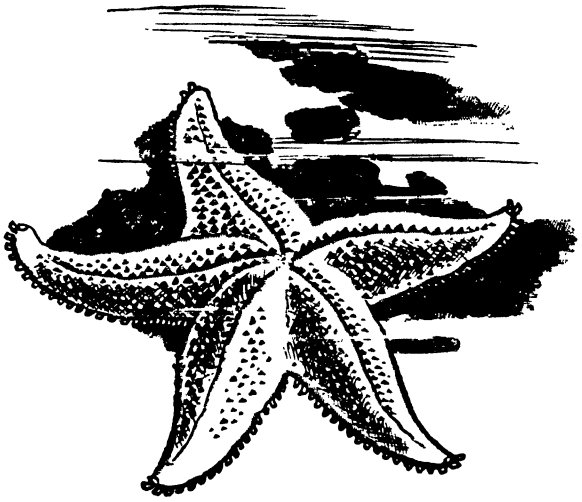
This Lady's Perfume attracts Males for Miles

The banded-monk moth can find his mate by her perfume, even though the mate may be a mile or more away. The odour is imperceptible to man.

Careful tests have been made with this moth. The female has been taken a mile and a half or more from places where males were known to exist, yet she attracted, by her scent alone, not one, but dozens of males. As soon as she was put in a glass jar, whence her odour could not escape, no male moths came. When the antennæ of the males were removed, they paid no attention to her.

An Eye at the End of each Arm

There is a fish that lives in the sea and has long arms, on the underside of which are hundreds of feet,



THE STARFISH

and at the ends of which are eyes. There is one eye at the end of each arm. This fish does not swim as we commonly think of fish swimming but walks along the bottom over the stones and the shells. We call it the starfish.

The common species has five arms with an eye on the end of each. The starfish can move in any direction. If it goes one way, it uses the eye on the end of the arm leading the rest of the body. If it wishes to go in another direction, it uses the eye pointing that way. The eyes of the starfish appear to us as small red discs on the tips of the arms.

Certain of the starfish's feet are designed to be used as smelling-organs. The foot thus provided with the sense of smell moves about, feeling and smelling each object which might serve as food. While it is not essential to the starfish's movement over the bottom of the ocean, it has the structure of a foot and can be used as such.

Bumble-bees on the Dole

Generations before we ever heard of such a thing, there was a bumble-bee that made a business of living on the dole. It is a species appropriately named cuckoo bumble-bee. The poor bee is not lazy nor is her husband out of work, but she has no equipment for gathering food. She has no long proboscis with which to withdraw nectar from the long flower-tubes.

It appears that nature played a mean trick on her, so that she is forced to depend on others whether she wants to or not. To preserve her life, she goes to the nest of another variety of bee and makes herself one of the family. She helps herself to the food which the other bumble-bees have stored for their young.

Although she is of a different species from those who furnish her with a home and food, she is accepted by them. Perhaps they feel sorry for her inability to find her own food or they know that it is their duty to care for her.

There are other insects, too, which are not provided

with the necessary equipment to gather their own food —for example, the queen ants and the drone ants have no way of feeding themselves.

Snake or Caterpillar?

All through nature there are many animals that imitate others in appearance in order to escape their enemies. But the larvæ of the swallow-tail butterfly, although perfectly harmless, perform one of the strangest imitations of all. The family name is *Papilio.*

No ordinary bird would attack a snake, so the *Papilio* larva makes himself look like a snake. He not only runs out what looks like a forked tongue but he makes an odour like a reptile. So perfect is the imitation that, unless a person looks closely, he can easily believe that a snake is warning him away. This, of course, is the effect it has on the birds that wish to eat the caterpillar. When combined with the snake-like odour, its imitation is perfect.

Vacuum Flasks were invented by Insects

Long before man ever thought of such a thing as controlling temperatures by special types of insulating materials, the praying mantis made vacuum flasks to protect her eggs from the weather.

She surrounds the eggs with a frothy mass of bubbles which works on the same principle as our vacuum flasks. No matter how cold or how warm the air becomes, the tender eggs within are thoroughly protected.

It took man a great many centuries to learn how to produce effective insulation. The mantis does it without any training or study.

Three Thousand Flies from Twelve Eggs

In studying certain parasitic flies, scientists have been able to count more than three thousand flies hatching from only twelve eggs. Two hundred and fifty individuals come out of one shiny, microscopic sphere.

Crickets hear with their Legs

What has become of their ears? They are in their front legs and there is probably a very good reason for it.

It seems very strange to us that not all animals have ears on the sides of their heads, for that is the usual position of ears in the larger animals.

If a cricket's front leg is examined with a strong hand-lens, the membranes of the ear can be seen at about the centre of the leg. No doubt this sense organ not only enables the cricket to feel the vibrations of the air which we call sound, but also those of the ground over which it hops. To many of the smaller animals ground-vibrations are much more important than air-vibrations. The approach of a friend or an enemy can readily be discerned by the vibrations he makes when he walks.

Fifty Thousand Chemical Laboratories in One Box

The ordinary beehive is small enough to be carried by one man. Yet inside it can be as many as fifty thousand complicated, productive chemical laboratories. The raw materials of these laboratories are the simple things : water, pollen, and nectar. With these at least five important chemical products are made.

The commonest one is honey. There is also formic acid, wax for the comb, bee bread, and royal jelly. When the nectar is gathered from the flowers it passes into the bee's honey-stomach. In this compartment it goes through a chemical process while the bee is flying back to the hive. The resultant chemical is then deposited in a cell made of wax.

In this cell it undergoes additional processes. Formic acid is added to it. It is aerated and air-conditioned ; and finally becomes what we call honey. The same bees can make several kinds of honey, depending upon the source of the nectar.

The formic acid is made as a preservative for the honey and is also used to inject into a wound to make it smart when the bee's sting has punctured the flesh.

A more complicated process is used in the manufacture of wax. Bees which are to make wax eat great quantities of honey, hang themselves from the roof of the hive, and then, through special muscular exertions, cause the wax to ooze out of their abdomens from under certain scales called ' wax plates.' Other bees carry away the wax as it is made and use it for making the comb in which the honey is to be stored.

The bee bread is a food which is made from pollen for the baby bees. Royal jelly is a food made specially to stimulate the growth of a new queen, although it is fed to all baby bees for a few days after they are hatched out of the eggs.

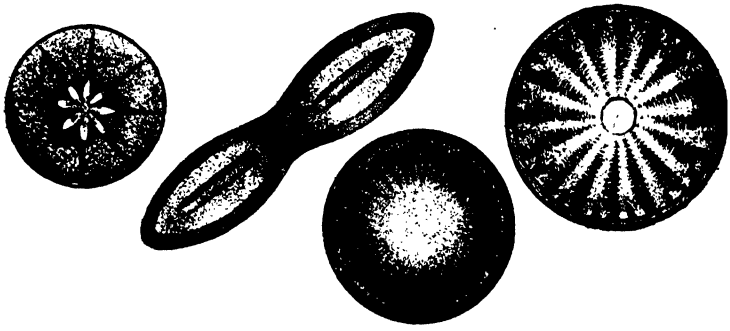
Diatoms have Pill Boxes as Skeletons

The shape and design of the skeleton of the diatom corresponds to a very minute pill box. There are two parts, one of which fits inside the other just as the pill

box fits inside the lid. The exterior is decorated with designs of fascinating beauty.

Inside the pill box is the nucleus of the plant—for diatoms are plants. In addition to this little spark of life, there is a watery substance which probably corresponds to sap in the larger plants. There is also the pigment chlorophyl which is needed by plants to aid in the digestion of food.

These tiny plants multiply by division. The nucleus is divided into two parts. Then the cover of the box is



DIATOMS
(GREATLY MAGNIFIED)

opened and two new pill boxes are formed, one round each of the two plants which now take the place of one.

The old pill box is abandoned and sinks to the bottom of the sea. With millions and billions and trillions of others, it forms layers of ooze which one day may be pressed down upon millions of other layers with billions of additional layers on top. Eventually, a long time hence, these layers may become limestone.

Even when the plant does not divide to form two, it periodically sheds its pill box skeleton and grows a new one. This corresponds very definitely to the shedding of the outside skeleton by the grasshopper and the lobster.

Ants had Public Nurses long before Man

Ants have had the public nursing system as long as they have been on this earth. Their community nurses are extremely busy. They control the temperature, prevent disease, and maintain cleanliness in the ants' nest. They bath and exercise the ant children. They care for the eggs and the cocoons.

Those ants which are born to be nurses stay in the service all their lives. They do not know how to do anything else. They do not even feed themselves. The foraging ants gather the food and bring it to the nest. There it is fed to the nurses and those other workers in the ant colony who do not hunt for food.

The nurses move the eggs, larvæ, and pupæ from one compartment of the nest to another in order to keep the developing youngsters in just the right temperature and humidity. Separate compartments are provided to serve as brooders. In each one is a different temperature and a different degree of humidity.

The nurses prevent disease by keeping the larvæ licked clean. They bath them with their large tongues. The tongue is provided with a kind of soap which helps to do the cleaning job well. When the children are large enough to walk the nurses take them out into the open for exercise every day until their muscles are strong and they are ready to assume their special jobs in the ant community.

No Bee stings Twice

A honey-bee dies immediately after it has stung a person because its sting cannot be withdrawn. The sting is tightly attached to vital tissues of the bee and, as the bee pulls away, trying to save its life, the tissues

are pulled out. Without them the bee cannot live.

It is a strange anomaly that the bee has been provided with a sting to save her life, but by doing so, loses it. Yet the bee has, after all, accomplished her mission. It is not her job to save herself, but rather to save her mates. When she drives away an intruder by stinging him, she gives up her life for her friends.

The sting is made of two notched portions with muscles which move them alternately. One is pushed in ; then the other is pushed on past the end of the first. The notches make it impossible for the bee to withdraw the sting. When the bee pulls away, she leaves the sting muscles with the two notched darts. The muscles keep on working until the sting is buried.

The queen-bee is the only individual in a hive of honey-bees with a smooth sting which can be withdrawn, and she uses it on other queen-bees only.

Mosquitoes built the First Self-bailing, Non-sinkable Lifeboat

Mosquitoes' eggs are made into self-bailing, non-sinkable lifeboats floating on the water. When rain comes and the lifeboats are filled with water, they automatically tip over to one side and bail out the water.

It might be well for man to study the design and construction of these remarkable craft. We probably have not done as good a job as the mosquitoes when they build these egg floats.

While the eggs must be kept dry, the larvæ that come out of the eggs actually live in the water. We call them ' wrigglers ' when we find them in rain barrels or in ponds. These wrigglers turn into pupæ. When

the final pupal skin is shed it is used as a raft on which the newly born adult sits to dry its wings.

Hair-combs grow on Ants' Legs

Insects need instruments just as we do. So, whereas man must make his, nature has provided the insects with instruments that grow on their bodies. Among the most important possessed by ants are combs which grow on their front legs.

Like the combs we use on our own hair, they have stiff backs and teeth that are pointed at the end and thickened at the base. On one of the combs the teeth are close together and on the other are far apart. So the ant has a coarse and a fine-toothed comb.

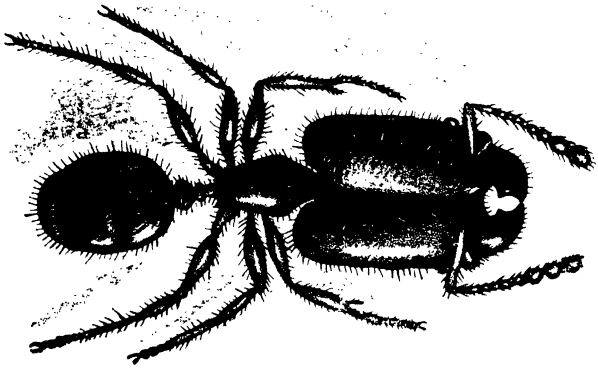
These are used to clean the hair on the ants' body. The ant has its skeleton on the outside, but this skeleton is covered with hair on which dirt collects. The ants do not wish to be dirty, so they comb their hair frequently. The antennæ are also cleaned by these combs on the front legs.

Is it Possible to jump so Far?

A jump one hundred times the length of the body seems impossible. No man five feet tall could jump five hundred feet from a standing start—nor even from a long running start. Yet the common field-cricket jumps proportionally as far. The length of its body is about an inch and it can jump one hundred inches, which is eight feet four inches. This is almost as unbelievable as the statement that a man can jump in that proportion. Yet the record stands, for it has been done by a cricket.

Her Head is Twice as Big as her Body

The animal whose head is twice as large as its body is a soldier-ant with the scientific name *Pheidole instabilis.* Ants have female soldiers whose job is to fight for the rest of the tribe. The soldier fights with her head. She has strong mandibles with which she seizes other



THE SOLDIER ANT'S LARGE MANDIBLES NEED STRONG MUSCLES TO OPERATE THEM

animals, and these large mandibles must have powerful muscles inside the head to operate them. That is why the head is so large.

The other ants feed the soldiers, who do not need to have large crops for food-storage like the workers. Worker-ants collect food in their crops. Then they feed it to the soldiers, the queen, the males, and the baby ants.

Resurrection

Thousands of animals are raised almost from the dead every spring. When cold weather comes on, they

cease activities, stop breathing, and apparently die. But still the spark of life remains, and when they are warmed by the spring sunshine, they start to breathe and gradually become fully alive again.

These animals are fur-covered, brightly coloured, tremendously useful bumble-bees. Only the mother hibernates. The others die. Every spring, the mother finds a hole in the ground in which she can build a nest. There she lays eggs and cares for her babies, working alone until her family has grown enough to help her.

Father Gryllidæ eats his own Children

The male mole-cricket, belonging to the family *Gryllidæ*, will eat his own offspring if the female does not keep an eye on him. The male is lazy and would much rather eat what is near at hand than dig in the soil where he lives to get food for himself.

That is why the mother mole-cricket gives so much attention to her babies. She lays from two to three hundred eggs in masses of forty to fifty. She watches them until they hatch, and then feeds the young until they are able to take care of themselves.

Perhaps we ought not to be too hard on the father mole-cricket. After all, it is a difficult job for him to recognize his own children, since his eyesight is poor.

Ants have More Domestic Animals than Man

Ants domesticated ' cows ' long before man knew there were such animals. Their most common ' cows ' are the aphides. These are tiny plant-lice which give a

desirable liquid, as our cows give milk. The ants pasture these ' cows ' and herd them in much the same way as we care for ours.

There are nearly six hundred different kinds of animals which have been domesticated by ants. We have nowhere near that number. Sometimes the domesticated animals seem to be kept as pets just as we have cats and dogs. In other cases they are maintained for the purpose of supplying a sweet odour.

Some ants have domesticated the American beetle. Others nurture crickets in order to benefit from them. In every case the ants take as good care of their domestic animals as they do of their own babies.

Worms wore Silk Underwear when Man wore Fig Leaves

Man had to develop his clothing from nothing. His first covering was made of fig leaves, because they were large. But nature's provision for certain worms was more adequate.

She provided them with the ability to weave themselves silken underwear. The worms which we call moth caterpillars spin genuine silk. Not only do they have silk underwear, but silk overcoats.

If you were to cut open the cocoon of a large moth, you would find that there is a silken layer on the outside ; then a layer of silk insulation ; and then the silk underclothes. Inside, the worm has gone to sleep and is gradually changing into an adult.

The Intestine serves as a Lung

The nymph of the common dragonfly breathes through its intestine. The nymph is the immature stage and it

lives in the water on the bottom of ponds and quiet streams. The adult dragonfly's legs are not used for walking, and those of the nymph are also of little value. The water required for breathing is also employed to move the nymph forward.

The water is taken into the intestine from the rear. Inside are gills which are a modification of the intestine. After the water has been used over the gills, it is forced out, and this moves the nymph forward.

When this nymph becomes an adult dragonfly and spends its life in the air above the water, it breathes through spiracles on the sides of its body in the same way as other insects.

Stowaway on a Bee

A ride on the back of a bee is necessary to the development of the meloe or blister-beetle. It cannot live and grow unless, by mere chance, it can hop on to the back of a special kind of bee and hide until it can successfully transfer to an egg, which is to be its food during early life. After birth, the larva waits until a mining bee comes near, hops on to the bee's back, and stows away in the silky fur. There it rides until the bee lays an egg in its underground burrow.

The larva then jumps from the back of the bee on to the egg, and is sealed with it in the comb in which the bee's egg is placed to hatch. There the stowaway lives by eating the egg and the food which the bee placed in the cell for her larva. After the meloe has eaten enough it goes to sleep. There, for several years, it remains in the cell of the bee. When it wakens, it has been transformed into another stage in its growth. Then it goes to sleep again, and is further transformed.

