Wonderful

Edith Carrington Tools

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WONDERFUL TOOLS.

ANTLER-BEARERS.

[See page 28.]

WONDERFUL TOOLS

BY

EDITH CARRINGTON

AUTHOR OF "ANIMALS' WAYS AND CLAIMS," "MAN'S HELPERS,"
"AGES AGO," ETC.

WITH NUMEROUS PICTURES

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DEDICATED
TO
FRANCES POWER COBBE
WITH
RESPECT, ADMIRATION, AND LOVE
BY
HER FRIEND AND FELLOW WORKER
EDITH CARRINGTON

“ Let a double portion of thy spirit be upon me ”

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PREFACE.

THIS volume, like its predecessors in the same series, has been written in the hope of encouraging an interest in the lower animals of all kinds, not merely as "specimens" to be described, collected, and tabulated, but as humbler brethren subject to like feelings with ourselves and worthy of our sympathetic consideration.

The "Wonderful Tools" which form the immediate subject of the book are those with which the creatures have been endowed by nature, and which are the result of that mysterious power of adaptation to surrounding circumstances, than which nothing in animate nature is more wonderful.

E. B.

WONDERFUL TOOLS.

CLIMBERS AND RUNNERS.

WORKING FOR A LIVING.

EVERY animal, whether great or small, weak or strong, must work for his living ; and all beings come into the world with a complete set of tools ready made. Very wonderful tools they are, far superior to anything which human fingers can make.

Not only do the tools of animals never wear out, because they form part of the owner's body, growing as it grows, but their happy possessor can never mislay them. How convenient it would be for a gardener, if he could turn his forehead into a spade, as one sort of beetle does, or for a boatman if he could use his arms for oars as certain water insects can !

It would save the carpenter much money and trouble if he could use his teeth for chisels, as the squirrel and dormouse, and the mason would do his work very expeditiously if he were able to use his hands for trowels, as the beaver, and carry mortar in his mouth as the swallow does.

Among animals, such wonders as these are common ; their tools serve them also as limbs, and do equally

well for running, walking, eating, drinking, or working. Yet, different as the limbs of animals appear to be, and various as the uses are to which they are applied, they are formed of similar parts.

It is plain that these beautiful creatures in their endless variety, including man himself, were all planned by the same mind, for they are all formed on the same model. It seems as if all their limbs or tools were contrived so as to be in some sort alike in their general form and structure, yet altered so as to fit each creature for the life it must lead.

The bones in your arm are the same in number and position as those in the fore leg of a horse, the flipper of a seal, or the wing of a bat ; but as each of these animals leads a different life from man's, its limbs are carefully altered, or, as it is called, "modified," so as to suit its surroundings, without being really changed.

Even the tiny ant has legs articulated as ours are, with a hip, thigh, and shank, and a little, five-jointed foot. The ape prefers climbing to running on the ground, and so we shall find that his arms are very strong and muscular, able to swing the creature's weight from tree to tree.

On the other hand, kangaroos, who never travel except on the ground, have legs of vast strength, while their fore paws are comparatively small and weak. Birds which fly much have long, narrow, and powerful wings, while the wings of those who live much on the ground dwindle away till they are no larger than those of the ostrich.

Fowls can hardly use their wings at all, though they flap them aimlessly sometimes. The legs of the ostrich have become his most useful limbs, while the swift can hardly use his short legs at all. He is almost always on the wing.

Beasts, birds, fishes, reptiles, and insects of prey must earn their living by means of teeth, claws, hooked

A TREE CLIMBER.

beaks, poison fangs, or other devices for catching and killing prey, and their sharp tools are all constructed in such a manner as to inflict the least possible amount of pain upon the victim.

WHAT IS RUNNING?

FLYING animals force their way through the air by pushing against it with their wings. Swimming

animals pass through water by pushing against it with their webbed feet, fins, or paddles. Animals which walk or run get over the ground by pushing against it with their feet.

By a more or less sudden effort the limbs try to push the ground in one direction and the body in another. But the solid earth does not yield to the push, and so the whole force of the muscular effort is spent on the body.

Almost invariably the feet of running animals are small, for it is important that they should be disengaged quickly from the earth, which it is not so easy to do when they are broad and flat. Therefore the swiftest runners have the fewest toes.

The horse runs on one toe, which we call the hoof. The ostrich has two toes, and most wild animals of the deer kind put two toes only to the ground, while the elephant, who moves much more slowly, plants his huge five-toed foot upon the earth.

Of all runners the ostrich is the swiftest. No horse can outstrip him in fair chase, for he travels fast as an express train, the broad cushions at his toes giving his feet a firm grip of the yielding sand. Twenty-four feet at one step is thought to be his swiftest pace, and though that of a race-horse has been known to equal it, he can compete for a few moments only, the ostrich soon leaves him in the lurch.

But the mother ostrich has other means of seeking safety when she has eggs which she cannot abandon. She has learnt patience as well as swiftness. Dropping her long neck in front of her, she keeps perfectly

still, letting her dusky feathers lie loose. You might come quite close to her, mistaking the heap for an ant-hill, a tuft of dried grasses, or a hillock of sand. Then she will raise her neck a little and hiss, so that you might take her for a snake, and go away.

THE SWIFTEST RUNNER.

It shows great self-control in an animal to do such a thing as this ; it is love that teaches her the lesson. When the natives of Australia try to escape their foes by imitating a burnt stump, and a dark-skinned Australian or African endeavours to look like a black pillar of basalt, standing motionless, we say that they

show *presence of mind*. Then why should we not say the same of a bird or animal who acts in a manner almost identical?

Many erroneous statements have been made as to the exact way in which a horse gallops. From the sound made by his feet, and by the marks left on the ground, people have supposed that he never had more than one foot on it at a time. Others have said that he always had at least two. But since people have learnt how to take *instantaneous photographs*, or photographs which show how the horse places his legs at each instant, there is no longer any doubt.

Some of the attitudes taken by flying, swimming, and running creatures, as shown by the new photography, astonish those who could but guess before at their ways of moving. When galloping, the horse is first poised on one leg—his left hind hoof. Next his weight falls on three feet. And then by turns it rests on two, three, and one. So that the *triple beat* gallop, as it is called, because the sound strikes the ear as threefold, is produced by the beat of *one*, three, *two*, three; *one*, three, *two*, three of the horse's feet alternately.

There is a moment at which all four of the horse's feet are off the ground at once. This is when he has finished the *one* three *two* three, and is beginning over again at *one*. While in the air his body is sent forwards by the *momentum*, or forward movement, which his rapid gallop has caused. Then he alights on the single hoof again.

It is perfectly wonderful that this one slender limb

should bear the whole weight of his body, and the shock of his descent, without being injured. But the whole limb is so exquisitely made and fitted with springs that it is not hurt.

SWIFT RUNNERS.

IT is said that a race-horse can clear from twenty to twenty-four feet at one stride. He is a very useless animal, for he is trained to go at a speed which exhausts him in a very short time. Often he is very cruelly urged to that speed, and it is always gained at the cost of *strength* and *endurance*.

Next to the horse the greyhound is the swiftest of quadrupeds, and this dog has been known to vie in speed with the larger animal. A greyhound who raced a horse was beaten by one length of the horse's neck only. Since the dog was so much the smaller of the two, this shows what a wondrous runner he was. Another greyhound equalled a swift dromedary, whose speed was being tried. Already this dromedary had outrun all the horses, leaving them far behind. But the greyhound joined the race of his own accord, and kept pace the whole way with the fast-trotting dromedary. At the end he lay down quite exhausted. Sixteen feet is said to be the length of a greyhound's stride, and the hare can run very nearly, though not quite so fast.

But the hare seldom tries to outrun the greyhound. His fore legs are so short that he is able to turn much

more quickly than any dog, and by making sharp turns, or *doubling*, he sometimes manages to elude his pursuers altogether. This poor little creature also shows great *presence of mind*, for, after running forwards a long way, he will double back on the same track, and then, making a great leap to the right or left, he will lie snugly hidden while his foes rush by.

When they have passed, the hare once more jumps back to the old track and steals quietly out of sight in one direction while the hounds are running in the other. But as the greyhounds hunt by *sight* rather than by *scent*, the hare's chance is small.

Of all running insects, the cockroach (*periplaneta Orientalis*) is perhaps the swiftest. He is the race-horse of his tribe. You never see him walking. He scuttles off at a great rate upon his little jointed legs when he perceives daylight.

A night-loving because a persecuted creature, he knows that to be *seen* means danger for him, and lays his legs to the ground as fast as they will go if anybody brings a candle into the kitchen when he and his friends are holding a feast. A sound like the scattering of dry leaves before the wind tells of the patter of countless light footsteps, and in a moment the floor is clear, though it was black before.

He manages his six nimble legs so that his body rests on three at a time, like a tripod or three-legged stool. Stepping out with one front leg, he pulls himself along, the claws of his feet taking a firm hold of the ground. At the same moment he pushes backwards his hind leg on the same side. Thus he both

pulls and *pushes* himself onward. Meanwhile the middle leg of the opposite side is used as a prop for his weight.

Then the other three legs are used in the same way, turn and turn about, and thus the creature saves his life by his activity. All six-legged animals run, creep, or walk on the same plan.

READY TO BE OFF.

Nature is fond of the cockroach if we are not, for she takes great care of him. He is one of her best scavengers in his native land of Asia, which he saves from many an outbreak of plague and pestilence. In this country the cockroach is a stranger and a pilgrim, having been brought hither in ships. He has taken

kindly to the insides of our houses, and likes to live wherever it is warm, stuffy, or dirty. He loves places which resemble most his Eastern home.