Both the beetle and the mining bee must lay large quantities of eggs to ensure that a few will grow into adults.

An Unbelievable Migration

When one looks at a butterfly, one of nature's most fragile creatures, it is difficult to believe that one of these insects is the greatest of all migrators. The butterfly is near-sighted. Its legs and wings are easily injured, yet the monarch butterfly engages in the greatest mass movement of any animal known.

In the autumn the eggs, larvæ, and pupæ of the monarch are all frozen by the first frost. There would be no perpetuation of the race if the adults still living did not move to a warmer climate where they can live. So they gather together in great swarms and start on their long flight to the south.

Some of these monarchs live from as far north as Hudson Bay. They fly along the Atlantic coast of America to the southern states and there either hibernate or lay eggs and raise a new generation. It is not yet known which is done.

In the spring they fly back north again in large numbers, find milkweed plants, and lay their eggs on them. The larvæ must have the milkweed leaves on which to live and grow.

This seasonal migration of the monarch butterfly is one of nature's most baffling mysteries. The monarch can see only a few feet ahead. Those that migrate certainly have never migrated before. Strong winds might blow them off their course, but they fly low or rest while the wind is too strong. They find their way unerringly 2000 miles to a place they have never seen.

Personal Maids to the Bees

While most insects clean themselves, some of the larger bees, known as ' solitary bees,' have maids to do this work. These large bees are covered with long fur. Dirt and pollen become attached to this fur and it is quite a big job to comb it all off. So the bees employ a number of trained maids for the cleaning job.

After the bee has finished her day's work, tiny mites begin their cleaning activity. They carefully remove every particle of dirt from every hair on the bee's body. In addition to this, they clean the pollen out of the pollen baskets on the bee's legs. All of this is done while the bee is resting.

These mites might almost be considered as hairdressers. They are paid by being given shelter in the forest of fur on the bee's body and by being allowed to eat the food that has been left in the pollen baskets.

Is it Fish or Seaweed?

The sargassum fish closely resembles the seaweed on which it lives. There is probably only one place in the world where these plant-fish live. It is in that strange part of the Atlantic Ocean known as the Sargasso Sea. This is a region characterised by tremendous quantities of seaweed, among which live millions of animals, many of which are found in no other place on the globe.

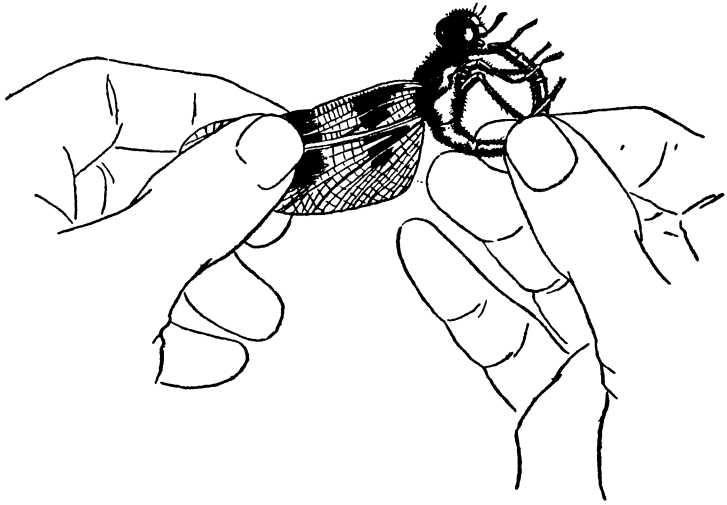
As long as sargassum fish cling to the seaweed and do not move about, they cannot be seen by their enemies. When they move, they do so in very much the same way as the seaweed is slowly moved by the motion of the water.

Instead of having sharp teeth and pugnacious dispositions, or great speed to escape their enemies, the

sargassum fish were made to look like their surroundings. Protection in the great Sargasso Sea is accomplished by laziness. The less these fish move, the more sure they are to live.

This Animal will eat itself

When the dragonfly is young, it lives in the water (see p. 96). In that stage it will eat any living thing which it can cut into pieces small enough to get into its mouth. If several dragonfly nymphs are placed in an



THE GLUTTONOUS DRAGONFLY

aquarium they are almost sure to eat one another unless plenty of food is supplied.

When the dragonfly becomes an adult, its abdomen is so long and flexible that its tail can be bent round in front of its mouth. If that is done, it will begin to eat its own body. This can readily be proved by experiment. The dragonfly is a glutton for food. One large dragonfly ate forty house-flies in less than two hours.

Five Years without Food

Cattle-ticks have been kept alive as long as five years without food. They have to live on the blood of larger animals. While they are on an animal whose blood they can suck, they are very much alive. But if there is no animal near, they simply sit still and do nothing. If nothing harms them, they live month after month even though they have no food.

Turtles can go for a Year without Food

All cold-blooded animals eat only a few times a year. But it has been determined that turtles can go for an entire year without any food. They are rather sluggish animals and do not use up very much energy. They have hard shells which prevent the moisture from escaping from their bodies and they readily store up fat which serves them in time of famine.

This Worm carries a Wood-pile on its Back

As soon as it is hatched out of its egg, the bagworm spins a silken bag in which it lives for protection. To prevent birds and enemies from noticing it, it fastens little wooden sticks on to the silk bag in which it lives.

In this bag, very well concealed from its enemies, it travels round on the tree where it obtains its food. A bird is not likely to pick up a pile of wood, and if it did, would hardly swallow it.

According to a native superstition in Ceylon, any one who steals wood during his lifetime will turn into a bagworm when he dies and will be required to carry a pile of wood on his back until the offence is expiated.

Air-conditioning is Centuries Old

Honey-bees have for many centuries employed air-conditioning more effectively than we have yet learned to use it. The bees require a constant temperature and a specific condition of air in order that their larvæ may be properly reared and honey successfully cured.

Muscular exertion of certain bees generates heat from their bodies. Air-circulation is provided by other bees known as 'fanners.' They anchor themselves to the floor of the hive and vibrate their wings at just the right speed to create and maintain the exact amount of air-circulation needed.

The Honey-bee has Twenty-two Special Instruments on its Legs

There are eleven different instruments on the three legs on each side of the bee's body, making twenty-two in all. These eleven kinds are :

1. A rake for collection of pollen.
2. A brush for cleaning the eye.
3. A pollen-brush for the body.
4. An antenna comb.
5. A spur for holding the antenna against the comb.
6. A pollen-brush for cleaning the other legs.
7. A wax-spur for removing wax from the wax-plates as it is made.
8. A pollen-comb for removing pollen from other legs and from the thorax.
9. An instrument known as the pecten, which removes the pollen from the comb of the opposite leg.
10. A pollen-press, in which the pollen is made into a little ball.
11. A pollen-basket, in which the pollen is carried from a flower to the hive.

Trees build Houses from Cellar to Roof

Many trees construct houses for certain insects which we call gall-insects. The insect-mother first stings the tree, either on a branch or on a leaf, and then deposits its eggs in the puncture. In the sting there is a special chemical which causes the tree to construct a house round the puncture. In this the eggs and larvæ will be protected from enemies and the weather.

The tree grows a compartment of varying shape and size, depending upon the kind of insect that requires it. Each one must have its own special style of architecture.

How does the tree know what kind of a house to build? No one has found the answer to that question.

She hunts her Mate with a Torch

A firefly maiden in need of a mate hunts here and there in the night with a torch. She is not trying to see her prospective mate, but to attract him to her, and she usually succeeds. This torch is a part of her body. The light is manufactured in her own abdomen in some way scientists have not yet been able to explain. Probably a chemical reaction makes the light.

It is the most perfect type of light known because all its rays are light-rays. No heat is produced. Man has not yet learned how to make this kind of light. The light is not seen continuously, but is flashed as the insect wishes to send a signal.

Because the light is not burning continuously many people call these insects lightning-bugs. As a matter of fact, fireflies are neither flies nor bugs, but beetles.

Mrs Mantis eats her Husband

The praying mantis has such a tremendous appetite for live meat that she actually eats her own mate. Following the mating the male lingers near, and it is not long before he is in the clutches of the female. She proceeds to devour him without any apology.

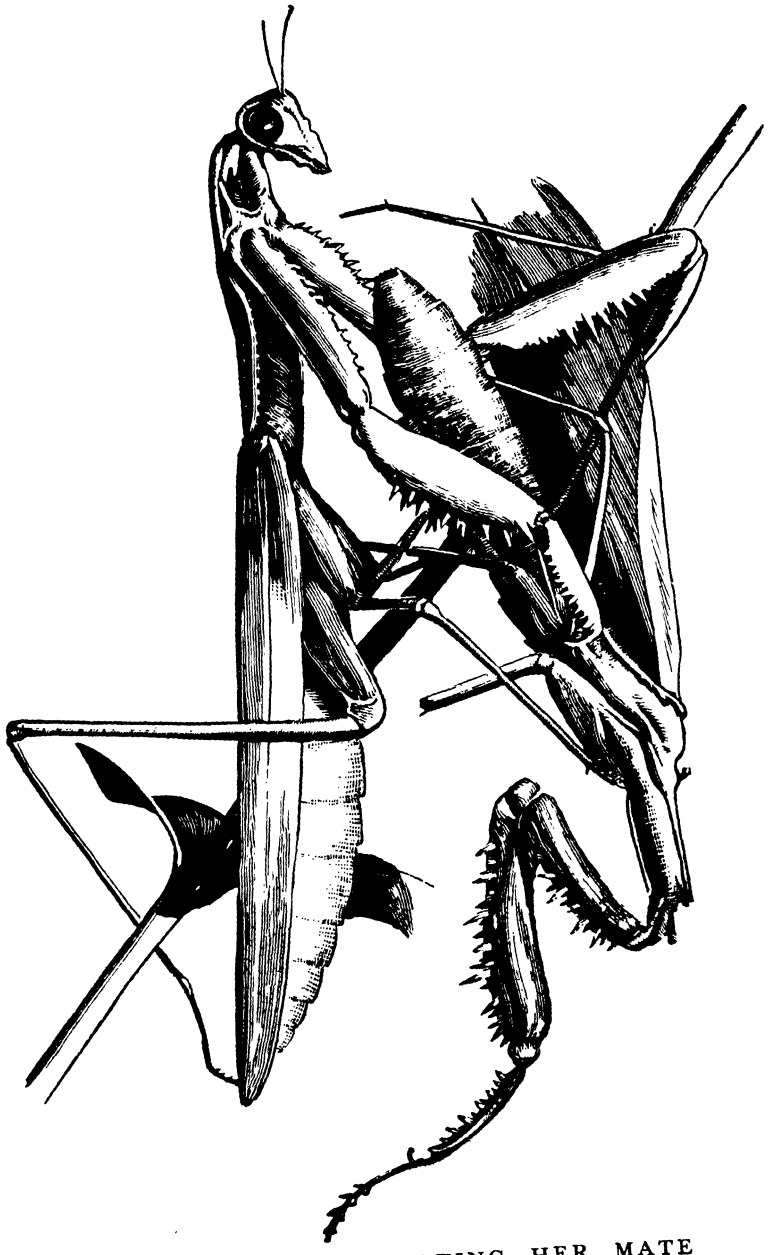
These huge insects grow to be as much as three and three-quarters inches long and they are about three-quarters of an inch wide. Their front legs are attached to what appears to be a long neck, but really is a part of the thorax. They use only four legs for walking. The two front legs are employed in capturing and holding other insects while they eat them.

Although the mantis is large it is very difficult to see, because it is so nearly the colour of the plant on which it sits patiently waiting for its food to come to it. It has wings and can fly, but it spends most of its time sitting, concealed by its green colour.

Baskets Full of Food from Mountain-streams

One of the strangest animals to be found in mountain-streams is the nymph of one of the mayflies. It eats tiny floating plants and minute animals, which it catches as they are rushed downstream by the current. This tiny insect's two front legs are provided with many fine hairs which form a kind of basket when the legs are held out. Whenever it feels hungry, the nymph anchors itself to a stone with its four hind legs and holds out its basket ; the water passes through the hairs but the necessary food is retained.

The name of this mayfly is *Chirotenetes.* Most of its life is spent in the water where it leaps and dashes through the strong current with remarkable agility.



FEMALE MANTIS EATING HER MATE
(ABOUT TWICE LIFE SIZE)

By means of its very convenient fishing apparatus it is able to obtain at any time whatever food it needs from the water flowing past it.

When full grown in the larval stage this water-animal is about an inch long. Then, its life in the water finished, it turns into a mayfly, leaves the water, and flies into the air for its mating. When it changes from a nymph to an adult, however, it loses its digestive tract. It has no mouth, and lives for a few hours only —usually about a day.

Gardens inside Trees

The bark-beetles live in or under the bark of trees. They dig right into the wood, making long tunnels. In these they plant the tiny seeds of a fungus which is a plant that is not green and does not need sunlight. It will grow where there is moisture and darkness.

The beetles eat the inner bark and sapwood as they make their tunnels. After their gardens begin to grow, they feed on the fungus. The family name of these beetles is *Scolytidæ*, and the species includes some of the most destructive forest insects.

His Nose is Six Times as Long as his Body

One morning the eggs of a katydid, which I had collected a few days before, hatched and the strangest creatures I had ever seen began to crawl about in the bottle in which they were confined. They were a bright green. Their bodies were about an eighth of an inch long, but their antennæ were about three-quarters of an inch long. The antennæ serve as the smelling organs, so we can perhaps say that the nose of the baby katydid is six times as long as its body.

It sounds grotesque, and it really is grotesque to see it waving those tremendously long antennæ as it walks briskly along the side of a bottle or jumps suddenly from one side to the other.

Though the katydid has wings, it is thought to glide rather than fly when it wishes to go some distance. Its jumping-legs are large and strong, and it can move short distances without the use of its wings.

The ears of the katydid are on its front legs.

Rust lifts a Building an Inch a Year

One of the buildings of an electric laboratory in Ohio was built upon a layer of a mineral called iron pyrites. When this mineral was exposed to the air, it began to rust—that is, the oxygen united with the iron and formed rust.

This rust was created at such a rate that the basement floors were lifted fifteen inches in fifteen years. In other words, the rust lifted the floors an inch a year. The rust occupies more space than the iron pyrites and the chemical action taking place in the formation of rust has enough power to lift a building.

One Thousand Miles on an Empty Stomach

Large fish weighing about twenty-two pounds travel as far as a thousand miles, sometimes even farther, and eat nothing during the whole trip. In fact, their stomachs are so shrivelled up that they could not digest any food if they did swallow it. They are ocean fish, and, when they are fully matured, they travel up long rivers of fresh water seeking the place in the headwaters of the rivers where they were born. There they will lay their eggs and die.

This fish, called the Chinook salmon, lives only in the Pacific Ocean. The Chinook's eggs hatch in shallow water far up the river near its source. As fingerlings, the young swim down the stream and disappear in the ocean. After about four years, when they have reached a weight of twenty-two pounds or more, they return to their original river to spawn. After spawning they die. They lay eggs once only in a lifetime.

In many places these fish fight their way over waterfalls and through rapids. They use up a tremendous amount of energy, and by the time they reach their spawning-grounds there is not much left on their bones.

Their feeding takes place in the Pacific Ocean. They eat other fish ravenously while they are in the salt water, and develop bodies containing a great deal of oil which serves as fuel for the long, hard, final journey.

Fish do not drink Water

Fish take water into their mouths, but they do not drink it. It would be more correct to say that fish breathe water, for they take it and pass it over their gills just as we draw air into our lungs. The blood in the gills extracts the oxygen from the water but none of the water is swallowed into the fish's stomach.

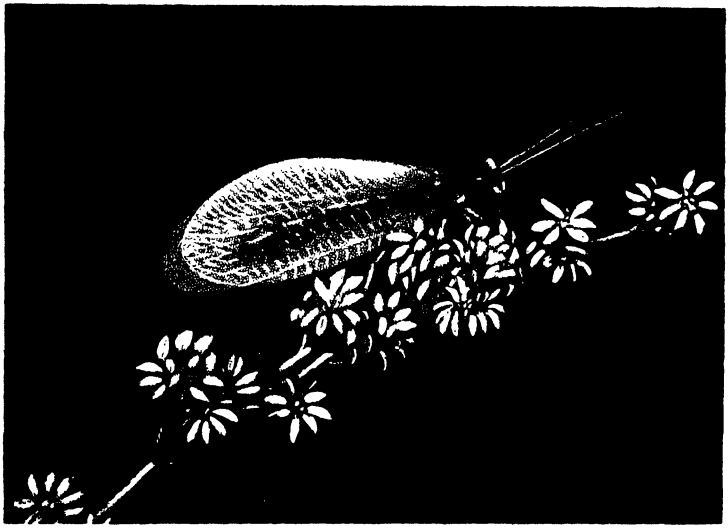
Fish obtain enough moisture from the food they eat, and, although they are constantly surrounded by water, they drink none of it.