Fresh air and cleanliness are death to him, and he starves or goes away if the floors are clean and the food kept out of his reach. Unfortunately there is no way of giving free emigration to cockroaches, or else no doubt they would be glad enough to get back to Asia. And we should prefer their room to their company.

The egg-bag of the cockroach is one of the most wonderful things of the kind to be seen. It looks something like a little purse, and the eggs, always sixteen in number, are arranged in two neat rows, in such a way that when the little cockroaches are hatched they shall find themselves heads uppermost.

At the upper edge of the bag, just above each egg, is a little nick or pinch. This is the place at which each young cockroach is to come out, and he melts a hole there with a secretion ejected at the mouth. Every cockroach in the bag comes out at his own particular hole, so that there is no pushing or crowding in the nursery.

The mother cockroach carries her bag about with her for a week and then stows it in some safe crack: she takes care to put it right side upwards. Also she has been seen tearing an egg-bag open to help the little ones out, but when she does this she does not seem to care whose bag it is. She is merely anxious to do her duty by juvenile cockroaches in general, not her own in particular.

THE EARS OF THE FOX AND HARE.

THE ears of animals betray much of their habits : they are among the most useful tools both of flesh-eating creatures and of those who browse on vegetables. Those of the fox and hare are an index to the life of both these animals, though the fox feeds on other living creatures, while the hare feeds on grass, roots, and hay. Those creatures which, like the cat, hunt others for their food, must listen chiefly for sounds which are in front of them, and so their ears, though they may easily be moved as the animal likes, have the opening placed forwards.

Sounds enter our own ears through a passage or opening, and we find that we may shut out noise by putting our fingers into our ears so as to close that orifice. Sound is also carried to the brains of animals through a somewhat similar tube, along which it passes first to the inner ear, and thence to the brain.

It is the brain, and not the ear itself, which hears ; many creatures have no outer ears and yet can hear well. The earthworm is one of these. The outer ear, or ear-flap, collects the vibrations and these are handed on to the brain. The fox is a crafty fellow ; he does not get his dinner by chasing the rabbit or hare which he is to eat, but he steals softly to the place where it is, and springs quickly upon it.

And as birds form a large part of his diet, it is needful that he should be able to hear very quickly the least rustle made in the branches over his head.

So the ears of a fox are set in such a way that, when his head is lifted up a little, the outside flaps of his ears act like small cups, collecting the least sound from above and carrying it to his brain.

At the same moment that his head is slightly raised, his eye follows the same direction in which his ear has caught the sound, he sees the bird, and in a moment couches and springs. The poor fox would often be ready to die of starvation if his quick ears and eyes were not such first-rate tools.

It is not nearly so easy for the unfortunate fellow to hear noises behind him when cruel sportsmen are chasing him to death. Unless he turns his head and keeps his ears strained backwards he can only hear a confused sound, and he loses time if he stops to listen.

Foxes are often forced to find some complicated plan for cheating the hunters, instead of trusting to speed. A fox which was once being hunted found himself too exhausted to run any further, while the dogs were close at his heels. He made for a high wall, jumped over it, and lay down on the other side. Of course all the dogs soon leapt over after him, but no sooner was the whole pack over, than the fox sprang back again. In this way he puzzled the dogs and gained time, so that he gave them the slip and got away.

If we must get rid of foxes, how much better it would be not to make a day's amusement out of the dying agonies of so beautiful and clever an animal! If he must die, it is much better to shoot him. It would be a ridiculous sight were it not painful also, to

LISTENING FOR NOISES IN FRONT AND BEHIND.

watch a whole troop of men, horses, and dogs, rushing with idiotic bawlings across the country in pursuit of one poor, panting, frightened little creature! It is a cowardly and a contemptible action.

A TAME FOX.

NEAR Guildford, a keeper once saved a fox cub, and kept it in a wire inclosure as a pet. The creature scooped out an *earth* or den for himself inside his wire prison, and into this he vanished like a streak of light when anyone intruded upon his privacy. He smelt a man coming. But he made great friends with one lady, who used to bring him bits of sugar and other things to eat. For some reason best known to himself, Sammy, as the fox was called, would let her do what she liked with him, and he never ran away from her, but would stand swinging his tail like a dog when she drew near.

Sammy would take the piece of paper in which his treat had been wrapped and play with it like a ball, tossing it into the air and catching it again, in graceful play like a kitten. When his only friend was gone, he would gaze wistfully after her, still wagging his tail expectantly in the hope that she would come again.

Which of us would like to see our pet dog or cat worried to death by hounds, while men urged them on to hunt the poor creature till it dropped, and called that good sport? It is quite as barbarous to find pleasure in killing one animal as another, since all alike feel pain, and love life.

In time men will learn to see more clearly and truly in this matter, and will abhor fox-hunting as they now abhor bull-baiting, which once was considered a noble amusement for Englishmen, though nobody thinks it so now. The world is growing better, though very slowly, and we can all help it to do so by setting our faces against cruelty, whether it is named sport or called by any other specious title.

Animals which, like the hare and rabbit, are often pursued by other creatures, have ear-tubes which run in a backward direction, and openings to the ear-flaps which are directed in the same way. It is needful that these creatures should be able to listen for noises from behind when they are trying to escape from their enemies.

The ears of a wild rabbit or a hare are placed so as to lie most easily with their openings backward, though the animal can prick up his ears or push them forward if he chooses. Presumably an animal whose ears are laid back cannot hear noises in front of him distinctly.

A hare, who was being pressed hard by greyhounds, was seen by a woman running towards her along a turnpike road. The poor little thing was so deeply absorbed in what was happening behind him, and listening so eagerly to the noises there, that he knew nothing of what was in front.

The woman knelt down, and stretched out her apron, and the hare ran right into it. This seems to prove that the hare's senses told him little of what was going on behind his back. He had been accustomed

to danger in the rear, and to flee from it, but not to encounter perils in front.

TOOLS BECOME USELESS IF NOT USED.

THIS is true of the tools of all animals, and also in a great measure of our own bodies. *We help to make ourselves*: that is to say, we may cause our bodies to deteriorate, or may help to make them stronger, purer, and better, just as we may do our minds. There is one very common creature which we see every day, who is a curious proof that when an animal ceases to use his tools he loses them altogether.

The pig in his sty has no tusks, but his wild relations possess these tools for digging out the roots on which they feed, as well as for defending themselves. When men took the pig and shut him up in a sty, by degrees his tusks disappeared, growing shorter and weaker as each new generation of captive pigs was born, till at last sty pigs had no tusks at all. When Captain Cook let loose some pigs in New Zealand so that they ran wild again, their tusks developed once more.

As there are no fierce creatures in that country to chase the birds, some of them cannot fly; they never acquired or have lost the habit of doing so, and now they cannot use their wings. Probably they found plenty of food on the ground, and fed with nothing to disturb them.

The owl-parrot is among these flightless birds. It

feeds by night, cropping grass like a rabbit. The kiwi is another, and he has feathers like hair. Birds which live always on the ground become a little like ground animals.

The ostrich has hard places on his legs where he kneels down, as the camel has, and he doubles his legs in the same way. The natives call him *the camel of the desert*.

The kiwi snuffs after his prey along the ground,

THE KIWI.

like a dog. But the races of birds which have lost the use of their wings from never employing them are all likely to be exterminated. It is death to man or any other creature not to use his powers.

The flightless birds of New Zealand, and other places, become each year more rare, as cats, dogs, rats and other animals which attack them are by degrees introduced into the countries which they inhabit.

All this teaches us the lesson that if we fail to use

the powers given us by God, who made the world, and all other creatures too, we are likely to perish through losing them altogether. Human tribes and nations which became lazy and self-indulgent have been swept away, giving place to wiser and more energetic people.

For though we are far higher and grander than swine or birds, our bodies obey the same laws as those which govern the bodies of animals. We are animals ourselves, though something infinitely more as well.

INHERITED TRAITS.

THE manner in which insects follow the same rules which guided their parents, though nearly all insects come into the world without even seeing them, is most wonderful. They know by nature how to feed, how to protect themselves, how to build nests, and all in the most perfect way possible.

It is as if a man or woman could know how to read and write without ever having been to school. Sometimes it is easy to find a trace of this kind of thing in human beings. A boy will often have the same habits as his father or mother, even though he may have been taken from his parents when an infant and brought up among strangers.

Good or bad qualities are often handed down from father to son, and children may inherit the disposition or temper of parents just as they might inherit their furniture or money. But the loftier and grander an

animal is, the less plainly marked will be the inherited traits of character.

Man is, we know, the highest of all earthly beings ; he is the lord and king of creation, only " a little lower than the angels ; " he rises above the laws which govern his lower brethren, the beasts, as a grown-up elder brother is free from rules which keep the nursery in order.

No man need be bound by any slavish rules which make him a drunkard because his father was one, nor need a woman copy what was wrong in her mother. With the races beneath our own all is different, and the lower we go the more strongly we shall find creatures bound by inherited traits. In the insect tribes these laws are perhaps strongest of all.

When a horse shies, as he often will, at a clump of whispering reeds by a river's bank, he does so because his ancestors, once wild horses, far away in other lands, were afraid of wild beasts, which lurked in such places. The tame horse inherits the dread, for he is timid by nature.