A Fly with Beautiful Eyes

Most Americans know about the unpleasant scent of the polecat and leave it alone. The lacewing fly or *Chrysopa* is a small insect about three-quarters of an

inch long which has an odour just as unpleasant as that of the polecat. Being so small it is not so well known, although it exists all over the United States.

If you pinch a lacewing fly between your fingers, the smell is most difficult to get rid of. It will not come off



THE LACEWING FLY
(TWICE LIFE SIZE)

by the use of soap and water. The odour is, of course, to protect the fly from its enemies.

The larva gorges itself on plant-lice. It then spins a cocoon, and out of this cocoon comes the beautiful lacewing fly. It is sometimes called the golden-eyed fly because of its beautiful eyes. (See also p. 78 for the lacewing fly.)

Now you see it—Now you don't

Often known as the Jack-in-the-box of the Pacific, the island of Fonuafoo in the Tonga group, east of

the Fiji Islands, is sometimes above the surface of the ocean—sometimes below. It acts like a Jack-in-the-box.

In 1865 it was reported as a reef below the surface of the ocean.

In 1885 it was an island 1¼ miles long, and its highest point was 153 feet above the surface.

In 1894 it disappeared.

In 1896 it rose again to 100 feet above the surface of the sea.

Three years later it was gone.

In 1927 it reappeared.

It is now (1941) 1½ miles long and 360 feet high.

The reason for the activity of this strange Jack-in-the-box is a volcano on the bottom of the ocean. Its eruptions build up an island. Then, either the winds blow the loose earth away, or an earthquake-like activity causes it to drop back into the water again.

Not fed for Four Weeks

After the birth of rainbow trout in mountain-streams, the baby fish are not fed for four weeks. Even when born in a hatchery they are not offered food until they are from two to four weeks old, depending upon how cold the water is. The colder the water, the longer they go without being fed.

While they take no food from the outside during the first month of their lives, they get nourishment from the egg. The yolk of the egg of a fish is used as food by the fish fry. If the water is quite warm the yolk is absorbed in about two weeks. But if the water is colder, as it usually is in the mountain streams, it lasts

about a month, and the fish will not eat until the yolk has been used.

Fish that cannot swim

The European eel cannot swim for a few months after birth. It is born in the ocean and for some time after it comes out of the egg it merely drifts with the ocean currents. The eels are hatched on the bottom of the ocean and the larvæ make no effort to move about, for their food comes to them. They simply open their mouths and the food flows in.

When they are old enough to swim they go slowly towards the European continent, where they arrive the third summer after they are hatched. They live in the fresh-water rivers as adults and go back to the sea to spawn.

The Worm turns into a Fish

A worm without eyes and without teeth hatches from one of the twenty-five thousand eggs laid by its mother in some small stream. The worm or larva burrows into the sand in the bank of the stream and lives there until it is about five inches long. Then it turns into a fish known as the lamprey, which lives on the blood of other fish. In extracting the blood, it kills many fish in the small lakes, ponds, and streams. The dead bodies are found later floating on the surface with large holes bored through their sides.

The lamprey has a long, slender, roundish body. Its mouth is a round suction-device bearing circles of sharp teeth used in rasping the sides of other fish. When a hole is thus made the lamprey sucks out the blood. The fish pulls the lamprey along with it as its life-blood is being withdrawn.

Mr Stickleback craves More Wives

The world's champion polygamist is the tiny fish known as the brook stickleback (*Eucalia inconstans*).

He builds an enticing nest in the form of a ball with an opening on each side. The nest is constructed of algæ and plant stems which he bites off and smears with a cement which originates in his kidneys. With this cement he fastens the pieces together in a ball and makes a beautiful egg-incubator.

Then he swims away up or downstream in search of a wife. The first one he selects, he drives forcibly to the ball. He watches to make sure that she does not leave until she has laid her eggs. Then he spreads milt over the eggs.

He then goes in search of another wife and forces her to add to his store of eggs. Time after time, he forces female sticklebacks to his nest until it is filled to his satisfaction. Then he guards it and watches over the babies as they are born.

What an easy life Mother Stickleback has! Father assumes all of the responsibilities of the family.

The stickleback gets its name from a series of sharp spines on its back. The length of this polygamist is only two and one-half inches. The nest is only about three-quarters of an inch in diameter. Attached, as it is, to a green plant, it is very difficult to discover.

Fish record their Ages on their Scales

A fish keeps the same scales as long as it lives, but they grow larger every year. There is very little, if any, growth during the winter. When the scale starts to grow again the next spring, the new layer overlaps the old part just enough to form a little ridge. Another

ridge is made each year. These ridges can be counted to learn the age of the fish.

By counting the scale rings, it has been discovered that the pike and the carp have lived to be as old as thirty years. On the other hand, the Pacific salmon usually lives only four years. Most fish continue to grow as long as they live.

This Mason carries Stones in his Mouth

The rainbow trout (*Salmo shasta*) is a mason—a house builder. The male builds a nest of stone for his mate —and he carries the stones in his mouth. He selects a place in quiet water in a mountain lake and makes a nest of pebbles. In order to place his pebbles where his fancy dictates, he picks them up in his mouth. If there are not enough of the right size in the immediate vicinity, he will carry them from anywhere they may be found. The female lays her eggs in the nest he has prepared and then the male spreads his milt over them.

Instantaneous Disguises

The Nassau grouper is a fish that can disguise itself by changing colour. It has been known to assume eight different colours and markings in as many minutes.

Sometimes it has stripes ; sometimes it has spots ; sometimes it is plain. The changes are made instantly, and, in case of danger, the fish can make itself invisible by assuming the colour of its surroundings.

The Nassau grouper is used for food. It is mainly found in West Indian waters, but it wanders north and has been caught in New York Bay.

The Most Polite Bird in the World

Explorers who visit Antarctica are surprised not only at the fearlessness of the birds there, but at their politeness. No other bird in the world will show so much respect for human beings as the emperor penguin. They approach men without any fear whatever, and as they approach, they bow with the greatest of respect. Their habit of walking upright and the colour of their coats—which resemble a man in a dress suit—make the appearance of politeness all the more emphatic.

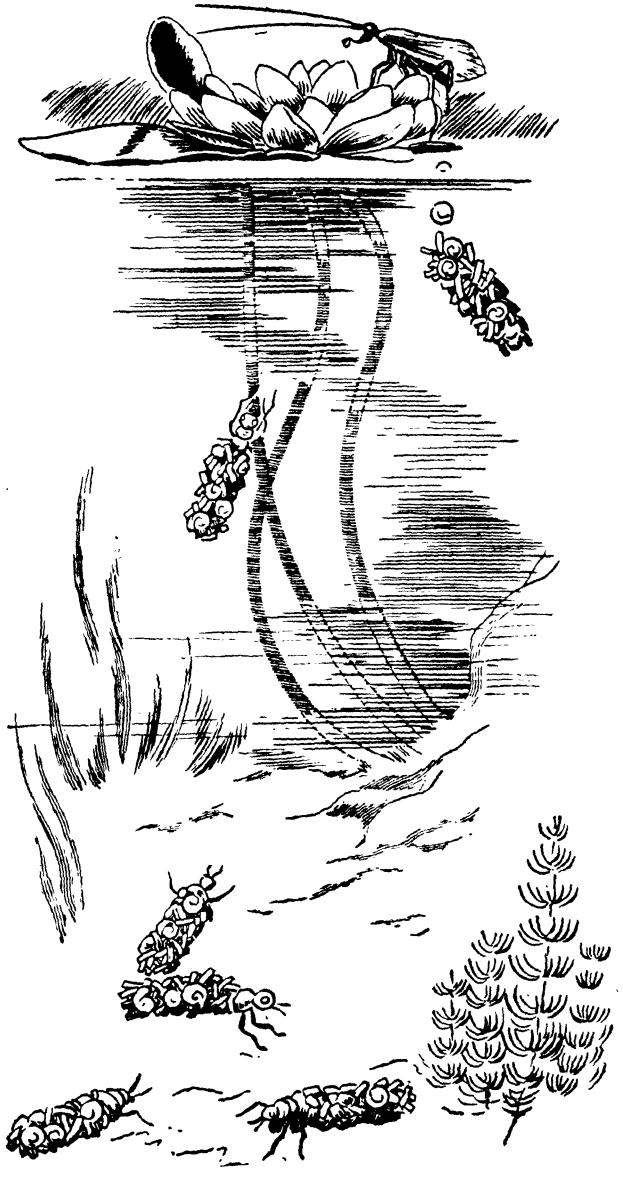
Road-signs in the Ocean Deeps

Many deep-sea animals travel long distances. They find their way because there are plenty of road-signs in the ocean. For example, fish are able to recognize the difference between currents, not only by the direction of their flow, but also by the amount of salt in the water. Fish have a row of sense-organs along each side and they can readily detect conditions in the water.

Some currents flow rapidly, others more slowly. The rate of speed is a sign in itself. Some flow along the surface, while some are farther down in the ocean. They move in different directions—some up towards the surface ; others down towards the bottom. There are current-roads in the sea.

Submarines made of Stones

The caddis-fly larvæ used submarines many generations before man existed on this earth. The mother caddis-fly lays her eggs on the bottom of a river. These hatch into tiny worms which, with the aid of silk that



CADDIS-FLY LARVÆ AND ADULT

they spin round themselves, collect quantities of stones and shells to provide a strong tube in which they live.

These larvæ can cause the tiny submarines to rise to the surface or sink to the bottom at will. They have just as much control over their diving-tubes as the Navy has over its submarines.

A Jumping Fish

There are several kinds of fish that can live an hour or more in the air. One called the mud-skipper is found in the warmer climates of the world ; its most interesting characteristic is that it hunts its food on land and jumps about something like a grasshopper.

It does not go far from the river, for it readily finds its needed food in the space on the bank where there is no grass. It explores the rocks, roots of trees, and other objects where insects may be hiding.

The little mud-skipper jumps into the air and propels itself from place to place by means of its jumping-fins. These are on the underside of the body and are formed in a special way to enable the mud-skipper to throw its bulk forward. After its stomach is full, it jumps back into the water and swims away.

This Fish has Two Husbands

The female sucker has two husbands. When she is laying her eggs, a male stays close on each side of her and, as the eggs leave her body, the two males spread their milt over them.

The sucker is a rather peculiar fish which is found in streams and ponds. Instead of having a mouth at the

end of its head as other fish do, its mouth is on the underside of its head and is in the form of a sucker—a round, disk-shaped opening.

The sucker feeds on the bottom of the stream where it draws various tiny animals and plants into its mouth, together with any worms that may be living in the mud.

There are many varieties of suckers, several of which, especially in the summer, are not considered to be good for food. Others have a high commercial value.

Scientists have not explained why it is necessary for the sucker to have two husbands, but the reason may be discovered eventually.

Twenty-five Thousand Miles a Year without a Map

The distance from northern Greenland to Antarctica is about eleven thousand miles. In both areas there are long periods of daylight, but these long days are at different times of the year. Whether it is the desire for the utmost daylight or something else that causes the Arctic tern to spend its summers in northern Greenland and its winters in Antarctica is not known. At any rate, by doing this, and controlling its flight each spring and autumn, it lives in almost perpetual daylight.

But the Arctic tern does not fly direct from northern Greenland to Antarctica. It travels to Europe, and then along the coast of Africa. It flies over the ocean, until it has covered not less than twelve thousand five hundred miles over vast expanses of water—and without a map.

No one knows what guides the bird on its migration. We do know that the older birds do not show the younger ones the way. In most cases, the younger

birds migrate first, and without any older guide. Yet they go by about the same route and arrive at the same destination as their parents.

The Arctic tern is a beautiful gull-like bird, largely white, but with a characteristic black bonnet over its head. It has a red bill and red legs, and a forked tail something like that of a swallow. Its average length is fifteen and a half inches. It is the world's champion traveller. Almost its whole life is one round of amazing migration.

Abu waits for his Food

Most birds look for their food. Some of them travel long distances every day. But the shoebill stork waits for its food to come to it.

In the Arabian language this stork is called 'Abu-markub,' which means Father of a Slipper. The bill of this bird looked like a shoe to the first Englishman who saw it, and like the father of a slipper to whoever gave it its Arabian name.

The body is about five feet high and is built on long brown legs. On these the bird stands perfectly motionless in some swamp in the vicinity of the upper White Nile in Egypt. The fish, with their poor eyesight, think that the legs are rushes and swim up within reach of Abu-markub.

Then the bird reaches out so quickly that the little fish does not know what has happened to it. The sharp hook on the end of that shoe-like bill never misses its mark.

Abu is also fond of frogs, snakes, and clams.

The shoebill has a very comical walk. Its legs shoot forward in slow measured pace with the long toes pointing outward.

The colour of the shoebill is a faded blue-grey. Its

eyes are a light yellow. Its food-gathering depends on its ability to stand still and wait for food to come to it.

A Bird-meal from Soup to Nuts

The Clark's nutcracker is nearly as big as a crow, and walks like a crow, but its body is greyish-white with black-and-white wings and tail. It lives in the Rocky Mountains and adjacent regions. A nutcracker's meals are as complete as a seven-course dinner, from soup to nuts.

The soup is the liquid contents of the bodies of two or three fat grasshoppers. In some nearby camp it picks up its meat or perhaps a stray piece of bread. Then it flies to a tree and eats half a dozen caterpillars. Next it finds a dessert of juicy berries. Last of all, it goes to a pine tree, picks off a cone, and flies to the ground. It hammers the cone against a stone until the seeds fall out. These are its nuts.

Seventeen Years a Baby; Four Weeks an Adult

After taking seventeen years to grow into an adult, it does not seem possible that the cicada, known as the seventeen-year-locust, could possibly live as short a time as four weeks. But that is its regular span of adult life.

After living in the ground as a developing larva for seventeen years, it would seem that the reward of adulthood should be much greater. But, for some strange reason which we do not well understand, the life of the adult is only four weeks. During that time its chief object is to mate and lay eggs in slits which it makes on the twigs of trees (see p. 84).

The larvæ are not hatched from the eggs until after their parents are dead. Then the larvæ, which look like worms, crawl into the ground and there live like worms most of their lives.

When it is ready to become an adult, the cicada crawls out of the dirt, climbs up a tree trunk, and, by throwing out its chest and bulging its back, cracks its shell.

The shell of the cicada, as is the case with all insects, is its skeleton. After considerable manœuvering the cicada steps out of its skeleton and leaves it hanging there on the bark of the tree. Many of these discarded skeletons may be found during a morning walk.

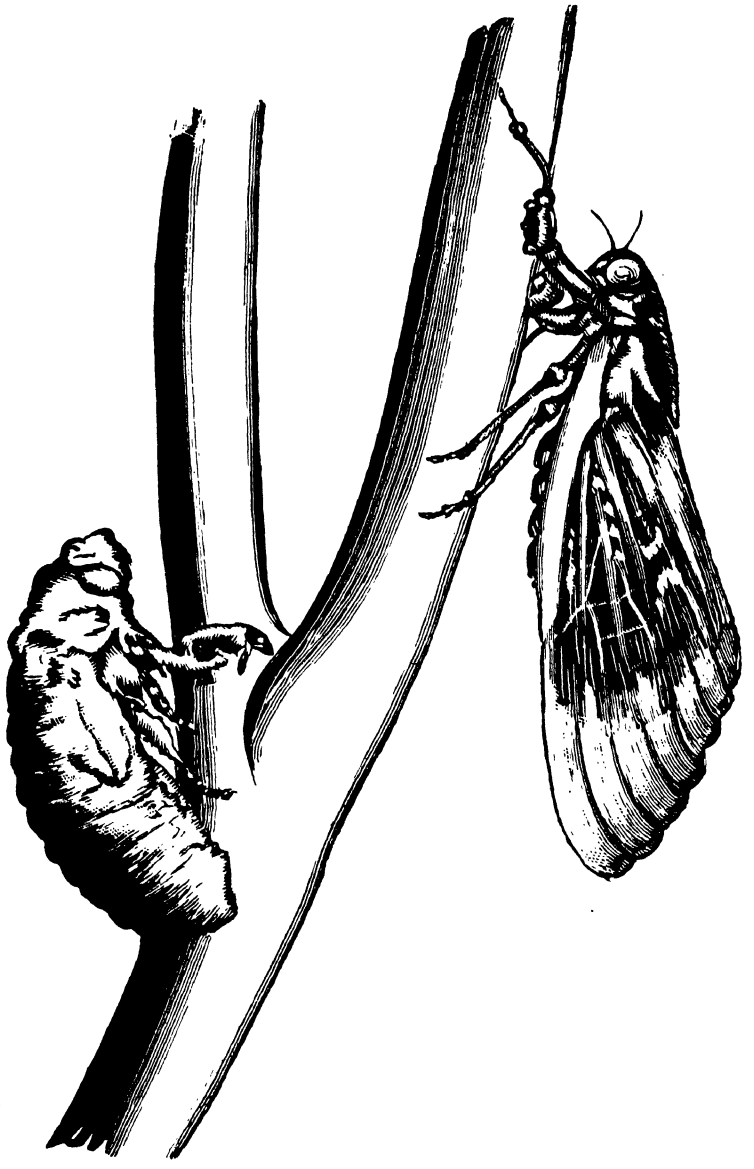
All cicadas are orphans because both their parents die before they are born. And when they lay eggs, they never see their own children because they die before the eggs hatch.

Mountain-birds hatched in Frigid March

The female Rocky Mountain jay lays her eggs in March when the ground is still covered with snow. The babies hatch early and are ready to take care of themselves by the time other birds are hatching their young. Mother Jay gets her spring work done early. (Illustration on p. 155.)

She usually selects a spruce tree in which to build her nest. She finds twigs here and there and laces them tightly together to form a bowl about eight inches wide and more than four inches deep. Then she weaves moss and lichens into the bowl of twigs.

Finally she flies down to look for pieces of rabbit's fur. With this she makes a cosy lining to her nest. When she has finished, it is not a bad place to be born in on a frigid day in early March, on the mountain-top.



THE CICADA AND ITS DISCARDED SKELETON

The World's Best Flier cannot walk

The humming-bird's feet are used only for perching. One foot cannot be placed in front of the other in walking. The wings are always used when the humming-bird wants to move. Even when it lifts itself for the first time out of the silky down in which it is brooded, to sit on the edge of the nest, it must use its wings to get on to that delicate perch.

The tiny humming-bird is the strongest of all fliers. The muscles used for flying are fastened to the breast bone or keel of a bird. Those of the humming-bird, the smallest of all birds, are larger in proportion to the size of body than those of any other flying animal.

The structure of its legs is such that they cannot be moved as is necessary for walking. The legs are short. But the chief difficulty is in the way the upper part of the leg is made. The thigh does not move freely but is embedded in the flesh. To compensate for this lack of walking ability, the humming-bird is provided with the means for flying in any direction. It flies forward, sideways, up, down, or backward. No other bird can fly backward. The humming-bird can remain stationary in the air. Its strong wings are so perfectly controlled that they can just support the bird in a given position until it is ready to move backward or in any other direction.

It needs to fly backward in order to withdraw its long, slender beak from a flower. Very often the flowers in which it finds insects and nectar for food hang downward. In order to reach inside of the nectar tube, the humming-bird must stay in the same position in the air as it thrusts its beak and long tongue into the blossom.

The World's Most Noiseless Flier

People walking through the woods at night sometimes see an owl dart through the air to capture a mouse, but they never hear it, for owls have noiseless wings. The long wings are fringed with very soft down, so that, no matter how fast they are moved through the air, no noise is made.

Owls are not often seen. They hide themselves in hollow trees during the day and do their hunting at night. Even then they are rarely seen because they are so stealthy in their habits. Their eyes are keen in the darkness. An owl can be sitting high in a tree and see a tiny mouse moving among the leaves on the ground. Swish ! and the mouse is caught.

The owl swallows the mouse, bones, fur, and all. The digestive apparatus separates the bones, the fur, and other indigestible parts, and rolls these into a pellet which is regurgitated.

A Glider that cannot land on a Level Surface

The world's most expert glider has no landing-gear for either land or water. If it alighted on the surface of the ocean, it could not take off again. If it landed on level ground, it would be grounded for ever.

This expert glider is the man-o'-war bird. Its habitat is the great atmosphere over the warmer oceans. With its wingspread of seven feet it stays in the air, with little exertion, a greater part of its life than any other bird. It knows how to make use of the wind currents. Some observers have said that they believe it sleeps in the air.

The man-o'-war bird's feet are not made to land on and take off from a level surface. It must live on ocean

fish, yet its feet are not webbed and it cannot swim with its wings like the penguin. All the leg bones, except the ankle and the toes, are embedded in the bird's flesh. It cannot put one foot in front of the other and is therefore unable to walk. Even with its tremendous wingspread, it is almost impossible for it to rise from the ground. The only way it can take off is to jump into space from the edge of a cliff or from the branch of a tree.

The nest is commonly built on the high limb of a dead tree, for the man-o'-war bird has difficulty in flying among branches. It is a perfect glider, but on the surface of the water it would soon drown and on land it is awkward and helpless. (See also p. 129.)

Snow-shoes grown to Order

Snow-shoes grow on the feet of the American ruffed grouse, a ground bird that must be able to escape its enemies without flying. During the winter it needs some device by which it can run quickly over the soft snow. Its enemies have no way of making such speed. But the grouse has snow-shoes growing on its toes. With these it can make rapid progress.

Stiff spines grow out of the toes on both sides to form shoes which resemble the Indian snow-shoes made out of thongs.

These Birds build Nests in those of Other Birds

The nests of grackles and English sparrows are reported to have been built in those of the osprey. This is a large hawk that lives on fish and builds tremendous nests out of large sticks, straw, and weeds, high on the

branches of trees, or on rock ledges near a lake. The sticks are placed so far apart that there is plenty of room between them for the smaller birds to build their nests.

Of course the smaller birds' nests are not placed where the osprey sits on her eggs but near the bottom on the outside.

The reason why these squatters help themselves to this choice building-site is that they too like the meat of fish, and the osprey is a very successful fisherman. She wastes a great deal of food and her uninvited house-guests help themselves to the choice morsels they find under the table after the osprey has satisfied her own appetite. (See also p. 172 for the osprey.)

Scent is as Good a Language as Talk

Most of the lower animals depend more upon the sense of smell than upon those of sight or sound. The scent-language among the insects is the chief method of communication.

One of the most interesting examples of the scent-language is quite easily observed during the hunting season. A good retriever follows game by scent rather than by sight. Dogs are near-sighted but they can follow a rabbit or a bird by the odour left on the trail.

There are many different scents which mean different things. The retriever will gallop through a meadow in a zigzag course and pick up the scent of the quail. It can tell whether the odour is made by the body, the toot, or the nest ; whether it is fresh or old ; and the direction in which the birds were going.

When a dog chases a rabbit, it does not hold its head high in the air, but keeps its nose to the ground. As it gets near to the rabbit, it barks with excitement, yet

it does not see the rabbit. It knows, however, from the scent, that it is near the end of the chase.

One American Robin eats Fourteen Feet of Worms a Day

A careful experiment with robins kept in captivity showed that they ate sixty-eight earth-worms a day. If these worms had been placed end to end, the line would have been fourteen feet long. Each bird ate forty-one per cent. more than its own weight in twelve hours.

The American robin belongs to the thrush family and is nearly twice the size of an English robin. It has a red breast but is actually a relative of our blackbird.

Nature's Automatic Cradle

The nest of the American coot is built of dried rushes and floats on the water. By being rather generous in the use of rushes, the mother coot builds a nest that will hold her weight and that of the babies which hatch from the six to fifteen eggs which she lays. The nest is not allowed to float freely, but is anchored to upright reeds which hold it in a restricted area. As waves come the nest floats on the crest and the babies are rocked by the movement of the water.

The mother starts to incubate the eggs as soon as she lays the first one, and she continues to lay eggs after some of the baby coots have hatched from these first laid. Some of her babies, therefore, are ready to go away in search of food while the mother is still sitting on the other eggs.

That is where the father comes in. He leads the

A RETRIEVER FOLLOWS GAME BY SCENT

babies off to hunt for water-insects and plant-buds which supply them with their food.

The Bald Eagle is a Highwayman

While the bald eagle is beautiful both in form and colour, it is a highwayman of the air. One of its favourite foods is fish, and, although it can fish for itself, it makes a practice of stealing from other fishermen.

Hovering above the fish-hawk, or osprey, until it has captured a fish, the bald eagle flies after the hawk and threatens it until it drops its prey. The eagle then dives through the air so fast that it usually catches the booty before it touches the water. A fish-hawk can seldom get away when a bald eagle makes up its mind to rob the osprey of its dinner.

The bald eagle is the national emblem of the United States.

Babies Bigger than their Parents

Incredible as it appears to be, the babies of the bald eagle are larger than their parents during the first year of their lives. Usually there are two babies in the huge nest built of coarse sticks high on a mountain ledge.

The nests are frequently five or six feet in diameter, and about five or six feet high. Some that are twelve feet in height have been found. It is common for the eagle to use the same nest continuously for many years and each year a few more sticks are added.

It requires almost a month to hatch the eggs and the parents share the work. While the female is off the nest, the male takes his turn. When the babies are born, both parents give them the very best attention.

The babies do not become the colour of adults until

they are three years old, and during the first year they weigh more than their parents.

A Fish-eating Bird that cannot swim

The man-o'-war, or frigate-bird, cannot swim or land on the water. It lives on fish and it can swoop down close to the level of the ocean to pick up with its long, hooked beak any fish near the surface. Another way in which the man-o'-war obtains its food is by forcing the booby, an expert fishing bird, to give up its catch. To do this, the man-o'-war flies high above the water and waits until the booby is starting for its nest well loaded with fish. Then it dives down, forcing the booby to disgorge its meal, and, with almost uncanny ability in manœuvring in the air, drops below the booby and catches the food as it falls.

The man-o'-war must not let its feathers become wet as they do not shed water and the bird would soon be weighted down and drown (see p. 123).

Spiders were the First Telephone Users

It is a common practice of the orb-weaver spider to attach a ' telephone line ' to the centre of her web. She carries this line to some hiding-place and goes to sleep.

The instant her services are needed to subdue a captured insect, the ' telephone line ' wakens her. She then uses the line as a bridge over which she runs to the centre of her web. From there she goes to the place where the insect is caught. The line is a piece of silk which the spider pulls tight. The instant the web is struck by an insect, this silk vibrates and the vibration acts as a warning signal.

Invisibility by Reflection

There is a species of spider covered with reflectors in the form of ridges all over its outside skeleton. These ridges are at such angles that they reflect the colour of the surroundings and make the spider practically invisible.

As a result of this the crab-spider, whose scientific name is *Misumenoides aleatorius*, is very difficult to find. If this crab-like spider is on a yellow flower, it appears to be yellow. When it hides in a red flower, it looks red. Its body does not change colour but reflects the same light as the flower on which it is resting.

Plants grow in the Bodies of Animals

The tiny animals called polyps, which make coral in the ocean, cannot digest their food without the help of tiny plants known as algæ. Almost all the different kinds of coral have algæ in their bodies.

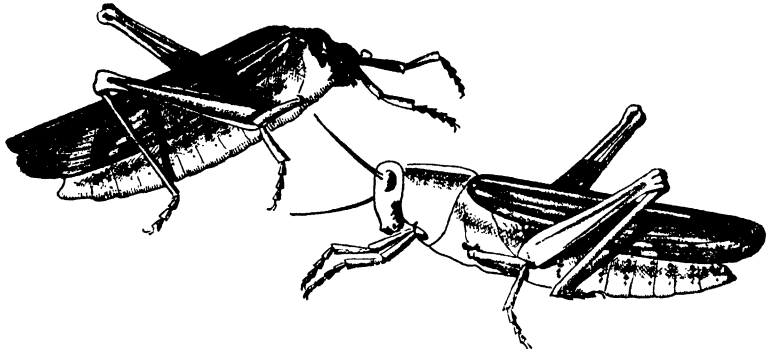
The algæ can take the mineral matter out of the sea-water and change it into a food which the polyp can use. The coral cannot do that alone. This is a digestive process, so we may truthfully say that plants digest the food for the little animal polyp.

He can walk without a Head or a Body

There are three parts to a grasshopper: the head, the thorax, and the abdomen. The control of the legs by nerve ganglia is such that no head or abdomen is needed to enable the legs to walk.

The legs are attached to the middle part, the

thorax. If the head and abdomen are removed, the legs can still walk as though the grasshopper were complete.



THE GRASSHOPPER
CAN WALK WITHOUT ITS HEAD

An Underwater Breathing-trick

The aquatic spider, *Argyroneta aquatica*, builds a silk diving-bell. It is an inverted silk hemisphere with space inside for air. She pulls this under the water and fastens it to the stem of a plant. Some air remains in it. At frequent intervals she goes to the surface, gets a quantity of air, and takes it down to refill the diving-bell.

The spider's body is covered with fur. When she emerges from the water, air fills the space between all the tiny hairs. When she dives into the water, the air remains round her body. On arrival at the diving-bell, she has a way of transferring the air from her body so that it will stay in the bell.

The aquatic spider dives under the water to build her nest in order to obtain special protection for herself and her young.

A House Lined with Silk and with a Water-tight Door

The house is a hole in the ground, lined with pure silk made by the trap-door spider. The trap-door is also made of silk with earth and tiny stones mixed in to make it solid. It has a bevelled edge which fits into the hole in the ground so tightly that no water can get through.

This door fits so well that the spider herself would have a hard time opening it if she went out and let it slam. So she sits on the inside, holding the door with two of her eight feet, and waits until some living food comes near enough for her to seize it. She then pushes open the door quickly, grabs the food, and pulls it back into her silk-lined house.

The Spider's Meat-preserving System

Without refrigerators or ice, spiders and some wasps preserve meat for weeks. Spiders must have live meat to eat, but they cannot depend on getting a sufficient supply every day. When, therefore, a spider makes a catch, she does not immediately eat all the food collected in her web but preserves the surplus for future use. This she does by injecting into the body of the insect a certain liquid which stupefies but does not kill.

Many wasps do the same thing. Their babies must have live meat to eat, so they inject their paralysing fluid into the spiders or caterpillars which they catch for their babies' food. These living yet inanimate animals are pushed into the cells with the wasp's eggs. There they remain unconscious until the wasp larvæ are born and eat their bodies.

All the Power of Niagara does not uproot these Fragile Plants

When men get within two or three hundred feet of the brink of the tremendous cataract at Niagara, they know that their boat and their own lives are doomed ; for the force of the water drags the boat over the crest. No human power can pull against that irresistible current. Yet there are plants growing at the very brink of that huge waterfall. These plants are on the bottom of the Niagara River and continue right up to the edge of the precipice. They are known as fresh-water seaweeds.

These seaweeds are made of clusters of tiny plants called algæ, and they exist in this precarious position only because the water of the Niagara River is clear. If it were muddy, they would quickly be carried away. Their roots are not especially strong, and they do not use them for procuring food but only to anchor them to the rock, in the crevices of which the roots take hold.

The tiny filaments that make up these plants offer very little surface for the water to push against. If the water were muddy the mud would collect on the plants and offer a large surface against which the water could push and the seaweed would quickly be torn away.

Solomon's Seal keeps a Record of its Age

Probably the majority of people know that trees keep a record of their age in such a way that man can tell the years by counting the rings in the trunk of the tree. But it is not generally known that a wild flower known as the True Solomon's Seal also records every year of its life.

It has a many-jointed, thick root-stalk. A single

graceful stem rises from this stalk. It withers after fruiting and, as it rots away, a round scar is left on the root.

The outlines of this scar suggested the seal of Israel's wise king to the man who named this wild flower. By counting the scars on the root-stalk one can easily tell the age of the plant.