When a dog insists on turning himself round three times before he will go comfortably to sleep, it is because the wolves or jackals, his wild forefathers, made their beds in the tall rank grass, and could not settle to rest till it was all smoothly trodden down and the hairs of their coats were lying the right way. Though the house dog may lie on a flat carpet, and his bed be smooth as a table, the inherited trait causes him to keep up the old habit of his race.

Puppies and kittens are born with all that it is needful

for them to know, besides many strange inherited traits. They need no schools to train them in the way of wisdom.

I once possessed a young puppy which had been taken from his mother before she had taught him how to bury bones. Yet, one day, when I gave him a big bone to gnaw, just as one gives an india-rubber ring to a baby, because he was cutting his teeth, he tried to bury it in a woollen shawl of mine which lay on the floor.

Toddling across the room with his toy in his mouth, he began poking it under the heap of soft stuff, raking the shawl over it as well as he could with his nose and paws. When he thought it was hidden he seemed very much pleased, and began a sort of lumbering dance round the spot where his goods lay concealed. I suppose he thought that his property was now secured so that no other puppy could deprive him of it. He was showing an *inherited trait*, the same sort of feeling which once made his fierce ancestors carry off their prey to hide it from their fellows.

A cat, too, will prefer to drag her piece of meat off the plate before eating it ; often she is not satisfied till she has pulled it to a considerable distance. This is a lingering trace of the habit which all wild cats have of taking home their prey to be devoured in the den.

Though hens, ducks, and geese in our farmyards look very different indeed from their ancestral races, the tame birds show that they have by no means forgotten the old habits of their tribe.

A mother duck or hen is often delighted to steal away from the poultry yard if practicable, to lay her eggs under the shelter of some friendly hedge, where she may hatch her eggs and keep her chickens to herself. Both birds seem to recollect well how to make some sort of nest, though for many generations they and

WHERE SHALL I BURY IT?

theirs have been accustomed to lay in the baskets or boxes provided for them in the yard.

It is wonderful that each bird should build a different kind of nest, and that her young should keep to the same pattern with exactitude year after year and age after age, so that every sort of bird may be known by the nest which she makes.

THE CHAMELEON'S TOOLS.

THE tongue, eyes, tail, and feet of the chameleon are the tools by which he lives. His whole body, too, is fitted by its curious power of changing colour to aid him in bread-winning. To see this little animal catch a fly or caterpillar is to see a bit of work wonderfully done. Claspings a bough with his toes, which are very much like those of a parrot, and winding his tail round it as an extra prop, the chameleon sits waiting for his repast.

What eccentric eyes he has! He rolls them two different ways at once, and can look at the sky with one while he glances over the ground with the other. Suppose that you could watch a fly on the ceiling with your right eye and a black beetle on the floor with your left! Presently some creeping thing comes near enough to be swallowed, or he himself takes a few slow, solemn steps towards it, as a fly settles a few inches off.

All of a sudden the chameleon wakes up, rears his helmet-crowned head, and brings both his eyes to bear on the fly. A crack seems to come across his face like a big smile, there is a whirl in the air, the chameleon has not moved, nor so much as uncurled the tip of his tail, but the fly is gone, and he sits contentedly munching something.

The prey has been caught so cleverly and quickly that one could hardly see how its capture was achieved; nothing but a pink flash, and it was over. A fleshy

tongue, like a great lump inside his chin, was flung out; aimed at the fly from a distance of six inches; he hit it, and carried it back sticking to the tip. This lasso of a tongue flipped back into its owner's mouth of itself, just as a bit of elastic shortens again mechanically after being stretched out.

Somebody has said that the eye of a chameleon has no more expression than a boiled pea with an ink-spot in it, but this is not true. The brilliant speck, which

THE CHAMELEON.

is all that shows of his eye, shines like a tiny jewel, and his way of spying about with it gives a wary and wise look to the queer beast. The fact is, that the greenish gray skin covering and protecting the eyeball is an eyelid, or two lids fused into one, which leaves a little spot open, through which the bright pupil of the eye may be seen. The chameleon would painfully feel the glare of that sunshine he so dearly loves, without his green spectacles.

And then the changing colours of his skin not only hide him from his enemies, but enable him to feed.

This little creature would starve if the sight of his form lurking among the leaves frightened away the insects. But his skin approximates in colour either to the rough bark or the green leaves, and when he shifts from one place to another, he changes his hue to match his new surroundings.

We find many common creatures in England, such as the frog, newt, and several kinds of fish, who possess the same power of altering their colours to suit new circumstances, though they have it in a lesser degree. Many people have tried to explain how the chameleon changes colour, but nobody seems quite to understand his ways of doing so.

We know that under his skin there are coloured grains; when the light falls on these grains they change their shape, now rolling into tiny balls, now branching out like sea-weed. Also a French naturalist tells us that sometimes these grains of colour sink deeper into the creature's skin, or spread out to form a network nearer the surface. The nerves seem to have much to do with these grains. In this way, by change of form and change of place, the coloured grains modify or alter the skin's colour.

A CHAMELEON IN A PASSION.

THE changes of colour in a chameleon's skin are not nearly so marked or so varied as many people fancy. Old fables have circulated falsehoods about him. The creature can but *modify*, that is, *alter* his one hue, which is gray, and he can give to it a whitish, bluish,

greenish, brownish, yellowish or blackish tinge. And he not only changes colour for safety's sake, when he roams from one spot to another, or for food's sake, but also when he changes his mind. His emotions or feelings alter his colour. If he sees a snake, the chameleon's body becomes limp from fear, and he turns blackish. When he is angry or excited he sometimes blushes green, though he cannot blush red, and alternately puts on as many of the colours of the rainbow as he can, one after the other, fast and suddenly.

Professor Lloyd Morgan tells of a chameleon who lived by himself on a bough, alone in his glory, and monarch of all the flies he surveyed, till somebody put another chameleon on the same branch. The first chameleon thought that the second had no business there. He turned greener than ever with rage and jealousy, and they fought.

Never were two such furious dwarf lions seen! They forgot to be slow and careful, they untwisted their tails, and chased each other up and down the bough, till at last one of them, either by accident or because he thought discretion the better part of valour, dropped off. As soon as he reached the ground, he sidled off in an awkward and shamefaced way, and hid under the bushes.

It was some little time before the victor settled down to his previously calm state of mind. But in half an hour or so, finding that the enemy was not coming back, he fixed himself firmly as before, and blew himself out to twice his natural size, with a look of content

and satisfaction. You could see that this dwarf lion was truly puffed up with pride.

This habit of puffing out the body gave rise to the old story that chameleons lived on air. When it suits him, the little animal makes himself as thin as a pancake, and this he does in order to expose as much as possible of his skin to the sun's rays. He spreads out his sides in the sunshine, as you would spread out your hands to a blazing fire.

Many naturalists think that this very curious creature is not a true lizard, but a small descendant of some huge reptiles, called *Dinosaurs* or "terrible lizards," who lived before the flood. Some of these monster reptiles were as large as elephants and whales. In one of these giants the fossil upper bone of the leg (femur) measured 6 feet 3 inches in length. The lizard itself was from 80 to 100 feet long!

Some of these "terrible lizards" deserved their names, for they had fearful claws and teeth. Others were more peacefully armed with bony plates and spines. Happily these dreadful tyrants have long ago vanished from the earth, leaving behind them their gentle little relation, the chameleon, who harms nothing but a fly.

A FISH THAT WALKS.

ANCIENT writers tell curious tales of the flying fish. They thought that as soon as night came on, he left the sea, flew ashore, and slept there till morning came, safe from his foes. Of course we know better than

that now ; but there is a fish, the climbing perch of India, who has at least learnt to walk without legs. He somewhat resembles the bass or Sea Perch found on our own southern coasts, making use of his pectoral or breast-fins, which he hitches round the stems of grass and weeds to drag himself along over the ground.

He is also said to climb trees, in search of little tree crabs which he likes, but has only once been seen to do this. Daldorf, a traveller, found one of these fish

THE SEA PERCH.

six feet up a palm tree ; he was creeping by fixing his fins in the rough bark.

This wise fish leaves the water for the same reason which prompts the flying fish to do so—prompted by the impulse of self-preservation. Warned by some wonderful instinct that the parching heat of summer is going to dry up his stream, he seeks another habitation and is guided to the nearest tank or river, nobody knows how. Being a true fish, that is, an animal which breathes air drawn from water by means of gills, he yet manages to live for hours, and even days, out of his element.

A kind Power watches over him, as it does over the little brown sparrows, not one of whom falls to the ground without our Father. This poor fish, making a brave struggle for dear life, is helped by certain cells which have grown above his gills. These cells look something like a kind of coral or sponge, and he saturates them with water before leaving his stream. As often as his gills become dry, he can moisten them from this store, and before it is all gone, he is sure to find some ditch or tank, or supply of dewdrops, to renew it.

These journeys or migrations are nearly always undertaken by night, for the fishes know that many birds and other enemies would attack them by day; it is also cooler after sunset. They generally march in large troops. In our own country, eels, though they are true fishes, often travel from place to place overland.

Perhaps the most remarkable of all air-loving fishes are the funny little mud-skippers of the Pacific Ocean, sometimes seen also on the shores of West Africa. They use their fins in scrambling along over the mud of the shore, or for climbing. Holding on by these muscular breast-fins, exactly as if they were arms, the mud-skippers climb up trees, and clamber over pieces of grass, sticks or plants.

At a little distance these fishes look like large tadpoles, lying still and gazing about them, or snapping at flies. Suddenly startled by something, away they go, with a hop, skip, and jump, either inland among the trees, or on to the water like a flat stone or piece

of slate sent skimming by a school-boy. Now and then they plant their fins firmly, just as one might place one's elbows on a table, raise their heads, and take a good look all round.