Spiders fly Balloons over the Sea

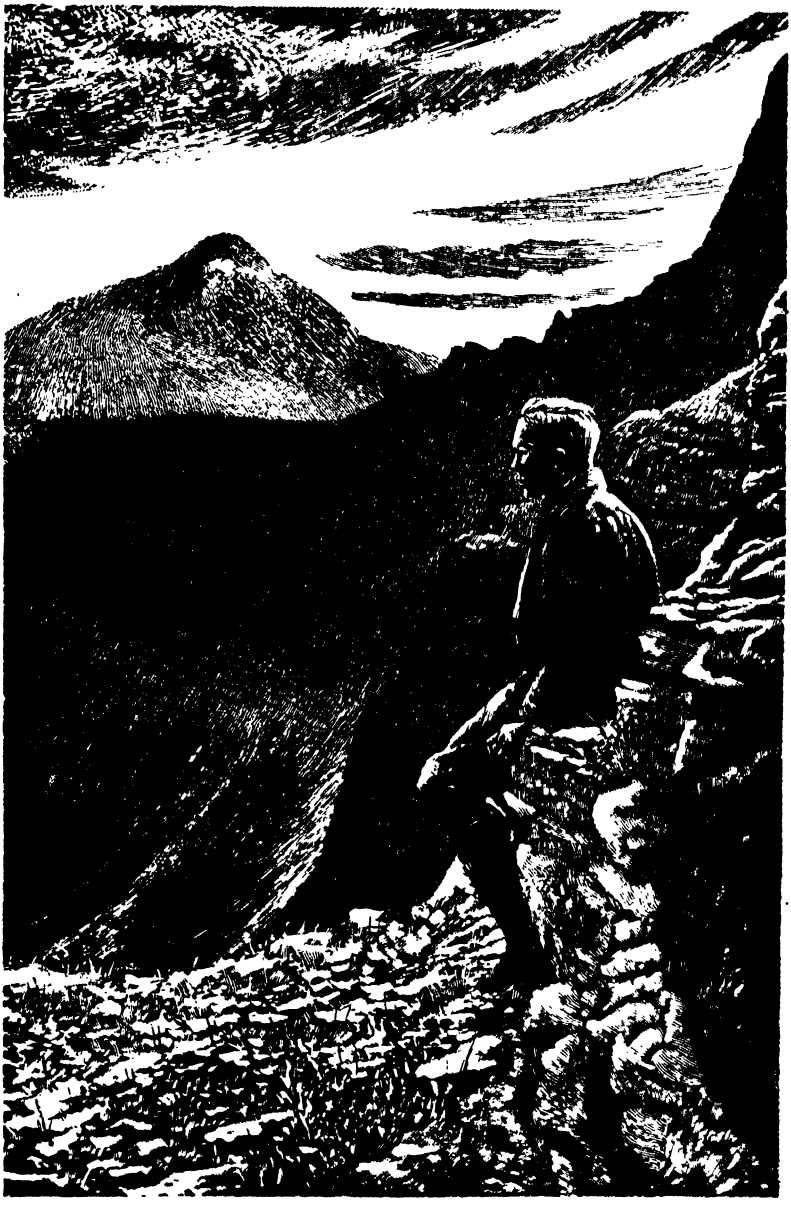
Young spiders must get away from their own families, where they would be eaten if they stayed too long. They must find new places where they can live solitary lives in safety. The baby spider, when she is ready to leave her mother's nest, goes to some high point, such as the top of a fence-post or the top of a stone and there lets out silk from her spinnerets at the end of her abdomen. She pulls out the silk with her hind feet and lets it float in the air.

This must be done when the weather conditions are just right, otherwise the silk would not float. Usually it happens on a sunny day when there is sufficient breeze to carry the balloon away.

Enough silk is released to catch the wind and lift the young spider into the air for her long and uncertain ride. When these rides originate near the sea, strong winds sometimes carry the tiny spiders out over the waves until they reach an island or another country.

The Wind blew this Mountain away

In Glacier National Park, America, is Going-to-the-Sun Mountain, which is now two miles high but was once four miles. Half of it has been blown away. It took a long time but that means nothing to the wind.



GOING-TO-THE-SUN MOUNTAIN

Three million years ago Sun Mountain was first thrust above the surface, and in three million years a lot of rock can be moved. The wind is still at it. In another three million years the mountain will have lost its fame—it will be so small by then.

Every year tons of rock are carried out over the plains and used to build up plateaux. Extending east from the Rocky Mountains are great plateau areas. Thousands of square miles are two thousand feet or more above sea-level. These plateaux were built up by the wind that blew away the mountains.

The process is simple. Nature breaks up the rocks by using frost to freeze water in the cracks. As the water freezes, it expands. This expansion breaks the rocks into pieces. As they fall a thousand feet or more down a cliff, they are smashed into many more pieces. Usually they land on a glacier and after a hundred years this glacier may have ground at least half of them into dust. The water melting from the glacier then carries this dust, which is known as glacial flour, down the sides of the mountain.

At various places the water is dashed against rocks and some of the glacial flour is left on the rocks where it dries. Later the wind blows some of this rock-dust for miles through the air. The rest is carried down the mountain and more of it is spread out over the plains. Some is carried on to the ocean where it helps to enlarge the continental shelf.

Bees must pay a Fine to be released from a Flower Prison

Many of the flowers would be helpless without the assistance of certain insects. They could not get the

pollen transferred from one blossom to another, and so could not reproduce seeds.

One of the strangest devices to ensure pollination is used by the stemless lady's slipper, a wild flower with the scientific name, *Cypripedium acaule.* This blossom is so constructed that the bee must crawl entirely inside to obtain the nectar. Once inside, it is imprisoned and cannot get out until it has paid a fine.

The fine exacted by the lady's slipper is that the bee must deposit on the pistil pollen it has picked up from the stamens in another flower. The bee must crawl over these fertilizing elements in order to get out of the prison. She pays her fine in golden pollen on the pistil.

Spiders that capture Birds and Fish

Occasionally a tiny humming-bird may become entangled in a spider's web, but this is not common. There is a spider, however, which spins no web but actually captures humming-birds. This spider is found in South America.

During the day it lives in a burrow, and hunts out the sleeping humming-birds at night. It pounces upon the mother or her babies, and paralyses them with the poison it carries in its poison-sac. It then eats their flesh at leisure.

The spider that hunts for fish lives in Australia. Her scientific name is *Thalassius spenceri.* She sits by the water, balancing herself on two feet with her other six feet held ready to seize a fish. When a small fish swims near, the spider jumps into the water, and dives so quickly that it is able to seize the tiny swimmer.

It immediately paralyses the fish by injecting poison and then drags the carcass out on to the bank. There it begins a long meal at once.

These are not the only spiders that do not catch their living food in webs, for there are some in America, known as wolf-spiders, which run along the ground or jump from a bush on to their victims. If the animal that it is chasing happens to fly out over the water, the spider pays no attention to where it is going, but follows in hot pursuit.

There is a film over the surface of all water, strong enough to hold up very light objects. The wolf-spider is not only light in weight, but its legs and feet are covered with long hairs. Its weight is distributed over the water-film by these hairs. This gives the wolf-spider the ability to walk on the water.

An Evil-smelling Cabbage

If you sometime wander through an American swamp and think that you smell a decaying animal, look for skunk cabbage. It imitates the odour of decayed animal matter—for a very definite purpose. Certain flies and other insects which feed on decayed meat help the skunk cabbage to transfer its pollen from one flower to another. In order to attract these insects, it produces their favourite odour. This unsavoury plant is sometimes called swamp cabbage and has the scientific name *Symplocarpus fœtidus*.

The bad scent serves another purpose in the life of *Symplocarpus*. It prevents the cattle from eating its leaves. Not only does it have an odour the cattle do not like, but it also secretes a stinging juice which irritates the cows' mouths if they eat the leaves.

At least one bird has learned the secret of the skunk cabbage and builds her nest in its centre. This is the Maryland yellow-throat—an American warbler. She has learned that, by building her nest in the space in

the centre of the plant, enemies do not steal her eggs. Evidently the evil smell does not affect her happiness and is not objectionable to her babies.

Blossoms under the Snow

Chickweed, *Stellaria media*, blooms any day of the year, except during the very worst frosts. When there is snow on the ground, blossoms may be found under the snow, for this persistent little plant sends out its blossoms even when they cannot reach the sunshine.

The seeds of the common chickweed are used to feed caged birds. The plants form a carpet on the ground in almost every place where moisture stays near the surface. The stems of the chickweed are reclining and bear oval leaves. The flowers are small and white.

Plants with neither Roots nor Leaves

How can they obtain food without roots or digest it without leaves? The food is taken out of the air, and the digestion takes place inside the plant's tissues.

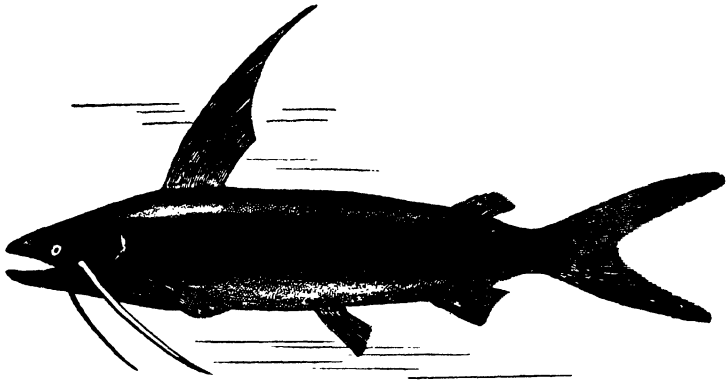
But how do they fasten themselves? Does not the wind blow them away? Instead of roots, the lichen has filaments which are so microscopic that they can penetrate the spaces between the particles that are joined together to form granite rock.

The whole body of the lichen absorbs moisture and food from the air. It also abstracts chemicals from the rock. It makes an acid which dissolves portions of the rock and these serve as a part of its food.

Babies live in Father's Mouth

When the female *Felichthys felis* lays her eggs, the male takes them into his mouth. He assumes the responsibility for results from that time on. It is usually about sixty-five days before he releases the young to shift for themselves.

The common name for *Felichthys* is gaff-topsail catfish. It lives in the ocean along the Atlantic



THE GAFF-TOPSAIL CATFISH

coast of America and grows to be about two feet long.

The young fish are carried about until they are three inches long. There are usually fifty-five of them. How the father manages to eat anything during the sixty-five days of his parental responsibility is a mystery. Perhaps he fasts the whole time. Certainly he knows what he is about. To perpetuate his race, he must carry his babies in his mouth until they are old enough to shift for themselves. Other fish would eat them if he neglected his duty.

From the picture you will get an idea as to why *Felichthys felis* is called gaff-topsail catfish. His dorsal

fin (the one just above his shoulders) is very much like the gaff-topsail on a boat.

A Whole Generation of Plants in Thirty Minutes

Tiny plants grow inside our stomachs and aid in the digestion of food. When food enters our stomachs it collects in a mass like a ball. Before the stomach juices can act upon the inside part of that ball, they must eat through the outer portions — and this action commonly requires about thirty minutes.

With every mouthful of food we swallow tiny bacteria, the smallest of all plants. In the warm stomach with plenty of food all about them, they begin to grow and multiply. At least one complete generation of plants has gone through its life in the thirty minutes it takes the stomach acids to reach them.

The Pokeweed buys Fertilizer from the Birds

The pokeweed, *Phytolacca decandra*, wants its seeds transferred to new locations and there planted with fertilizer which will help the young plants to grow quickly. The seeds are grown in a dark juicy berry which delights the palates of birds. They eat the berries, and because the seeds are small, they are swallowed.

The coats of the seeds are hard enough to prevent their being broken by the crushing and the chemical action they experience in the bird's gizzard and stomach. So they pass on out together with a quantity of fertilizer which ensures rapid growth of the seedling.

The pokeweed buys the fertilizer and pays one berry —in advance.

Nature makes Sticky Fly-paper

The wild pink, often called the catchfly, has always had a device by which it controls the transfer of its pollen. The pollen is best carried by butterflies, but the nectar the pink produces is liked by ants. The butterfly can reach the flower by approaching it through the air. The ants must crawl up the stem. So nature has provided the wild pink with sticky flypaper on which the unwelcome ants are caught.

Thus the nectar is saved for the butterfly which pays for it by carrying pollen to other flowers of the wild pink. The ants might pick up some of the pollen, but they would not carry it to other flowers.

This Plant's Seeds will not grow in Soil

Although most plants must have soil in order to obtain food for themselves, some will not grow in soil. One of these is the mistletoe. Its roots have not the ability to take food out of the ground direct. They must get it from some tree. The mistletoe grows parasitically on branches of trees, and sends its roots into the sapwood of its host-tree, where it receives a liberal supply of sap brought up from the roots of the tree.

The seeds are carried from one tree to another and from one branch to another by the birds. Certain birds like the berries which grow on the mistletoe and, although they probably do not know it, they plant the seeds and in that way provide more berries for their food.

The seeds have a sticky substance on them and, as birds eat the fruit, some of the seeds stick to the outside of the birds' bills. The birds then fly to other branches

or to other trees. There the seed on the bill is rubbed off against a limb. The seed, being sticky, adheres to the branch, and as conditions become favourable it sends out roots and starts to grow.

Raised from the Dead after Five Years

Remove one of the tiny grey plants you find on exposed rocks and keep it in a closed bottle where it can get no moisture. It will dry up and die.

After five years, expose it to moisture again. Put a sponge filled with water into the bottle with it, but do not drop it into the water. The plant will revive and start to grow again. Some lichens can absorb half their own weight in water in ten minutes.

The lichen has the unusual ability to retain its life for years, even though it may be where it cannot secure the necessary life-giving moisture. Its moisture is taken out of the air and it does not need any other supply.

The reindeer in Lapland feed almost entirely on lichens. Men also eat them if no other food is obtainable. At one time the people of Sweden made bread from lichens.

A Million Seeds from One Wild Flower

This marvellous seed producer is a wild orchid with the scientific name *Habenaria ciliaris*. It is found in many parts of North America. The seed is like a fine grain of dust and is called a spore. Each plant produces a million spores.

Spores of all the orchids are produced in enormous quantities but very few of them ever grow, for they

require very special conditions under which to germinate. These special conditions are found only occasionally.

The orchids in florists' shops are raised in greenhouses where conditions are scientifically controlled. Even then it is difficult to make a large percentage of the spores grow, although every one is a potential plant.

Only a Frost can germinate these Seeds

We usually think of warmth and moisture as the requisites for seed germination. Yet some seeds germinate in a temperature far below freezing-point.

High up above the tree line on the highest mountains, groves of willow trees may be found. These groves are not quite two inches high, but they are made up of willow trees. This variety of willow is called the Alpine Willow and grows only on mountain-tops.

It produces catkins almost as big as those which grow on the larger willow trees in the valley. Fully half the height of the tree is catkin. These catkins bear seeds which germinate only when cracked open by the frost. The trees grow in a cold temperature all their lives and so their seeds must germinate in a cold temperature. They will not germinate in any other way. When they are taken to the valley, they will not grow.

Trees bloom in Frosty Weather

The witch-hazel, *Hamamelis virginiana*, produces no blossoms during the summer. The flowers appear late in the autumn—usually in November. No matter how cold the weather may be, the blossoms are not injured by the cold but open just the same.

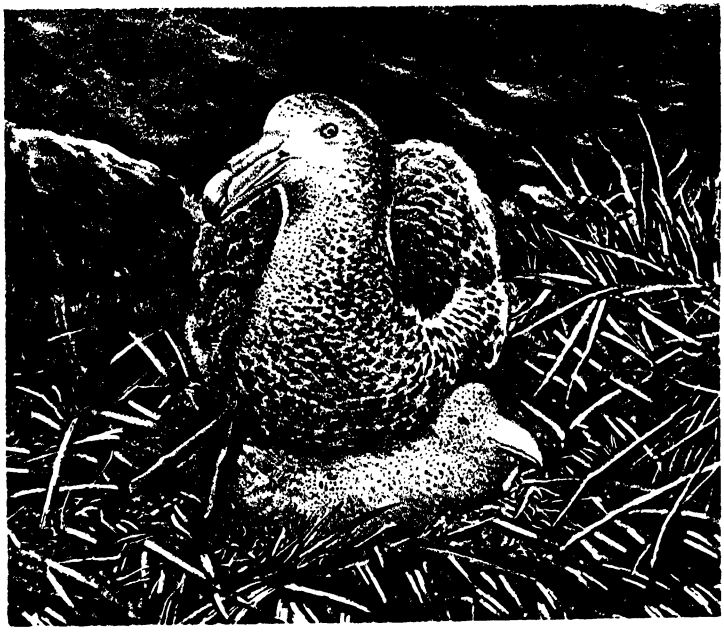
The seeds themselves do not develop until the follow-

ing year. Early in November of the second year, when the seed-pods have ripened, the seeds are shot from the tree with loud reports. Some are thrown as far as eighteen feet.

The witch-hazel spreads its seeds in this way so that they will not all drop directly under the shrub to grow into other plants that would compete with the parent.