The eyes of mud-skipppers, which are set close together near the top of the head, can not only be pulled inwards or pushed out by the animals as they please, but also have outer eyelids. Thus they can be accommodated either to the glare of daylight, or the subdued twilight under water. These creatures prefer the shallows near slimy river banks, and it is said that they cannot live in deep water.

SWIMMERS AND FLYERS.

A LIVING FLY-TRAP.

THOSE who are fond of walking near a wood on a June night may chance to hear a long, low, churring noise, not unlike the whirr of a spinning-wheel, which may go on for hours together with hardly a break. This is the note of the nightjar, and you may imitate it by nearly touching the inside of your mouth with the tip of your tongue, just at the roots of the front teeth, and then blowing very hard. But you will not succeed in making so mellow and musical a sound as the nightjar's muffled drum.

Keeping quiet, and looking carefully about, you may be fortunate enough to see who is singing this monotonous solo for his own amusement, or that of his mate and young, while he forages for himself and them.

The nightjar, dorhawk, jarr-owl, fern-owl, or wheel-bird, for he has all these names, and many more, sits on a bare branch while he churrs, not clasping it across as a thrush or robin would do, but standing with his claws stretched along it. In size he is rather smaller than a pigeon, but wider across the outspread wings. It is not so easy to trace the nightjar to the spot

where he sits, for, like the cuckoo, he tricks you by *ventriloquism* ; turning his head from side to side, so that the noise is flung far and wide. Now it sounds close by, then it echoes among the trees far away.

By-and-by you may see his dusky form flit out, flutter for an instant in the air and vanish again. In that moment the nightjar has caught a flying insect, his humming stops while he eats it, or takes it to his young. Then it begins again. Round the honey-scented oak trees, where cockchafer drowsily swarm, he hawks for his prey, stretching out one foot as he

NIGHTJAR'S FOOT.

flies, and grasping a beetle either with his long, jagged claw or with his mouth.

His mouth has a very wide gape when open, the slit going beyond the eyes, whose large pupils aid sight at twilight. Besides having sticky saliva inside it, the mouth has a fringe of stiff hairs or bristles which act as a fly-trap. When he flies along, snapping at the small moths as a swallow snaps at gnats, he looks so much like one of these daylight birds that sometimes he is called the *night-swallow*. Neither the swallow nor the nightjar have beaks of any size ; they use their *mouths* rather than their *beaks* in feeding.

One silly name for the nightjar is *goatsucker*. This

has been given him by foolish people who do not use their eyes, but fancy that when the nightjar skims about near cattle, sheep or goats, he sucks their milk ! The bird could not do such a thing even if he tried. When he flies close to the udders of these creatures he is doing them a great kindness, ridding them of the teasing insects which annoy them so much. The

THE FLY-TRAP.

beasts are wise enough to know this, and to stand quite still.

Nightjars are among the most useful of birds, but they do not stay with us long. Visiting this country in the middle of May, later than any other migratory or visiting bird, they depart southward in the middle of September, doing us immense good for about four months. Their young are reared here.

This is said to be the only bird who is *nocturnal*, or a night rover, and also *migratory*, or a bird of passage. The old birds build no nest, but the mother lays two-

beautiful eggs, white marbled with ash and brown, on the dry herbage of some lonely waste. The nursery is always cleverly hidden by a tuft of grass or heather, or by a small bush.

The plumage of the little ones matches the ground so closely that you might almost step on the little pair, huddled together and looking like a couple of tiny owls, before you spied them. The exquisite mottled back of the mother also hides her well among the parched vegetation while she sits. Should anyone pass too near the nest late in an evening, the old birds will boldly fly at him, and feeble, weak and inoffensive as they are, will at the risk of their own lives try to drive him away.

A FISHING-NET THAT GROWS.

A LONG while ago people circulated foolish tales about the pelican, saying that she fed her little ones with blood from her own breast. There is no need to *invent* wonders in speaking of animals' ways, for the truth is itself almost too wonderful for belief.

This faithful bird fishes for her little ones, and brings to them what she has caught. From the lower half of her beak hangs a large bag, which can be stretched out as it is filled. It runs the whole length of the bill and is large enough to hold about four gallons of water. The tongue is so small as to be a mere knob.

The whole beak of the pelican forms a bag-net, the upper half being the lid. When fishing, the pelicans choose rather shallow water, just deep enough to swim

in, and often a flock of them draw themselves up into a straight or horse-shoe line across a river or arm of the sea, each bird being about a yard from his neighbour. In this way they drive the fish in front of them towards the bank, flapping the water with their wings, and closing in a half-circle round their prey.

Sometimes when one of them has caught enough he goes ashore, empties his bag and spreads out all his fish in front of him, before he eats them at his leisure. When her pocket is full the mother pelican flies home and feeds her children with its contents. This she does by pressing the hooked red tip of the upper beak against her breast, which causes the fish to be disgorged into the ready beaks of the two, three, or four young ones.

The male does not feed his young, but is a good husband, for he waits on his wife while she is sitting, in the same way that she waits on her little ones. The pelican's bag can be wrinkled up by its owner so as hardly to be seen when empty. It is made of two skins, the outer being an outgrowth of that skin which covers the neck, the inner being a continuation of the lining of the throat, gullet, or œsophagus.

We must not suppose that this wonderful bag was made perfect all at once, or that it grew suddenly. It came by degrees, to cope with a necessity which this bird felt in supplying its own wants, or those of the helpless young. Fishing is a very uncertain trade, the weather is often rough, and then no fish can be had. The pelican soon found it a good plan to keep in his beak the remains of his food when he had caught more

fish than he could eat at the moment, either to carry home or to eat when he was hungry again.

This habit of storing fish in the beak made the skin near its base stretch ; little by little the pouch was formed, and grew larger as it was handed down from

PELICAN FEEDING ITS YOUNG.

one generation to another, each pelican being born with a small pouch to start with, which he used and made larger. Most likely if pelicans left off using the pouch it would dwindle away gradually as it was formed.

The nest of this quaint-looking bird is made of reeds or coarse grass, with a softer lining, and is placed in the

clefts of a rock near water or on an islet. The patient mother must sit for forty or even forty-four days, so it is fortunate for her that she has so considerate a mate.

Though the remains of their bones, found in the Cambridge and Norfolk fens, tell that pelicans visited these places not very long ago, we never see these beautiful birds in Britain now. They prefer tropical to temperate regions, but had they not been cruelly chased from our shores no doubt they would have made a colony in these islands by this time.

It is a pity that we banish so many winged guests by senseless shooting. These white-plumed birds, with their pure feathers tinged with delicate pink, like a rosy sunset reflected on snow, their golden bills and strong graceful flight would year after year add a charm to our landscape. A flock of pelicans, flying in lines, each with his long neck bent back over the body, is a very grand and striking sight.

THE KINGFISHER.

THE tool of this little fisher is his pointed bill ; his duty in the world is to thin out superfluous fishes. He is, in fact, a bird of prey, but his prey is fish instead of flesh ; he swallows it whole instead of tearing it, so a long pointed beak is better tackle for him than the curved bill of a hawk or owl.

Watchful, silent, and still, the kingfisher sits on the stump of a willow, or on some overhanging bough. You must creep very carefully, if you want to get near him, for he is shy. There he is, grasping the wood

with his tiny red feet, his bright blue eyes glistening in the sunshine, his orange breast reflected in the pool beneath, his long dagger-like bill pointed downwards.

He is investigating the minnows which swarm among the roots of the old tree, with roots stretching into the water. He stoops, darts downwards, plunges head-long into the water, reappears, flutters, sweeps off in a curved line, wheels round, and returns to his post. In his bill you see a shining silvery minnow. He kills it by beating it against the stump, then, tossing his head into the air, swallows the morsel and begins watching again.

A WINGED FISHER.

By-and-by a dragon-fly or butterfly flutters near, at this he swoops too, perhaps catching, perhaps missing it. Swift as an arrow his mate darts by—you see a flash of emerald, sapphire, and ruddy gold—she perches on a stone near the bank and looks all around her for a moment, then, all of a sudden, she is gone! Has she vanished into transparent air?

No; in that bank is a hole, some three or four feet long, and sloping upwards. Not a tempting place for a bird, one would think, under ground at the end of an old water-rat's burrow! Yet here she has patiently sat in the dark, hatching her round white eggs; and now she can hear her little ones calling to her as loud as they can for food. This she and her husband bring

them: fish, but swallowed and softened first, since cold raw fish is not a good diet for infants.

Bones, scales and all, the parents eat their minnows, and afterwards, like the owl, they cast out at their mouths a roundish pellet or ball made of the parts they cannot digest. A heap of these makes the nest.

Very soon the little ones are able to run down the burrow and out at their cave's mouth, in little velvet short-coats, for like all creatures born in damp places they are dressed in warmer clothes than others. The kingfisher is not a good walker, for his feet and leg bones are short. It is pretty to see the old kingfishers teaching the young ones to catch and eat fish.

They bring up their children to be merciful. No kingfisher allows a poor fish to lie gasping out his life slowly on the bank, though often they store up the overplus when they catch more fish than they can eat, hiding them on the bank. But all fish are put out of their misery at once, either by a sharp nip or a blow.