The Giantess throws her Dinner at Intruders

The giantess is a bird known as the giant petrel. It nests on the island of South Georgia in the South



GIANT PETREL AND YOUNG

Atlantic and protects its baby by spitting its recent meal at an intruder. That method of defence is very

effective. After the food enters the bird's crop, it is given a chemical treatment which makes changes that produce an unusually foul odour. As long as this is in the digestive tract of the bird it is beneficial, but when it comes out into the open air its smell is very distressing to enemies.

Roots that never reach the Ground

Many plants in the tropical forests grow high on trees. Some even live on telephone wires, but the roots never reach the ground. If they did so, they would not grow into the earth because they are not made to take moisture and food out of the ground (see p. 53).

Though we cannot see it, there is a world of plant food and plenty of moisture in the air we breathe. These plants have aerial roots, which absorb this moisture and food from the air.

The aerial plants are called epiphytes. An epiphyte is a plant which is supported by something else, but does not take its food from its support. Some plants, such as the dodder, are supported on other plants and also take their food from these plants. They are therefore called parasites.

It stands for Fifty Years after Death

The limber pine, *Pinus flexilis*, lives to be as much as five hundred years old, although it never grows to be much over fifteen feet tall. Then, after it dies, its sturdy trunk stands for another fifty or one hundred years. Its dead body is its tombstone.

Roots that resemble a Man

The bigroot plant, *Echinocystis fabacea*, has a root about the size and shape of a man. This plant is also called the bush morning-glory and grows in dry, sandy, treeless regions in the mountains of central California. Its huge root is developed as a storehouse for moisture.

The plant above ground grows to be only two or three feet tall. It has greenish-white flowers and spiny, round fruit about two inches in diameter. Another popular name for the plant is manroot.

This Plant uses Another to digest its Food

One of the commonest plants, found everywhere in the world, cannot live alone for it has no way to digest its food. Therefore it must use another plant to carry out this work for it.

To the naked eye these two plants appear to be one. We call it a lichen, but a lichen is made of a fungus and an alga. The fungus cannot digest food by itself because it has no chlorophyl. Algæ, on the other hand, have plenty of chlorophyl, but they need the protection given by the fungus. So they willingly absorb the food which they can extract from moisture in the air and share that food with the fungus for the protection they get.

Both are satisfied. Neither can thrive without the other. This association of two plants, both of which benefit from the association, is called symbiosis.

The lichens help us greatly in the making of soil out of rocks. Their reproductive parts are carried round the world by the wind. Some of them are blown to the rocks of the highest mountains and others to those of barren islands. They grow on the sides of rocks,

and obtain their food and moisture out of the air. When they die, they are perhaps the first to add vegetable matter to the fine particles of rock that have been worn away by the weather. That is how soil is made—by combining vegetable matter with fine rock particles.

No Ripe Figs without this Little Assistant

The male flowers of the fig grow on a separate tree. Pollen must be carried from them to the female flowers, or the fruit, inside which the flowers form, will not ripen. The only known way that pollen can be carried from the male to the female flowers is by a tiny insect, called the fig-wasp, which infests wild fig trees.

No other insect is small enough to enter the half-formed fruit. Before this was discovered, many prospective fig growers were seriously disappointed and lost a great deal of money. They imported fig trees from the Orient to America, but they did not bring any of the fig-wasps. The fruit did not develop or ripen.

Finally, when it was discovered that the services of this small insect were necessary, the troubles of the American fig growers were over, for fig-wasps were then brought to the groves in the New World.

This Amphibious Plant has Two Kinds of Leaves

Because it grows in shallow water, the broad-leaved arrow-head must be able to adapt itself either to water or air, for shallow water often dries up. The arrow-head, to preserve its life, must then be able to breathe through its special air leaves. But when there is water

round the plant, it likes best to obtain its air from the water.

This plant grows two kinds of leaves. Those below the surface are long and narrow—ribbon-like. They take the carbon dioxide from the water. Those above the surface are shaped like arrow-heads and are not adapted to under-water use, for they would be much more readily torn by the current than the ribbon-like leaves.

These Roots grow upside down

The mangrove-tree, which is described on p. 8, sends some of its roots straight up towards the sun so that they actually grow into the air. Roots must have a certain amount of fresh air. It is very difficult for plants growing in soil that is constantly saturated with water to obtain very much fresh air unless they send some of their roots above the surface of the water.

The mangrove-tree grows in salt marshes, or on land that is covered with water when the tide is in. Its aerial roots contain minute breathing-holes. The air is conveyed through these to the spongy interior and, through this spongy mass, it descends to those roots that are growing in the salty mud.

An Incubator on her Foot

The female of the king penguin, which nests on the island of South Georgia, incubates her one egg on the top of her foot. This penguin is a strange bird that walks like a man. She lays only one egg and this is placed on the top of her right webbed foot. A special piece of skin (which grows above the foot for the purpose

of incubating the egg) is pulled down over it. The skin holds the egg in place and also helps to keep it warm until the baby is hatched.

In the meantime the penguin waddles here and there, with a funny Charlie Chaplin walk.

FEMALE KING PENGUIN WITH FOOT INCUBATOR

If she is robbed of her egg, or if it is broken, she will pick up a stone about the same size and place it in her incubator. She is not happy at the period of incubation unless she has something the size of an egg on her foot.

These Babies get under Mother's Skin

When the eggs of the Surinam toad are laid, the father presses each one into the mother toad's back. The egg is then covered over by a skin. Not only does the egg hatch in this little space, but the tadpole lives there until it is mature. It never swims away by itself.

The Surinam toad is about the ugliest of all animals. It has a flat body which looks as though it had been run through a mangle. It has no tongue and no teeth.

These toads live in northern South America and are very sensitive to violent temperature changes.

Seeds that lived for Centuries

A few years ago, some Indian lotus seeds were discovered in the soil about five feet below the surface of a naturally drained lake in the country of Manchuria (then a part of China). Scientists examined the seeds and believed they were still alive. They were planted and every seed produced a vigorous water-plant.

The scientists then set about calculating the age of these seeds. Trees were found growing on this dried-up lake-bed and some of them were sawn down and their growth rings counted. The genealogy of a family that had used this land for farming purposes for centuries was studied. It was then calculated that the lake-bed had been dry for very much more than one century. Lotus seeds are produced by plants that live only in the water. There had been no water in this lake-bed for several hundred years. The seeds, therefore, were several centuries old.

One Hundred and Fifty Thousand Animals at One Meal

This glutton is the common bladderwort often found in quiet water. To see it, you must look under the surface of ponds or gently flowing streams. Nowhere else could it find enough of its special kind of food to satisfy its astounding appetite.

At the bases of many leaves of the bladderwort are traps in the form of bladders, open at one end. The entrance is guarded by a valve and hairs pointing inward. When an animal once gets inside, it is almost impossible for it to escape.

The presence of the microscopic animals stimulates the valve to open. Once inside, the animals make a meal for the carnivorous plant. A digestive juice is provided in each bladder and the animals are changed into food by a chemical process. About every twenty minutes the traps are set for another one hundred and fifty thousand animals.

Alive—yet Older than the Pyramids

The largest and oldest living thing in the world may be seen by anyone who visits Sequoia National Park in California. The big tree known as ' General Sherman ' is believed to be nearly five thousand years old. A tree that was not nearly as large in diameter was cut down a number of years ago and the rings on its stump were carefully counted. That tree was 3126 years old when it was cut down. ' General Sherman ' is much older. Its scientific name is *Sequoia gigantea* and it is believed that this species was once prevalent over large areas of the earth.

This tree was large long before the birth of Christ or the building of the pyramids. So far as is known, the sequoia never dies. It may be destroyed by man, as many have been ; or by fire, earthquake, lightning, wind, landslides, or erosion.

It would take 6875 sequoia seeds to weigh an ounce, yet ' General Sherman ' is nearly three hundred feet tall, over one hundred feet in circumference, and over thirty-six feet in diameter. The largest branch on this tree is one hundred and thirty feet above the ground and is nearly nine feet in diameter. It is estimated that the total weight of the tree is 4,299,851 pounds.

Earth-worms Twelve Feet Long

In Australia earth-worms grow to be twelve feet long ! The only bird known to feed on these huge worms is the laughing jackass, which also eats snakes of various kinds.

The twelve-foot Australian worm is of the same species as the ordinary earth-worm. The only difference is that it is a larger variety.

This twelve-foot earth-worm digs a hole and eats the earth as it digs. When it comes out of its hole it deposits the dirt, which has passed through its body, in a circle round the entrance, forming a mound of the same shape as a volcano.

An Expert Shot with No Neck

The frog is an animal without a neck. It cannot turn its head nor bend it towards the ground. The only way it can point its head in a different direction

is to turn the entire body. This must be very inconvenient, for the frog lives on live insects and catches them with its tongue which must be shot out so accurately as to hit the insect and draw it back into the mouth. The frog, therefore, must aim its blow carefully.

The frog's tongue, instead of being hinged at the back of the mouth, is hinged at the front. It lies pointing backward.

The frog's eyes are also peculiar since they see only objects which are moving. The frog, therefore, does not know of the presence of an insect unless it sees the insect move. When it does see its prey, it adjusts its body so that its aim will be accurate, opens its mouth, and deals the insect a hammer-blow with the end of its tongue, which describes a semicircle as it moves on its base at the front of the mouth.

Mountain Jay fills a Winter Pantry

Instead of migrating to the South where there is plenty of food for the winter, the Rocky Mountain jay stays among the trees of the mountains. To live in the cold mountains during the winter, the jay stores a larder with food. During the autumn it picks up berries, rose hips, and other kinds of food, and stores it in the larder. Some is stored under the bark of trees, some in the forked branches of bushes, and some is put in hollow trees.

The young birds seem to know how deep the snow will be in their first winter. The jays select places where they will be able to get their food during the cold months when they need it. Not many birds follow this interesting method of food-storage. (See also p. 120.)

ROCKY MOUNTAIN JAY WITH FEATHERS FLUFFED OUT FOR WARMTH IN WINTER

The Somersault-bird of the Rockies

Sitting on the top of a tree limb, the Rocky Mountain jay will suddenly topple over forward, completely encircle the branch, and be back on top again in the twinkling of an eye.

This bird is often known as the camp-robber because it helps itself to any kind of food or shiny article it can carry away from a camp.

The camp-robber turns these somersaults in the air

because of the sheer joy of living. He puts on an interesting show. It is worth a piece of bread or a bacon rind to watch his aerial antics.

He carries his Pantry in his Tail

The camel has his hump for carrying extra food in the form of fat. Birds accumulate extra fat under their skins before they migrate. The bear provides extra food by putting on a layer of fat before he hibernates. But the gila monster, a lizard of the desert, has his larder in his tail. Before the hot summer comes, his tail fills up with surplus fat because, during the hottest weather, he cannot come out of his burrow in the ground. During that time he sleeps, just as hibernating animals do, but, because his sleep is during the summer, it is called estivation.

Deadly Poison a Part of Every Meal

The scorpion takes poison into its stomach along with food. It all comes about in this way. A beetle or other insect is seized with the scorpion's claws, which look much like those of the crayfish. Then the long abdomen, or tail, is lifted up over the scorpion's back and brought down to the front of its body. On the end of its tail is a sharp point which pierces the insect. Under this point is a small opening through which poison is injected into the insect to kill it.

Then the scorpion proceeds to eat the insect, poison and all—and this is its daily fare.

The scorpion is a relative of the spider and lives in the tropics. There is no danger to a human being unless he accidentally puts his finger where the claws might seize it.

Fifty Years on its Feet

The African elephant always sleeps standing up. It has never been seen lying down. This species commonly lives for fifty years or more, so that it stands on its feet for fifty years.

It is, however, quite different from the Indian elephant which does lie down.

One of the outstanding characteristics of the African species is its large ears. The ears of the Indian elephant are small, but those of the African are very large. They are sometimes called fan-ears.

The natives believe that, when these elephants are about to die, they know it and go off to an elephant burying ground. Perhaps a better name would be elephant morgue. There they fall to the ground for the first time in their lives, and give up the breath of life.

The Shrew eats Four Times its own Weight daily

If shrews lived on shrews the race would quickly die out, for each eats four times its own weight every day. But this tiny mouse-like animal feeds on insects that it finds on the ground, under leaves, and under fallen trees. It also eats grubs, spiders, sow-bugs, and earthworms—and mice, when they can be caught.

So ravenous is its appetite that it requires almost twenty-four hours a day to find enough food to satisfy it. You can well understand that the shrew must be a very busy animal. It is not much larger than your little finger but is a tireless worker.

When a shrew digs its tunnel through the soil, it can progress at the rate of about a foot a minute. And that is fast digging for so small a creature.

Baby jumps from Mother's Back when he is Thirty Minutes Old

The baby in this case is the mountain-goat which lives, for protection, on the highest crags of the mountains. During the winter, these animals find shelter in small caves or under rock-ledges. They are exposed, however, to the cold. Perhaps that is all the more reason why the baby or kid must begin his exercise at once. It is said that these little fellows actually begin to play, climbing to mother's back and jumping off, when they are not more than thirty minutes old.

When they are ten minutes old they stand up. When they are twenty minutes old they drink milk. In half an hour they are ready for play.

For more than a week, however, the mother keeps her kid hidden on a ledge where the goat's enemy, the eagle, is not likely to find him. She does not go far away, however, and if an eagle should come, she puts young billy between her front legs, and meets the enemy head on. (See also p. 180.)

Father does the Fighting, but Grandmother is the Boss of the Family

The bull elk or wapiti is not the boss of the family. Grandmother attends to that job. The bull does not even stay with the family during the summer. He comes along only late in the autumn, and defends his relatives during the winter months. Then, in the spring, he leaves again.

The fighting occurs in the autumn. The first male to arrive defends his right if he can. There are tremendous battles, each bull meeting the other head on, time after time.

In the meantime, grandmother and the rest of the herd pay very little attention to what is going on. They have their own duties. It matters little to them which bull wins in the dispute of ownership. Grandmother must be on the job twelve months of the year. She decides where the herd is to go. She leads the does and their fawns to places where they can get salt and food.

Baby Cougars walk in Mother's Footsteps

Strange are the ways of the wild—strange because we cannot understand how the wild animals learn many of the tricks they use. For example, how do the cougars, those cautious hunting cats of the mountains, know that their cubs must be trained to disguise their trails ?

When the cubs are first led out of their den, the mother takes them into the mountains cautiously, and each one knows that it must place its feet exactly in the spot where mother placed hers. This helps to disguise the trail.

The mother is afraid of the wolves for they would capture the cubs if they could. As a matter of fact, the wolves would go right into her den and help themselves to the tender young meat, if she did not take the necessary precautions to prevent them from finding out where her home is.

She keeps the position of her den a secret by making trails that mislead the predatory animals. She circles the area in which her den is located a number of times, zig-zagging here and there. She jumps off fallen logs, over the sides of cliffs, and into trees. She brings her trail to an end, as far as the wolf's nose is concerned, as often as she can. Finally, after all these precautions, she goes to the rocks in which her babies are hidden.

She must teach all her tricks to her young when they leave the den in the rocks. Baby cougars must be taught to follow in mother's footsteps.

Seven Months of the Year in Bed

The marmot is a fat little rascal in the autumn. How his cheeks bulge ! Every part of his body seems covered with extra meat. He is about ready to go to bed for seven long months. He lives high up in the mountains where it is too cold, and food is too hard to find, to be up and stirring in the winter. So he stores his body with food enough to last him during his long sleep.

He is often called ' whistling marmot ' because his common method of communication with his friends is to whistle. He belongs to the woodchuck family and is sometimes called ' mountain woodchuck.' While he is asleep he uses very little energy. He sleeps continuously, deep in a den among the rocks where he never has a worry—at least not until spring. Then he comes out very thin and badly in need of food.

The whistling marmot lives on vegetable matter. He eats roots, buds, seeds, and leaves which he finds in his favourite hunting-grounds all during the summer. But he must be a busy hunter for five months, for he must eat enough to last him for the other seven.

This Lizard ' swims ' through the Sand

The fringe-footed sand-lizard's lower jaw fits into the upper jaw in such a way that the two become one, and no sand gets into his mouth when he dives under the surface of the ground. This he does in the middle of

the day. Lizards that live in the desert cannot stand as much heat as we should naturally think they could. They are able to live in the desert only because they have ways of getting away from the heat. The method used by the sand-lizard is to dive into the sand and 'swim' beneath it.

She 'flies' under Water

A bird called the dipper or water-ouzel always lives beside rapid mountain streams. She builds her nest under the brink of a waterfall or in a mossy bank or

THE DIPPER, OR WATER-OUZEL

even in a tree close to the stream. The nest is made of moss and is a round ball with a tiny entrance at one side. The name 'dipper' comes from a frequent movement of the head; this and the white throat are conspicuous.

Her food is found only on the bottom of the swift-

flowing brook and is made up of aquatic insect larvæ, and molluscs which live in the cold water. Sometimes she is wrongly accused of eating fish-spawn. The water-ouzel dives to the bottom and walks about looking for food. If an insect dashes by, she goes after it. She uses her wings under the water just as if she were in the air.

The feet of the water-ouzel are not webbed but she can swim on the surface as well as dive.

Well, Sons, fancy meeting you!

Black bear cubs are born while the mother is hibernating and instinct enables them to find the two nipples provided for them. There they attach themselves and live on the warm milk which they extract from the mother's body without her knowing anything about it.

By the time the mother bear wakes up in the spring, the cubs have grown enough to romp all over her. They are then ready for a frolic outside the den. They have many things to learn, for the mother is unconscious while they are having their first few weeks of experience in life.

During the training period she often becomes impatient with them, and slaps them so hard that they roll many feet. But they do not seem to mind the way mother emphasizes what she has to say, and they learn rapidly.

Cony eats his own Home

It's a long winter on the mountain-top and the cony's little short legs will not enable him to migrate down to the valleys. Neither does his disposition allow him to sleep all winter as the whistling marmots do. So he

builds himself a house made out of food and lives in the centre of this food-pile all through the cold months.

The house is made of hay. He is often called 'the little haymaker.' During the summer and autumn he harvests grass and carefully cures it in the sun. He then hides it in crevices in the rocks, often using as much as a bushel of dried hay to make his winter quarters. He hollows out a little nest inside this haystack and there he lives, munching at the walls of his house all winter long.

However, he is always provident enough to provide several additional haystacks, so that if, for some reason or another, he is driven from one house, he has another place to which to go. He always has enough of his house left in the spring to eat until fresh grass has grown.

Desert-mice do not drink Water

The tiny mice that live in the desert, where there often is no water, have learned to get along without it. In fact, they will not touch it if it is offered to them. They bury themselves deep in the sand or under the rocks when the sun is out. They come to the surface only at night or when it is cool and cloudy. Even then they use up very little energy. They live on seeds, cactus, and other desert plants.

The bodies of the desert-mice are so made that they do not require much water, the small amount necessary being obtained from the plants they eat.

Hunger arouses him

Early in September he goes to bed. There he sleeps so soundly that he breathes only rarely. By midwinter

his body has used up the food he ate in September and he visits his storeroom to fill his stomach again. Then he goes back to sleep for another few weeks.

He is the mantled ground-squirrel of the Rocky Mountains—a friendly little fellow who is quite at home in summer around the lodges and camps when the cook throws out the scraps on which he feasts. Before he goes to sleep in the autumn, he has the presence of mind to carry a quantity of berries and other food into a dark storeroom in his burrow.

A Year to digest One Meal

Many animals are not able to get food even once a day. There is, for example, the leech, which must have the blood of other animals for its food.

A boy who wades barefooted in a stream may find, when he comes out, a big red leech attached to his leg. He calls it a bloodsucker. He probably does not know it is there until he sees it. That is because it can make a wound and suck blood without the victim's feeling it. It ejects a fluid into the wound so that the blood will remain thin and flow freely, and this prevents pain.

The leech takes about two and one-half times its own weight in blood into its digestive tract. When its stomach is thus distended, it has enough food to last it for as long as a year. The food is preserved and stored in the stomach all that time and is digested only as needed. It takes a year to digest a meal completely.

Cotton-tails talk with their Feet

The process of talking with the feet is simple. The cotton-tail rabbit rests most of its body-weight on its

front feet and strikes the ground with its two hind-feet The sounds are plainly audible nearby.

Other cotton-tails feel the signals even when they are some distance away, for that resounding whack on the earth sends a vibration through the soil. There are different kinds of thumps. Each one means something different. One indicates fear; another anger; one is a warning; and one is a challenge. There may be other meanings which we have not yet interpreted.

At any rate, the cotton-tail is an excellent conversationalist.

The Mountain-sheep's Feet never slip

There are plenty of things to slip on when climbing up and down over the loose rocks on the mountains. In winter there are icy stones, in summer there are wet ones. But the mountain-sheep's feet have been made to carry their owner safely over both these dangers.

The mountain-sheep are probably the most sure-footed animals in the world. It is astonishing to see the places where they can go. They can climb where men cannot. They can make their way down the side of what appears to be a sheer cliff. Naturally, they would not try this if they were not sure that their feet would never slip. Those feet are specially constructed for the dangers in which mountain-sheep find themselves.

The centre of the hoof appears to be made of black rubber. The outside is a sharp, black horny wall. The sharp hoof with the rubber-like pad enables the mountain-sheep to go anywhere it likes.

The World's Most Hen-pecked Husband

The male red-necked phalarope seems to have no authority in his own family. Not only does the female drive him round to suit her every whim, but she does all the courting. She woos her mate just as ardently as the male birds of other varieties woo the females. Then, after she has won her mate's affection, she browbeats him into the jobs of hatching the eggs which she lays, and caring for the children.

This beautiful marine bird looks a little like a duck and a little like a sea-gull. It is about eight inches long and is found in very cold regions. Seldom seen south of the Yukon delta in summer, it is common in Iceland and Eastern Siberia. It is a rare visitor to the coasts of Scotland.

The colours of the male and female are reversed in comparison with those of other birds, the female having the more brilliant plumage. The poor male is the world's most hen-pecked husband.

It is Possible to walk on the Water

As well as the wolf-spider there is a lizard in Panama known as the basilisk lizard which can and does walk on the water. It always lives near a stream or pond, and if it is frightened, or is chasing an insect which it wants for food, it runs out over the surface of the water.

Its toes are very long, and these help to spread its weight over the surface-film. Instead of running on its four feet, it runs only on its hind feet, moving rather rapidly, of course. If it stopped or ran slowly, it would probably sink beneath the surface.

MALE RED-NECKED PHALAROPE ON NEST

The Tail breaks away and rises to the Surface of the Sea

The palolo-worm lives in a burrow which it digs in a coral-reef. But the eggs must be incubated at the surface, and at the egg-laying season the tail breaks away from the head part and rises to the surface of the ocean. There it bursts and scatters the eggs.

All this happens in the South Seas and millions of these worms divide themselves at the same time. The natives of the South Sea Islands have discovered that the tails of these worms are good food, and they collect them in great quantities in nets. They know exactly when the tails may be expected to appear on the surface.

Teeth only on the Tongue

The snail's tongue has many rows of sharp teeth which are used to scrape off pieces of vegetable matter from plants which grow in the water. These teeth are pulled over the stems and leaves of plants, and in that way the snail obtains its food. (See also p. 192 for the snail.)

Nature's Colour-changing Artist eats its own Skin

Several times each year, during the spring and early summer, chameleons eat their own skins. They seem to lose their interest in life. Their skins turn a lustreless grey colour, appearing much like a wrinkled piece of tissue paper. During this time the lizards do not eat.

Then the skin splits along the legs and the centre of the back. The chameleon seizes some loose portion of

its skin and carefully pulls it all off its body. It then calmly eats the skin with considerable relish.

The chameleon's usual diet is worms and insects that frequent plants. It is called ' nature's colour-changing artist ' because it appears to be a different colour when placed on materials of different hues. This ability to look like its surroundings is a protection from enemies.

You may have my Tail, but I'll keep my Head

The lizards living in Panama are willing to give up their tails, if necessary, in order to save their lives. When the natives try to catch these lizards, they usually find that only the tails are left in their hands.

Only certain lizards which cannot protect themselves by biting have the peculiar ability to let go their tails when in danger of being captured. They have muscles that surround the tail near the body and can be tightened in such a way as to shut off the blood which otherwise would run out if the tail were pulled off. Without the power to close the blood-vessels, the lizard would bleed to death.

After losing its tail, the lizard usually keeps out of sight until a new one grows.

Oysters live on Trees in Jamaica

Oysters attach themselves to any convenient object and stay in one place all their lives. Sometimes they grow on one another and their shells cling together so firmly that it is almost impossible to pull them apart.

In Jamaica the high tide covers the bottom branches of mangrove trees. Oysters attach themselves to these

branches in large clusters. Their exposure during the short time they are uncovered while the tide is out does not seem to do them any harm. They simply use that as their rest period.

Of course, they obtain no nourishment from the trees, but extract their food from the sea-water when the tide comes in again.

A Tiny Handspring Artist

Although it can move about in other ways, the fresh-water hydra has the strange habit of turning handsprings to get to where it wants to go. This hydra lives in ponds and streams, but to observe this odd method of travel it is usually necessary to put it into an aquarium. There it will attach itself to the glass by its foot.

The hydra looks like a long tube with six tentacles or arms on one end. The other end is considered to be its foot by which it usually fastens itself to some object. When it wishes to move about, it will bend forward, attach its tentacles or arms to the glass, and then turn a handspring. It will travel long distances by the handspring method.

It lives on minute worms and other tiny water animals—the same type of food, in fact, that is eaten by small fishes. (See p. 184 for further details about the hydra.)

Plants without Leaves

The food of most plants is digested in their leaves, but there are many different kinds of plants with no true leaves. The cactus family is one of the most common.

It is thought that the spines on the cactus are the

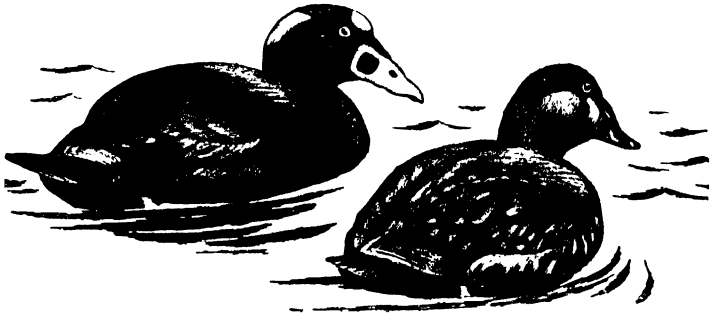
remnants of what were leaves at one time. The green part of the cactus, however, is the stem. Even though the stems are leaf-shaped, they are not leaves. The stems are thickened and provide space for storing moisture. They are also supplied with the green element, chlorophyl, which is needed for digesting food.

Asparagus is another plant which has no leaves. The feathery material on the top of the asparagus, when it is getting ready to bloom, is no more than a mass of thin branches.

Other plants which grow and blossom and produce seeds without leaves are : butcher's-broom, Tasmanian yew tree, spurge, duckweed (p. 174), Mormon tea, dodder (pp. 54, 146), beefwood tree (p. 184), and rafflesia (p. 175).

He eats Oysters—Shell and All

The surf-scoter lives in the northern oceans but sometimes is seen on the Great Lakes of North America. This bird has no special beak to open the shells of



SURF-SCOTERS

oysters and clams, so it swallows them whole. They are opened in the bird's gizzard.

In order to digest them, it is necessary for the surf-

scoter to swallow stones with which to grind the shells. Then the food inside the shells is digested.

Snails walk on the Bottom of the Water-film

Over every body of water there is a film strong enough to support considerable weight. Water-striders run over the surface, supported by this film. It is perhaps more astonishing to learn that snails actually walk on the underside of the surface-film.

A snail, moving along just under the surface in an aquarium or in a pond, appears to be on the surface. But the snail is actually walking on the underside of the surface-film. The snail has considerable weight with its large shell, so there must be a lot of strength in that film which we so easily break with our fingers.

The Osprey dives at Dead Branches

The osprey is a huge hawk that lives on fish. Its feet are so constructed that it cannot walk or hop on the ground. But those feet are very useful for capturing food. The claws are long and sharp and strong, while the legs are sturdy.

When the nest is to be repaired, the osprey flies high in the air. Then, closing his wings, he dives head first towards the branches of a dead tree, in the same way as he dives to catch fish in the nearby lake. When he hits a limb, the force of his body breaks it from the tree. He seizes it in his strong feet, flies to the nest, and weaves it among the other sticks that are there.

He never picks up a stick from the ground. If he finds one floating in the water, he dives for it just as he dives for a fish—always seizing it with his feet.

THE OSPREY

The World's Largest and Smallest Flowers belong to the Same Family

The world's largest flower is six to eight feet in diameter and ten to fifteen feet high. The world's smallest flowering plant is smaller than a pin point. Yet these two plants belong to the same family—the arum.

The largest flower is the rare *Amorphophallus*. The smaller one is very common. The big fellow grows only in the humid forests of the East Indian islands. The blossom is in the form of a cone with a huge tongue projecting upward from its centre. The cone part of the flower is a yellowish colour on the outside and a rich deep purple on the inside. The tongue in the centre (called a spadix) is yellowish, very much the colour and texture of a chamois skin.

After the spadix is fully grown, the entire height of the flower from the ground to its top may be as much as fifteen feet. While it is unfolding, this huge blossom gives off a very disagreeable odour like that of decaying meat. One of these flowers was induced to bloom at one time in the New York Botanical Garden. Ordinarily they grow only in the rain forests of the tropics.

The tiniest of all flowers is the duckweed *Wolffia*. The whole plant is not much bigger than the point of a pin and the flower itself is invisible except under a magnifying glass. It would take five hundred of them, placed side by side, to measure one inch. *Wolffia* floats on the water, and is found as a group of tiny green specks on the quiet water of many ponds.

Babies thrown to the Fish

Unless this mother throws her babies to the fish the babies cannot live. She is a clam who lives on the

bottom of a river. For a certain time, during the growth of her young, they must have food which they can get only from the bodies of fish. For ten weeks they remain attached to their travelling dinner-table. By that time they have grown enough to drop to the bottom of the river and take care of themselves.

When they are ready for their fish diet, the mother clam waits for a chance to throw them at a passing fish. The young clams have little hooks by which they attach themselves to their host, but if the fish happens to turn or starts to swim rapidly at just the wrong time, they drop to the bottom of the water and soon die.

When they are successful in attaching their hooks to the fish, they live a happy life, being carried from place to place without any effort on their part. This process distributes clams over a wide area.

A Flower without Roots, Stem, or Leaves

This flower, the rafflesia, is a parasite and grows on a vine which is a relative to the common wild grape-vine. It uses the root of the vine as a host and grows only in the rain forests of the tropical parts of Asia.

It is said that the seeds are carried largely by the feet of elephants, although birds have transported some of them. There are, of course, tiny tubes which transfer the food from the host-plant to the developing bud of the flower, but they are not roots and there is no stem.

Roots above Branches

Along the eastern shore of Lake Michigan are many shifting sand dunes, the sand of which is piled up one year and blown away another. The trees which can

adjust themselves more quickly than any others to this shifting soil are the cottonwoods. It is not at all uncommon to find a cottonwood tree which has sent out roots above the place where there are branches.

When the tree started to grow, the surface of the sand was only a short distance above the roots. But there came a time when the sand blew in round the tree.

THE WIND BLEW THE SOIL AWAY AND LEFT THE NEW ROOTS EXPOSED

Soil was filled in to a depth of two, three, four, five, or even ten feet. Then the tree sent out roots near the new surface of the soil—above some of the lower limbs.

The covered branches, below which the roots now grew, stopped growing, of course, and died. Later, after the new roots had a good hold in the sand, the wind blew away the soil and left large portions of the new roots exposed. They can be seen above the places where the old limbs were. Sometimes an old branch which has not been broken away can be seen.

They breathe through their Feet

The fairy shrimp breathes through gills that are a part of the twenty-two feet which it waves above it as it swims on its back through the water. The feet are provided with many gills containing blood-vessels, through which the oxygen in the water enters the blood. The fairy shrimp swims about in pools during late winter and early spring, for it prefers the coldest water. Its egg, which is called a resting egg, 'sleeps' during the summer.

Fairy shrimps are quite abundant in fresh-water pools in eastern North America. By living in the season which comes before most animals are active and hungry, they have few enemies. They eat microscopic animals and plants, which are gathered by the waving feet and moved towards the mouth.

The resting eggs will live for a long time if conditions are not right for them to hatch. Some have been placed in mud which was then dried and kept for fourteen years. When the eggs were put in cold water, they hatched as though they had been laid only a few months before.

You can watch her Food digest

The water-flea's body is transparent and everything that moves inside it can be seen. Water-fleas, *Cladocera*, are so small and so plentiful in ponds and streams that several thousand can be picked up in one cup. In spite of their small size, they can be seen with the naked eye as they swarm near the surface, but their interior operations can best be observed by placing them under a microscope.