Once these pretty sights were to be seen near almost every English stream, and the kingfisher's note, like the sound of a little watchman's rattle, was heard far and wide. But avaricious, greedy, or cruel people shoot the pretty kingfisher as often as they can, either to stuff his dead body, and set it up in an ugly glass case for sale, where it looks horrid, or else because the bird does not know the difference between young trout and minnows. This makes the gamekeeper angry, and the idle sportsman too. Perhaps there is nothing more harmful to the country than the selfish wish to preserve game. It leads to the destruction

of many creatures far more useful to mankind than the few trout or game birds preserved for the tables of the rich, after amusing the barbarous idlers whose pastime is cruelty.

Loth to quit the place in which he earns his living, the kingfisher always follows the line of his stream when flying. A naturalist was in a train which, passing beside a river, disturbed a kingfisher. In spite of the puffing monster in front of him, the bird actually raced the train, and tried to outstrip it rather than turn to the right or left and fly inland. For several seconds the kingfisher and the engine kept abreast of each other, till, the stream and the railway taking different turns, they parted company.

CAPITAL PINCERS.

UNLESS you knew what it was for you would almost pity a bird for having such a beak as the crossbill's. It looks like a mistake, and one would fancy that its owner must find it difficult to pick up a meal. His near relations, the bullfinch, goldfinch, linnet and the rest of the finch family to which he belongs, get a living by picking up seeds. Most useful birds they are, because they prevent the spread of troublesome weeds, thistles, groundsel, plantain, and a multitude more.

Though the crossbill's beak does not seem so neat a pair of nippers as that with which the pretty goldfinch snips the down from a thistle seed, this apparently deformed bill can pick up seeds as easily and quickly

as that of a sparrow or chaffinch. But this is not the chief use to which he puts his twisted pincers.

They enable him to get at the seeds he likes best. These he finds inside the scales of ripe fir-cones, which he splits apart with great ease. Instead of meeting each other at the tip, and closing tightly, the two points of his upper and under mandible or beak cross one another at the tip. In some crossbills the upper point comes down at the right side, and in some at the left of the lower mandible. He is the only bird with such a beak.

When the crossbill wishes to feed, he breaks off a fir-cone from a branch : holding it firmly with one foot as a parrot might do, he opens his beak a little so as to make the two points meet ; if it is a large cone he clings to it with his claws. The beak then forms a sharp strong wedge like that of other birds. This he pushes between the scales of the fir-cone, and then the beak is opened, not up and down, but the *inferior mandible* or lower beak is moved *sideways*, so as to force open the scales.

While the points of his beak press the scales from the body of the cone, the crossbill puts out a hard, horny, scoop-shaped tongue, also exquisitely adapted for the purpose, and spoons the seed into his mouth. He can peep into the hole and see whereabouts the seed is, while his beak is holding open the scales, as he puts his head on one side.

In Germany, where great fir forests are, the crossbill is found all the year round. He merely visits this country, but has been known to build here, in the

Scotch firs of the Cotswold Hills, and in Holt Forest, Surrey.

It is not good for trees to grow too thickly, and many creatures are always busy at the work of eating such seeds as acorns, beechnuts, and chestnuts, that the ground may not be too thickly covered with young saplings. Though pheasants, dormice, squirrels, and many more animals eat seeds of other trees, it seems as if the crossbill were almost the only creature which acts as woodman to the fir woods. He must have been useful before human wood-cutters arose, and in wild spots must be so still.

These interesting birds seem to shrink but little from being watched at their work, and are so intent on it, clinging to the branches or working away at the cones, that they will let one come quite close to them. They feed in flocks during winter. In this country the crossbill finds out that apples are nice, and easy to split up, and that the pips are very good. Of course we cannot make him understand that he is not wanted in the orchards.

The nest of the crossbill is nearly always made in his favourite tree, the Scotch fir, with dry grass, lined with finer grass and a few hairs. The little ones, when first born, have beaks like those of young sparrows. They do not need the crossed tips till they are old enough to feed themselves, and in the meantime the

THE CROSSBILL.

crooked points would be much in the way when their parents dropped food into their mouths.

THE WHALE'S HAND.

WITH the biggest animal in the world it is very difficult for man to make friends because he lives in the deep ocean, and never comes ashore if he can help it. It is very pleasant, though, to think about this our big gentle brother, who is huge, yet harmless, and to find out all we can about his ways.

The Greenland whale sometimes reaches a length of more than 60 feet, so that his body is ten times as long as the height of a tall man. Very magnificent he looks, when he is at home in the wide sea, like a monster fish, though he is not a fish but a *mammal* or milk-giving animal.

On dry land the elephant is the largest animal we know; he belongs to the same class of animals as the whale, and we might as well call the one a fish as the other. Elephants often stay in the water with their trunks only above the surface, yet nobody calls them fishes. The whale stays in the water always. In prehistoric times the forefathers of these two creatures were alike.

The ancestors of the whale were animals who lived on land or wallowed and browsed at the mouths of rivers. By degrees they took to a seafaring life, and then their bodies and limbs were *modified* or changed to fit this new life. The shape of a fish is

well adapted for passing through water, and so the whale's body is fish-shaped.

Of course in the sea it is better for him to have fins or paddles to swim with than legs for walking like an elephant's, and so the bones of his forelimbs have grown shorter and his hands are covered with big gloves of skin—they are changed into paddles. But he still keeps the same number of bones in his paddle as an elephant has in his fore leg: he has five digits or

THE WHALE'S HAND.

toes like every other mammal; just as you have in your hand. But where are the whale's hind legs? These are gone, because he does not want them. You would have to search under the skin to find the remains which are still there. When he wants to swim along, the whale uses his tail, which is like a single broad flat oar. But instead of fanning the water sideways, as a fish does, he moves his tail up and down, and thus he drives his body forward. The paddles are used to balance the body but not for swimming.

How fast can a whale travel? An Englishman estimated that eight miles an hour was the whale's ordinary speed, but French naturalists have supposed that he can go more than twenty-two miles in an hour, quicker than the trade winds. Supposing that twelve hours of rest a day is enough for the whale, it would take him forty-seven days at this rate to go round the world, following the equator. The fact is that his pace varies much, when frightened he is swift, but when feeding peacefully with his friends he is in no such hurry.

Though a timid creature, the Greenland whale plucks up courage enough to come to the rescue of her wounded friends. If a harpoon strikes one of a "school," or flock of female whales living together under the charge of one or more old males, the rest will not attempt to escape. They will swim in an anxious way round their suffering companion and not leave her till she is dead.

The young males, who also live together in bands, are much more selfish. And when one of their number is struck the rest make off as fast as they can, leaving their wounded friend to shift for himself as best he may.

A USEFUL CASTING-NET.

AS soon as the whale has a mate, he learns unselfishness, and becomes a most devoted husband. The pair feed and play together, often leaping out of the water in their glee.

When her little one is born the mother becomes a most tender nurse. She loves her child intensely, and cruel whale-hunters know that she will never abandon him. They therefore wound him if they can in order to catch her.

The first thing that her baby must be taught is how to suck, and this he is not slow to do. She goes to the surface and turns her great body over on one side, so that the little whale may get the teat between his lips, while at the same time his nose is on a level with the top of the water. In this way he can breathe and feed as well.

His mother watches him, feeds him, guards him, never lets him out of her sight—not till he has cut his teeth, for he never cuts any, though he is born with traces of teeth in his mouth—but till his whalebone plates have grown: these are to be used instead of teeth.

SKULL OF WHALE, SHOW-
ING WHALEBONE.

Should a whaler give chase to this mother and child, she pushes her little one along with her paddles and body, and if he cannot swim fast enough she carries him. Tucking one of her fore arms or paddles round the young whale she presses him against her neck and back, and often escapes with her treasure in this way.

But not always. A sad story is told of a mother whale, whose sucking infant was struck by harpooners in the hope of tempting the mother within reach. It was pulled into a boat. A moment afterwards, the

old whale rose close to the side, and seizing the young one, pulled him out of the boat with great force, dragging about 600 feet of line with him, which was fastened to the harpoon. She dived—again she rose to the surface, and darted furiously to and fro, giving every possible sign of extreme anxiety.

For a long time she acted thus, though closely pursued by the boats. She was filled with the courage of despair, and cared nothing for the dangers around her. Hugging her little one fast, she was at last killed in about an hour from the time her child was caught. Is it not a shameful thing that men should seek to grow rich by such iniquitous means!

As soon as the young whale can feed himself he begins to use the wonderful whalebone net, with which he is to sweep the seas. Opening his vast jaws, he swims along near the surface of the water, through a shoal of the small creatures which serve for his food. These are little crabs, swimming molluscs, or sea-butterflies, jelly-fish, and many other tiny things. No sooner is his great mouth opened than a row of whalebone strips falls down like a curtain across the gape of his jaws. Each strip of whalebone, or baleen, is fringed at the end, being split into fine hairs. More than 380 plates of baleen hang from each side of the upper jaw.

The mouth, when wide open, passes through the sea like a three-cornered wedge, from six to seven feet across at its base, sixteen feet long, and twelve high, big enough to float a jolly-boat. The whalebone plates act like a sieve or strainer. Nothing too big

for the whale to eat passes through them, but the little creatures pass between the strips, and are caught in the hairy fringe. The whale's throat is so narrow that anything larger than a herring would choke him.

The fringed ends of the whalebone strips prevent the whale's food from escaping when once fairly inside the net. When he has swam about forty or fifty yards with his mouth open, he slackens his pace, and lifts his lower jaw, feels the whalebone plates with his lips, shuts his mouth and swells out his tongue. The water then runs out between the meshes of his net. With the point of his tongue he gathers together all the little animals he has collected, rolls them into a sort of ball, and swallows them.

It is a good thing that this great good-natured giant contents himself with minute organisms for a meal. Did he join his own immense size to the habits of a tiger, feeding with equal ferocity, he would soon empty the seas of every living thing. But the minute forms on which he feeds swarm by millions so as to dye the waves with their colour. He does good by clearing the waters of their unnumbered myriads.

WHERE ARE THE WHALE'S EARS?

NATURALLY the whale's body can float on the water when he chooses to rest in that way. The coat of blubber, two feet thick, which prevents his warm blood from chilling, helps to make him lighter than the water. When he wants to sink, the whale uses a

curious muscle, not unlike that by which the hedgehog rolls himself into a ball.

By means of this muscle the whale squeezes himself up into a smaller space or contracts his bulk. Thus he makes his body heavier than the water in which it floats, and down he goes. As he is not a fish, but an animal, breathing air by means of lungs, he cannot stay below for more than an hour at a time. His lungs have been modified to allow of his doing this, but if not alarmed, the whale likes to rise to the surface and breathe oftener. He would be drowned if he never came up.

When he does come up, the whale must go on breathing for nearly ten minutes, in order to purify his blood. Then he spouts into the air those fountains of water and vapour, which may be seen several miles off. These come from his blow-hole, an opening placed on the upper part of his head in such a manner that it is the first portion of him to appear above water. The blow-hole opens into the nostrils, and, strange to say, the whale hears through his nose.

The organ of sound in a whale is a tube, called the Eustachian tube. We have one in our own heads. But we have also an outer ear, the whale has none. This tube carries sounds to his brain. When he is breathing at the surface of the water it is a time of danger, and he needs to listen more keenly than at other times. As soon as his blow-hole is open, sounds are carried through it to the Eustachian tube, which is connected with the blow-hole. And so his tube and blow-hole make the whale able to hear all sounds

carried through the air as well as if he had large ears.

As soon as he dives, the water pressing on the blow-hole shuts it up, and then he can listen only to such sounds as travel through the water, which would be far too loud if his blow-hole were open. Every diver knows how loud the least noise sounds under water.

The eyes of the whale are much rounder than ours, a fact which helps him to see better in water. The

THE GREENLAND WHALE.

Greenland whale has now become rather a scarce animal, since the greed of gain causes men to destroy him whenever they can. Since neither whalebone nor that kind of oil taken from whales are necessities of life, it is to be hoped that the very barbarous slaughter of whales will cease before this grand race of sea-monsters has become extinct.

Between 1788 and 1879 no fewer than 8,500 whales were killed by English whalers alone. Counting those slain by other nations, it is no wonder that their

numbers dwindled, and that in 1891 Scotch whalers killed eighty-seven only, which were all small. It has been thought that the rattle of the screw whereby modern steamships are driven through the waters has scared away the whales. But it is more likely that their numbers are failing because they multiply slowly and are killed fast.

FLYING UNDER WATER.

JUST as some fishes feel at home in the air or on land for a time, there are birds who can be quite comfortable under water. The penguin plunges into the sea for his meal of cuttle-fish, or other swimming creatures, and uses his wings like fins or oars. His movement is, in truth, *flying under water*, the stroke of his wings as he chases a fish through the water being very nearly the same as that by which other birds force their way through the air. In the air the wing strikes *downwards* and *forwards*, in the water, *downwards* and *backwards*.

A flock of penguins at play in the water might be mistaken for a shoal of porpoises or dolphins, with such perfect ease and grace does this bird dive, swim and gambol under and over the waves. On shore the penguin is awkward. There he uses his short flippers or wings in an unprecedented way, for when he is in a hurry he drops down on them instead of marching upright on his webbed feet. He then runs scuffling along like a four-legged beast.

A queer way of sliding down a slope has been

invented by him. Sitting on his breast and pressing it against the slippery rock or bank of ice or snow he

ON THE ALERT.

turns his body into a toboggan, and comes down as fast as a boy might do in his sledge. As his wings are never used for flight, they have grown shorter and shorter. They have no quill feathers, and are covered

with a sort of bristles which seem as if they were turning into scales.

In short it appears that the penguin cannot make up his mind whether he will be a bird, a fish, or a quadruped, and in the meanwhile he is a little of all three. His whole body is dressed in such a thick coat of soft down that it will turn aside a bullet. This warm clothing is very needful, for the penguin lives chiefly in the cold countries round the South Pole.

Those who sail near the shores where penguins dwell, see them drawn up in long lines on the rocks like rows of soldiers. When the time comes for nest-building the penguins collect into a great multitude, and gravely hold a parliament. After a great deal of conversation, they choose a piece of ground for a big *crèche* or nursery. It is generally about four or five acres in extent, and as near the water as possible.

They always prefer smooth ground, where there are not many stones or hard substances lying about, which might damage the eggs. As soon as the birds have pleased themselves as to a site, they lay out the ground on a regular plan, first tracing an oblong or square large enough to hold the households of the whole congregation. One side of this square, facing the sea, is always left open, for coming out and going in. And at night it is guarded by sentinel-penguins.

The next thing is to clear the ground of all stones. This the birds do by carefully carrying them away in their beaks and dropping them outside the lines.

Sometimes they raise quite a little wall on three sides of their breeding place, and this is a good shelter from the wind. Inside the wall of stones and rubbish they make a pathway six or seven feet wide, and quite smooth. On this path they walk by day, and at night sentries patrol it.

The next job is to lay out this big square into little

THE ALBATROSS.

squares, formed by narrower paths crossing each other at right angles. In the middle of each small square is a penguin's nest, but where the little paths cross other sea-birds are often allowed a lodging. The mother albatross often sits close to Dame Penguin, but each must keep a sharp watch on her eggs, unless she wants them stolen and eaten. Though they are such good neighbours and never quarrel, honesty is not thought the best policy in penguin society.

For her nest the penguin merely makes a little hollow in the earth, just deep enough to prevent her single egg from rolling out. But the albatross throws up a little mound of earth, grass, and shells, as high as a small bucket turned upside down, on the top of which she sits. None of their nests are left for a single moment, until the eggs are hatched and the young can take care of themselves. The male bird goes to the sea when he is hungry, and then comes to take his turn at sitting while his wife fishes for herself. She hands the egg to him on his return, in a solemn and ceremonious way, placing her toes together and rolling it along, then putting it into proper position with her beak.

Some writers say that the male feeds the female while she sits, but this seems to be an error. The mother keeps the egg warm by holding it closely between her thighs, and if danger draws near she will move away, carrying the egg with her. After the young one is hatched both parents go to sea and bring back food for him; he soon gets so fat that he can hardly walk, while they become emaciated.

HOW DARWIN MET A PENGUIN.

When sailors first landed on the Antarctic ice the penguins, who had never seen a man before, did not run away, but came quacking up to find out what sort of animal he was. Friendly curiosity, not fear or hatred, was felt towards man by all living creatures till long ages of unkindness shook the animals' faith

in the human race. They believed that man was good till they found him bad ; at least, so we must believe from the way in which wild animals in lonely places still receive the first men they see.

Men might have drawn out this simple trust and have made faithful friends of them all, but he chose to estrange them by cruelty, till, as the Bible says, the fear of us and the dread of us is upon every beast of the field and upon every fowl of the air. It is a punishment drawn down on ourselves by our own unmercifulness. When our race alters and grows merciful, and treats the lower brethren rightly, they may learn their old beautiful creed again.

It is sad to think that creatures which, like the penguin, are willing still to make friends with us, should be the first who are killed because of their gentle and affectionate spirit. *But it is sadly true that no race of wild animals which trusts man lives long.* The penguin is fast dying out, his near relation, the great auk, or gare-fowl, a British bird till about fifty years ago, has already disappeared from the face of the earth. He was tame as a domestic goose, was no trouble to kill, could not resist or fly away, and so his race was swept from the world.

Darwin gives an amusing account of how he met a penguin in the Falkland Isles. "One day," he says, "having placed myself between a penguin and the water, I was much amused by the action of the bird. It was a brave bird, and until reaching the sea, it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him.

Every inch he gained he kept firmly, standing close before me, firm, erect and determined, all the time rolling his head from side to side in a very odd manner."

If all who study Nature were content thus to observe creatures without hurting, frightening, or killing them, we should know more of their ways than we do.

HANDS TURNED INTO WINGS.

WHEN we say that a creature flies, we mean that he gets through the air by means of upward and downward strokes of his wings. This is *true flight*, and thus the flying fish is not a true flyer, because he never flaps his wings up and down. Other animals besides the bat can progress through the air. The flying squirrels achieve long leaps from a height, spreading out a skin which grows between their limbs and sides, and then floating or skimming to the ground.

But the bat really flies like a bird, though he has no feathers on his wings, lays no eggs and has no beak. He is a near relation of the mouse, belonging to the same great division of mammals or milk-givers, of which man himself is head. Though nearly all mammals have hind limbs longer than their front limbs, the bones of a bat's fore limbs or arms are far longer than those of his hind limbs or legs.

And his hand has been changed into a wing. Look at your own hand, and fancy for a moment that the middle finger has grown so long and slender that it

would reach to your toes if you were standing up. Then suppose that the other fingers are rather less elongated, and that a strong light web of silky skin stretches itself between them and joins itself to your sides.

Your thumb would not grow, but would stay small, and be changed into a little hook, your finger nails would become sharp claws. This would give you some idea of a bat's wings, though the bat's legs too, as well as his tail, are connected with the same kite-like web.