Water-fleas are of special interest to us because they

are one of the most important foods of young fishes. A new brood of eggs is hatched every two or three days and it is estimated that one female and her current offspring will produce 13,000,000,000 water-fleas in sixty days—that is, more than 216,000,000 *Cladscera* per day.

The eggs laid and hatched all summer are unfertilized, yet they promptly hatch into living female water-fleas capable of breeding. Only in the autumn are males born to fertilize the eggs. These fertilized eggs drop to the bottom of the pond or stream and lie dormant all winter, to be hatched the next spring. Fertilized eggs are laid also if a drought threatens, for only fertilized ova can survive during a long drought or through cold weather. They will not hatch after a drought until water is plentiful again.

Thirteen Thousand Children, but only Two or Three Offspring

The cycle starts on the floor of the sea where the female lobster lays as many as thirteen thousand eggs. When these eggs hatch, tiny baby lobsters swim towards the surface where they must get their food until they are almost adults. As they swim upward many of them become food for other animals. At the surface they form dainty morsels for many more. By the time the offspring of one lobster are ready to go to the bottom to live their adult lives, there are only two or three left.

These baby lobsters are needed as food by many of the ocean animals. The lobster lays many thousands of eggs to ensure reproduction of its kind, but the abundance of young lobsters supplies food for many other creatures in the sea. It is not a massacre, but a harvest of food for those who need it.

Plants can break a Concrete Pavement

Plants grow by what botanists call ' osmotic pressure.' This is a powerful force created by the flow of liquids in plants. Cases have been recorded in which growing shoots of the fern, *Onoclea struthiopteris*, have actually broken a concrete pavement in their upward struggle.

The Sloth wears a Green Coat

There are many strange associations between animals and plants, but the strangest is that in which an animal

THE THREE-TOED SLOTH

wears a green coat. This animal is the three-toed sloth which lives in trees. It needs a covering of tiny plants (algæ) in order that its body may look green and not

be easily seen by its enemies. It seems quite apparent that the maintenance of the coat is no accidental nor acquired habit, for the hairs of the sloth are provided with special receptacles in which the green algæ grow.

So far as we know nature has no way of making green hair. She makes green feathers and green coverings for insects, but she has in no case made green hair to cover mammals. So it is necessary to combine these tiny plants with the mammal in order to give it the protective colour. It has no other means of protection against the carnivorous animals of the jungle.

The sloths feed on the leaves of the trees they inhabit. They hang head downward, clinging to the limbs above with the long curved claws on their three toes.

This association, in which both the plant and the animal benefit is another example of symbiosis, mentioned on p. 147.

Mother pushes her Baby over a Cliff

High on the mountains where no other mammal stays during the winter, the mountain-goat must teach her offspring to leap from crag to crag. So sure-footed are these goats that they can land on what appears to be too narrow a ledge of rock to hold even one of their feet, let alone four.

In order to teach her kid what to do when it comes to the end of a trail or of a ledge, the mother goat takes it to some dangerous spot and, when it hesitates, not having jumped into such a depth of space before, she actually pushes it over the cliff. Terrified at first, the little fellow manages to strike his feet against a jutting rock and, from there, he bounces to another trail far below.

This all happens some nine thousand feet or more

THE MOTHER MOUNTAIN-GOAT PUSHES HER KID OVER THE CLIFF

above sea-level. Very often the ledges over which the baby goats are pushed are a thousand feet high. The mother, however, knows that there is a trail below, for she has made these jumps herself many times.

The feet of the baby mountain-goat, like those of the mountain-sheep mentioned on p. 165, are so constructed that they do not slip. There is a sharp-horned hoof, and inside there is a pad which enables the feet to stick to slippery or icy rocks.

Father stays out all Summer

The male porcupine helps to build the family den but he spends the summer by himself in some space under a loose stone.

The female porcupine usually has one baby at a time

THE MALE PORCUPINE HELPS TO BUILD THE FAMILY DEN BUT LIVES ALONE IN SUMMER

and cares for it all summer. The porcupine babies are larger than bear cubs when they are born, and, in proportion to the size of the mother, they are thirty times larger. Perhaps that is why the father is sent away from home.

They sit on their Heads and kick Food into their Mouths

When the barnacle is first hatched from the egg, it swims about in the sea-water, but it soon selects a place where it intends to live and attaches itself to any solid object.

It then makes a shell round its body with an opening in the top, and with its feet kicks vigorously towards the opening, thus forcing sea-water into the shell where the food contained in the water can be swallowed. This fact was first observed by Professor T. H. Huxley.

The Velella grows its own Sail

The velella floats on the surface of the ocean. In order to get from place to place, it grows a sail which extends above its body in such a way as to catch the wind.

The animal is sometimes called 'the sailor.' The common species in the Atlantic Ocean is a bright blue in colour and grows to be about two inches wide. It is plentiful in warm seas. But because it cannot control its sail as sailors do those of a ship, it is often blown to places where it cannot exist. The wind may blow it ashore or into cold waters.

To the velella, its home-grown sail may provide life one day, and death the next.

Flowers that change into Animals

Some forms of animals reproduce by the creation of buds or flowers from which new animals develop. One such animal is the hydra. A branch or shoot grows out of its body. On this shoot a bud or flower is produced. This bud later becomes a free-swimming animal.

The hydra is about one-third of an inch long. It commonly lives in fresh-water ponds. It has a hollow cylindrical body with a mouth surrounded by tentacles. These catch other tiny water animals which it uses for food.

If a hydra is cut into bits, each part will develop a new animal. It also reproduces through eggs fertilized by sperm cells, in the same way as those of other animals. It thus has three ways of perpetuating its race.

A Tree with No Leaves

The beefwood tree, *Casuarina*, which may be seen in Florida, resembles a pine with long, drooping needles. Careful examination, however, reveals that what appear to be needles are really branches of the tree which hang down in clusters and are as green as pine needles. The chlorophyl necessary to digest food is in these branches and the food is digested there. Round these stems are scale-like structures which the botanists call leaves but which are useless as leaves. So, in effect, the tree has no leaves.

The person who named the tree ' beefwood ' was evidently reminded of raw meat by the tree's red wood.

One Tree grows inside Another

A sugar-pine tree, which has the largest cones of any tree, is growing inside one of the giant sequoia trees in Sequoia National Park, in California. The sequoia tree was broken off about 190 feet above the ground. At that point it is ten feet in diameter and apparently has a hollow space inside it. The sugar-pine seed took root there and has been growing strongly for several decades.

It was first observed in 1902, and at that time the sugar-pine was fifteen feet above the top of the sequoia tree. The depth of its growth down in the trunk of the sequoia has not been determined. No measurements have been made since then, but the tree is still thriving, not as a parasite, but as an independent tree. Its roots apparently get food from the rotted wood inside the sequoia.

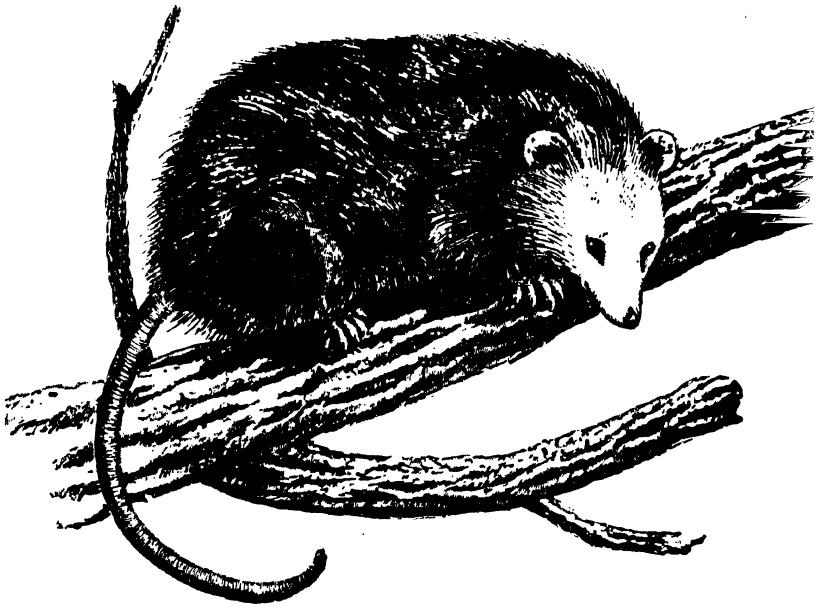
Wild Opossums are reared in Incubators

The opossum's incubator grows on its mother's body. When the baby opossums are first born, twelve of them would scarcely fill the bowl of a tablespoon. They are born before they are mature. They would die if they could not be put into an incubator.

The mother opossum opens the pouch on her abdomen, places the babies in it, and closes it tightly again. Inside, the babies find plenty of warmth and about a dozen nipples. Each baby fastens itself to one of these nipples and gets its milk, which, of course, helps the development of the little animal.

The opossum is the only animal in North America that has this natural incubator. In Australia, the kangaroo has a similar device. Baby kangaroos are only about

half an inch long at birth, and they, too, are born prematurely.



THE OPOSSUM

A Walking Fern

The walking fern, *Camptosorus*, is found in areas where there is considerable limestone in the soil, from Canada to North Carolina. The leaves are very long and thin, and are not divided into leaflets as most fern leaves are. At the end of the long thin leaf, which bends over and touches the ground, a new plant forms and sends roots into the ground. Then this new plant breaks away from its parent plant, and after a while sends out leaves which also bend over and produce other plants.

Each plant is started far enough away from the

parent not to take food its mother needs. In this way the walking fern travels, taking steps somewhat similar to a man's.

The Doodlebug always walks backward

It has six legs, yet its walking is done more by moving its abdomen than by using its legs. Its abdomen is made in sections and the doodlebug moves itself quickly by pulling the abdomen under its body.

The doodlebug is the larva stage of the ant-lion. The adult ant-lion looks much like a small dragonfly. But the adult's life is very short. The larva eats a great deal but it always stays under the sand. In order to catch its food, which is made up of ants and other insects, it digs a funnel-shaped opening in the sand by throwing out sand with its head. On its head are long, sharp, hollow jaws or pincers. These pincers seize insects, or other doodle-bugs, for that matter. The food tumbles into the funnel, where it is seized by the large jaws of the ant-lion.

It sucks the blood out of its prey through these hollow jaws. For some reason or another, nature has provided the doodlebug with the ability to walk backward only. But even so it gets along very well.

Plants that shine in the Dark

Luminous moss, *Schistostega osmundacea*, is found in the dark crannies of caves and underneath logs. It shines in the dark with a golden-green glow, similar to the colour of cat's eyes in the dark. The root-like portions of the moss have cells which reflect light. This causes the glow, which is absent if there is no light to reflect.

A Man can stand on a Leaf

Many of the water-lilies have large leaves. None of them is quite as large, however, as that of the giant royal water-lily. It is often called *Victoria regis*, after Queen Victoria, who was given the first blossom from one of these plants that was grown in a botanical garden. The leaves of these plants are so large that, when padding and light boards were placed on the surface of one, a man weighing 150 pounds stood on the boards and the leaf bore the weight without sinking beneath the surface.

The leaves are nearly round, and may grow as large as six feet in diameter. An upturned margin all round the edge of the leaf keeps the water from getting on to the surface. If it were not for this margin, a little weight on the leaf might cause the water to flood it, and it would sink. Not only the leaf's large size but also its structure make it possible for the leaf to hold up a heavy weight.

Leaves that absorb Two Hundred Times their own Weight in Water

The leaves of sphagnum moss will, when dried, absorb two hundred times their own weight in water. This moss is whitish-grey in colour and grows in peat bogs in Ireland and elsewhere. Sphagnum moss can be used, in place of absorbent cotton, for dressing wounds.

Squirrels plant More Trees than Man

It is quite certain that the largest oak and hickory forests in America were planted by the squirrels. When

these trees were nothing but embryos inside hard nut shells, there was a much larger squirrel population in America than there is now. These squirrels planted groves of trees and raised nuts for future generations.

CALIFORNIAN MOUNTAIN SQUIRREL

The provident instinct of the squirrel caused it to bury more nuts than it could eat. The result was that some were left in the ground. They sprouted and grew into trees. Soon there was a forest where formerly there were only a few trees.

A Cat with a Tail Longer than its Body

The clouded leopard is not often seen. It lives in trees in Asia, and very few specimens have ever been shown in zoos or museums. Its tail is longer than its body and is longer and more beautiful than that of any other animal. Although a wild leopard, this animal is said to be entirely harmless. It eats meat, but it has

never been known to harm a child, which it might easily do, for it very often lives in the vicinity of houses.

Fritillary goes to sleep for the Winter before she tastes Food

After being hatched from the egg, this beautiful little insect immediately finds a place to go to sleep for the winter without taking a bite of food.

After sleeping all winter, she wakes up and begins to eat. She lives through the summer and lays eggs in the autumn. These are hatched before winter and the babies immediately go to sleep without taking any food.

Little fritillary is a butterfly. When she hatches out of the egg, she is a tiny caterpillar. How she can live through the winter, sleeping all the while, without first having eaten a lot of food, is hard to understand. She waits until spring to eat and to spin a cocoon. When she finally comes out of her cocoon, she is a beautiful butterfly. Her wings are spotted and she has long antennæ or feelers with little clubs on the end. With these she smells.

Hibernation is a strange period in an animal's life which scientists have not as yet completely explained. But hibernation without preparation is the strangest of all.

Plant-like Animals and Animal-like Plants

We usually think that a live thing which moves about is an animal. But there are plants such as diatoms, bacteria, and some seaweeds, which swim through water and other liquids.

The animals that are like plants in that they cannot

move about are corals (p. 130), sea-fans (p. 36), sea-rods, oysters (p. 169), sponges (p. 61), and barnacles (p. 183). They attach themselves to stones, ships, or buoys where they stay unless they are forcibly dislodged.

(See p. 73 for *Seaweeds that swim.*)

This Expert Diver never makes a Splash

The most expert of all animal divers is the otter. It enjoys jumping in and out of the water, and dives into a lake or river from some distance. Yet it enters the water with so smooth a motion that the surface is scarcely ruffled. There is never a splash. No other animal has learned this trick, for all others make a splash when they dive.

A Plant that reproduces like an Animal

The close relation of animals and plants is well illustrated by the reproductive process of the green moss plant. Animals propagate their species by the combining of an egg and a sperm cell. The green moss plant reproduces in the same way. It first forms an egg, and then a sperm cell joins the egg and fertilizes it.

The fertilized egg grows into a brown parasitic plant which lives on the parent plant for a time and then produces a capsule full of spores. These are transported by the wind and grow into new moss plants. But there must first be the egg stage which is an animal characteristic.

It might be said that the moss is a connecting link between plants and animals, the two great systems of life.

Eyes that look round Corners

The snail's eyes are placed on long stalks which are so controlled that they can actually look round a corner. The snail can point this eye-stalk towards the edge of a shell and can see beyond the shell when another animal on the other side cannot see the snail.

15,000,000 Children in One Family

Scientists tell us that in five years the offspring of one pair of rats can be as many as 15,000,000. This, of course, includes the grandchildren and great grandchildren. But, within five years, one mother through her daughters and their daughters, and perhaps their daughters' daughters, can reproduce as many as 15,000,000 new rats.

The question that comes to our minds at once is, "Why are we not overrun with rats?" The answer is that nature produces most of this fifteen million to serve as food for other animals.

Thousands of them are caught by hawks. That is one reason why hawks should not be shot. Other thousands are killed by skunks, foxes, and other animals that live on meat.

After all, each plant or animal in nature has a very important purpose. When nature is interfered with, her balance is often changed to such an extent that we may be in great danger.

We occasionally see the balance in nature thrown out with the result that we have a horde of grasshoppers or some other insect. While the production in rat families is huge, we really cannot get along without them, and we are perfectly safe with them as long as the rodent-eating animals and birds are allowed to thrive.

Food Larger than the Eater

Although it seems an impossibility, there are fish living in the depths of the ocean which actually swallow and digest other fish larger than themselves. This family has the interesting name of Chiasmodon. This is pronounced Ki-az′-mo-don.

Nature has provided this strange creature with a mouth which can be stretched somewhat as the mouth of a snake is stretched to let in large pieces of food. But a large mouth is not enough in the case of the Chiasmodon. It must have a large stomach. So nature has provided it with one, whose walls will distend to such a size that a much larger fish can be put into the stomach and there be digested chemically.

About the only benefit that can be imagined from this special way of feeding is that the Chiasmodon does not have to look for food as often as a fish that eats animals very much smaller than itself. One meal lasts a long time. While other fish eat several times a day, this one with the full stomach rests and enjoys life.

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