HANDS ADAPTED FOR FLYING.

One change in the bat's arm makes it fit to beat the air strongly. In the human arm there is a double bone between the elbow and wrist, the two parts being called the *ulna* and *radius*. This gives to it the power of turning easily at the wrist. The bat's *ulna* and *radius* are joined into one solid bone, for a twisting motion would weaken it for flight.

The prettiest of our little English bats is the long-eared bat, who flits about like a small gray shadow at dusk. He measures about five inches across his out-

spread wings, but he can shut himself up like an umbrella when he likes. By day he sleeps hanging head downwards, his wings folded over his face, holding on by his hind claws. The body of this most lovely little animal frequently measures less than one inch and a half, his long delicate ears are of about the same length.

Made of the most exquisitely thin membrane or skin, almost transparent, they begin to tremble and quiver at the least sound, like flower-petals shaken by the breeze, the moment that the creature awakes and unfolds them from beneath his wings, where they lie tucked away while he sleeps.

The bat stretches his tremulous ears out as he flies, to listen for his almost noiseless enemy the owl, and also for the faint flutter of a tiny moth on the wing. So perfectly silent is his own flight, that it is a wonder to watch how he glides along, wheeling so fast, with so much movement of the wings, yet without the least bustle or flurry.

The only sound that tells of his presence overhead is the snap of his thirty-six fairy teeth, as he catches a moth, or a shrill squeak of delight like that of a very young bird or mouse as he greets a friend in the twilight sky. So marvellously keen is the sense of touch given to the network of nerves in his wings, that they are eyes, ears, nose and fingers to him in one. He steers himself clear of the branches of trees by feeling the motion of the air as it rushes against them, and need never slacken his pace to avoid knocking against the trees.

On the ground he can run fast, like a little mouse, using his hind claws and his thumbs. But he need not alight, for he drinks dew from the leaves, hanging upside down, and always feeds in the air.

By eating harmful moths and beetles, bats are as useful as swallows or nightjars.

A BAT AND HER BABY.

THE mother bat makes no nest, but ensconces her little one in some safe hole in a hollow tree, a chimney, or under eaves. She carries him about with her as soon as he is able to cling to her fur, that she may teach him to catch flies for himself.

Mrs. S. C. Hall took a bat away from a boy, who was treating it roughly. The poor little thing was half dead, and had lost one foot. Wishing to do all she could for it, she tried to nurse the little sufferer. She says, "As I took it in my hands I felt its heart beat. I placed it in a basket with cotton wool, and put it inside the nursery fender.

"I often peeped under the lid, and at last had the pleasure of seeing it hanging bat-fashion on one side of the basket, its keen bright eyes watching every movement. With trembling hands I doctored the wound, putting some ointment to it. All this time the poor thing stayed hooked on to the basket, and during the first day she would take no food, would not be tempted by meat, or milk, or by a fly, or a spider.

“The next day I saw her cowering in the cotton, and when I tried to touch her she tried to bite my finger, and made the least possible noise you can imagine. I then offered her a fly and in a moment it was swallowed, a bit of meat shared the same fate, and she folded her wings around her as if to say she had had enough.

“All day she never moved, and at dusk when I tempted her again with food she took it. This went on for some days. She became tame, and seemed to look forward to feeding time. At last, to my great surprise, I saw a baby bat, covered with light brown fur, but still looking as young mice look, under the folds of her wing.

“Doubtless Nature had taught her that for the sake of this little one she must take food.

“I believe she suckled it, for afterwards when she hung herself up again to the side of the basket the young bat was not in the cotton, and I fancied that it hung from the mother while sucking. The old bat became furious if I tried to touch the young one. Her soft hair stood up, and she would tremble all over and utter little short sharp sounds.

“I wanted very much to see if the baby was blind, but she would not allow me to find this out. But before a fortnight had passed, I saw its eyes like little bright beads in the candle-light. My bat and her baby excited great curiosity. The young one lived for about a month, when, to my great grief, I found it dead, the parent hanging as usual from the side of the basket.

"The old bat became as tame as a mouse, and would hang herself to my dress, devour what I gave her of animal food, and lick milk off my fingers. She knew me well, and would fly round my room in the evening and go out at the window hawking for insects. In a couple of hours she would return, and hang to the window-sill or the sash till she was let in.

"At night she would sometimes fasten in my hair, but she never went near my mother or the servants. She did not seem to miss her foot, but was a great favourite for more than two years."

KIND LITTLE SEA-MONSTERS.

CURIOUSLY like the chameleon in some of his ways is a pretty and graceful little animal known as the sea-horse. He looks rather as if he had stepped out of a fairy tale, but he is a very small and very kind sea-monster. We have seen that a creature need not be a fish because he lives in the water, any more than a man must be a Frenchman because he happens to live in France.

But this is a real fish, breathing by means of gills, though he does not look at all like one. When he swims, the sea-horse goes along upright, whirling the fin at his back in a screw-like fashion. He balances himself with his two arm fins, which look like large ears at each side of his head. But all the while his tail seems to be groping about for anything to which

it can cling, as if its master felt anxious at roaming so far.

So eager is this tail to grasp something, that when two friends meet one another they often tangle their tails together, and cannot disengage them for a long time. This way of shaking hands is quite an accident. Very soon the inquiring tail finds a stem of seaweed round which to curl itself, and the sea-horse comes to an anchorage.

Now he begins doing just what a chameleon does on his twig, looking about him on all sides for some small prey. And he, too, can move his swivel eyes two different ways at once. When he spies some swimming creature small enough for his purpose, he makes a dart without unfastening his tail, and seizes it with a sort of snout or beak. He has no teeth. This beak is very useful to the sea-horse in poking about among the weeds for fishes' eggs, worms, or bits of dead animal matter. By eating the latter he does good service as a scavenger.

The body of the sea-horse is not covered with scales, like that of most other fishes, but with horny three-cornered plates. These are generally of a bluish hue, and it is very difficult to see him in the water, for he sits among weeds the same colour as himself. From the bites of other fishes he is well protected by his bony coat of mail, and though he is no great swimmer, he travels far and wide, holding fast to a floating raft of weed.

Sometimes he pays a visit to British seas, and he is found in the Mediterranean and in the Atlantic, as far

south as Australia. One tropical kind of sea-horse has long red fringes streaming down his body, and he imitates the crimson seaweeds among which he hides so closely that it is all but impossible to find him. There is one thing greatly to the credit of the sea-horse; though so small and feeble, being only about four inches long, he is the most exemplary of fathers.

Among fishes there are some few that build nests, and care for their helpless young when hatched. And then it is always the *father*, not the *mother* fish, who shows this affection. The little stickleback of

our own ponds and ditches is a tender nurse to his little ones, fighting for them fiercely, and watching over them with the fondest attention.

The little sea-horse makes no nest, but he carries about his wife's eggs in his pocket! Near his tail he has a sort of pouch or bag; in these the mother's eggs are placed, and until they are hatched her mate takes charge of them.

THE SEA-HORSE.

BROWSERS AND GNAWERS.

THE ELEPHANT'S TRUNK.

THE first cousin of the pig is the elephant, and he has not lost his tusks yet. Anyone looking at an elephant wild in the woods must see that it would be very difficult for him to get his food without the wonderful trunk and tusks which are his tools. With the tusks he can tear up trees and get at the roots he likes.

A LONG NOSE.

As his neck is so short, he could neither pick grass nor reach down leaves from the trees above unless he had some instrument, and so he is provided with a tool, which is nothing else than a very long nose. How very convenient it would be to have a nose with which one could gather apples from the trees overhead, or suck up water to drink !

With his tusks he holds down the boughs while he picks the freshest leaves to eat, carrying them to his mouth with the trunk. He can use his trunk as a shower-bath when he likes, cooling his hot skin by squirting a fountain of water or sand over his back, which he first sucks up through the two holes that are his nostrils. These run through the whole length of the trunk. So strong is his trunk that the elephant can carry a cannon with it, yet at the tip it is as delicate and sensitive as your own finger points.

At the end it is furnished with two small finger-like pieces, which project like a forefinger and thumb ; with these the elephant can pick up a pin from the ground. Those mighty feet of his are quite as wonderfully made as his trunk, and are padded so carefully that they can support his vast weight and enable him to move almost as gently and silently as a cat. He knows how heavy he is very well, and in passing through a crowd will gently push people aside with his trunk, for fear that he should tread on somebody.

He is almost the only animal that has the least idea of forming a rude kind of tool for himself : he is sagacious enough to pick boughs from the trees with his trunk, choosing them carefully. With these he will fan himself and drive off the flies which tease him. And once an elephant was seen to pick a bamboo cane that he might scratch his side with it to get rid of a leech which was sticking there. He did not break off the first bamboo that came, but took great trouble to select one with a jagged end which would suit him,

throwing away several before he was satisfied. Monkeys, too, will use sticks and stones. They know how to crack nuts by using a stone or block of wood as a hammer.

TEETH, FEET, AND TAIL OF THE RAT.

IF one could make sure of having just enough rats, and not too many, the world would praise them more. They are indeed most useful animals, always have been, and always will be, in places where filth is allowed to lie about. In large towns, and, indeed, wherever he comes, the rat is a scavenger.

Many an outbreak of fever and other illness has been prevented by these persecuted creatures, and wherever the rat appears, we may be sure that he has work to do. The worst of it is that, after eating up all the foul waste, and rubbish that would make bad smells, he next attacks human food, and his numbers increase so fast that it is difficult to keep them within bounds.

The female rat is a very affectionate mother, and is so fond of bringing up a family, that she is seldom without one. She has her first litter when she is only four months old, and she has three broods in the year. Each brood may number from eight to fourteen baby rats. The mother makes a comfortable nest for her little ones, guards and suckles them with great care, and will carry them from place to place in her mouth, as a cat does her kittens, should danger threaten their nursery.

To earn his living the rat must of course have tools, and as he belongs to the class of *rodents*, or gnawing

animals (*rodo*, I gnaw), his teeth must be formed on purpose to do such work well. Those in the front part of his jaw, called *incisors*, or cutting teeth, have a wonderful power of growing as fast as their edges are worn away by constant nibbling.

Their roots are deeply planted in the jawbone, and are nourished with a kind of pulpy substance, of which the tooth is formed. A baby's teeth begin as little bits of soft pulp, inside the gums, and harden as they push up. If the rat were to leave off gnawing hard substances, his teeth would grow too long. But he is always busy, and grinds his tools well.

To keep the sharp cutting edge always keen, the outer part of the tooth is coated with a hard enamel, while the inner part is covered with a softer wrapping. The tooth itself is made of ivory or dentine, which is harder towards the front of the tooth than towards the back. Thus, when this tooth is rubbed against the rat's food the *inner* side of the tooth wears away faster than the *outer*, leaving an edge of hard enamel standing up like the blade of a chisel.

But the rat's food does not always fall into his mouth, he must often travel far to seek it, and that too in very difficult places. He is able not only to climb an upright tree or a wall, but to walk down, head foremost, with perfect ease. This he does by the aid of his sharp hooked claws, and his hind legs are so constructed that he can turn them outwards, to hitch the claws in any rough bit of bark or stone.

But his tail is perhaps the most useful appendage of all. It is like a *hand* to the rat. He can feed himself

by dipping it into bottles and jars, to get at the oil or sweet stuff which he could not otherwise reach.

Besides feeding himself with it, the rat can use it in climbing, as a monkey does, though not so freely. He is said to use his tail as a balance or support when making a spring, after the fashion of a kangaroo. It is covered with small scales, and it has more muscles in it than has the human hand.

RATS ON THEIR TRAVELS.

THE best way to get rid of rats is to keep our premises clean. Rats are forced to migrate or travel away from spots where they would starve, and this they have been seen doing in large troops.

A clergyman, the Rev. Mr. Ferryman, was walking through some meadows one evening when he noticed a great number of rats in the act of migrating from one place to another. He stood perfectly still, and the whole troop passed close to him. To his great surprise, he saw coming towards them an old blind rat, who was holding one end of a little stick in his mouth, while another rat had hold of the other end. In this way the rat who could see was helping his blind comrade along.

Many touching acts of the same kind have been seen, and they show that the rat is a good-hearted, as well as a sensible, creature. The same clergyman writes of a friend of his, also a clergyman, who was very fond of a rat whom he had tamed, and who followed him like a little dog, running about as he pleased. The rat was equally fond of his friend.

One night the gentleman who owned the domes-

“POOR OLD FELLOW, COME ALONG.”

ticated rat was reading in bed, and fell asleep. He was wakened by a sharp prick in his cheek, and found

that his bed curtains were in a blaze. He jumped up just in time to escape, but his house was burnt down. The faithful rat had warned his friend of the danger ; the marks of his little teeth were on the skin. But as he was never seen more, it was supposed that the creature perished in the flames.

There is no cleaner animal than the rat ; though he lives in a drain his fur is always spotless, and he cannot endure the least stain on it. After eating, or if touched by the human hand, he washes himself from top to toe, like a cat. When asleep the rat rolls himself into a ball, his nose between his hind legs, his thin, sensitive ears sticking out to catch the least noise.

Their enemies are so many, and their friends so few, that rats take their nap with both ears open. Cautious and timid though they have been made by constant persecution, they are still glad to make friends, even with creatures who would seem the worst foes of their race. Not human beings only, but dogs and even cats have been found on good terms with rats.

Mr. Jesse, who kept a good many pointer dogs, watched through a hole in the door and saw a number of rats eating harmoniously from the trough with his dogs, who did not attempt to touch them. Wishing to shoot these thieves, he put the food as usual next day, but kept out the dogs. Not a rat came near it ! He saw them peeping from their holes, but they knew the ways of mankind too well to venture forth without their guard of dogs.

After half an hour the pointers were let in, when the rats at once joined their hosts and dined with

them as usual. Terriers are clever and merciful in their way of killing rats, and when we must get rid of them, the best way is to employ dogs. But the cruel iron traps which catch and torment creatures alive are a disgrace to all who use them. We have the right to kill an animal who is doing us harm, we have not the right to torture him.

THE HARVEST MOUSE.

IN the fields the rat has a tiny cousin, who is almost the smallest animal that suckles her young. There is one smaller still, the pigmy shrew-mouse, but the pretty little harvest mouse weighs but one-sixth of an ounce. Her bright brown body with a cream-white breast is about two inches long, and her tail measures about two inches and a half. From nose to tail-tip she is less than five inches in length.

A TINY HOME.

So light is this mousie that she can easily run up a

stalk of corn without breaking or even bending it, clasping the stem with her little pink hands as a monkey climbs, and then she can come down faster than she went up, winding her tail round the stalk and sliding down to the ground as a boy slips down a greased pole.

A very beautiful cradle for her young ones is woven by this little mother mouse. It is quite a mystery how she contrives to make it. The nest is round like a cricket ball, and forms a hollow globe, woven of grass and leaves. It is hung to several tall stout grass stems, or fastened to wheat stalks, and it has been found hanging from a thistle head.

The walls of this little dwelling are so slightly woven that it is easy to see through them : there is no door to go in or out by, and the baby mice are packed into it so tightly that they entirely fill it up. As soon as they are big enough to come out and run about, the nest is worn to bits. How can the mother mouse give her babies suck ? that is the question.

She must either squeeze herself between the chinks of her basket-work ball, suckle them, and then come out, closing the opening after her, or she must cling to the outside of the ball while they poke their noses through to drink their milk. Nobody knows yet which way she chooses. The reason that we know so few things about even the commonest wild animals is, that people go into the fields and woods not for what they can *learn*, but for what they can *get*. Sad to say, they go out with the idea of chasing and killing creatures, or with the wish to make them prisoners.

Wild animals, taken to our homes and kept in cages, will not show us their natural wild ways—they cannot in prison. And, of course, dead animals tell no tales.

Loving, patient, and gentle watchfulness of the birds, animals, and butterflies while they are alive, free and happy in their out-door homes, will alone teach us how to know them. Though the harvest mouse belongs to the same class of animals as the rat and our house mouse, and has the same kind of gnawing teeth, he feeds a good deal on insects. The mice in our houses do so too, they eat cockroaches. Rats will eat the same, and will eat snails too.

As swiftly as a swallow on the wing, this little animal darts upon the flies and other insects he finds among the corn or in the hedge, he never misses his aim, though he is without a beak or wings. You can fancy what a benefit he is to the crops among which he lives.

THE FIRST BUILDER.

ONE glance at the beaver shows that he is a water-loving creature. His body covered with thick short fur, like that of a water-rat or seal, his webbed feet and tail formed like a paddle, fit him well for an aquatic life. And as water is needful for his comfort, this clever rodent, or gnawing animal, has set his wits to work and has found out a way of keeping a supply of it always at a convenient depth.

In summer the stream near which he dwells is likely to dry up, and this would be a great trouble for

the beaver. He contrives to prevent this misfortune by building a bank or dam across the brook, which stops it from running, and makes a pool. Or his reason may be that otherwise the stream would not be deep and tranquil enough. Long before the miller thought of this same plan for keeping his water-wheel always going, long before there were any men in the world, beavers built their dams in the same wise way, even on English rivers. Fossil remains of beavers are found in Berkshire, Cambridgeshire, Yorkshire, and elsewhere.

When the beaver begins his task he seeks out a narrow stream with plenty of trees near it. Then he sets to work at cutting them down. But where is his axe or saw? Inside his mouth! There he carries four sharp cutting teeth, made on the same plan as those of a rat or mouse, but, of course, much larger, because he is an animal two feet six inches long, not including his tail.

With a few of his friends, for beavers have found out how much better folks get on when they work together for the good of all, he begins the task of making a beaver village. First they choose a tree, and then, sitting up on his haunches, one beaver cuts a groove all round it with his chisels, or perhaps others join him. This groove he makes deeper and deeper, until the doomed tree looks as if it had a waist like an hour-glass.

When he has almost reached the middle of the tree, the beaver goes to a short distance and looks carefully at it on every side as if anxious to find out which way

it will fall. He wants it to drop into the water so as to save him the trouble of dragging it there. For this reason he will choose a tree which leans a little over it, but sometimes after all his pains the tree falls the wrong way.

When he has settled this question in his mind, he knows which side of the trunk must get the deepest cuts. He goes to it again, and with two or three powerful bites he digs out more wood. The tree of course topples over on that side most deeply notched, which is nearly always the side next the water.

The little wood-cutter has plenty of time to get out of its way, for he scuttles off the moment he hears it crack, and hides in

THE BUSY BEAVER.

the water, as if he knew that the noise of the falling tree might draw attention to his doings. His enemy the wolverine, or glutton, besides human hunters, are always on his track. Beavers can cut down a tree ten inches in diameter without much difficulty.

When once the tree is down, the next business is to cut it up into logs about a yard long. These are rolled and shoved into the water, the beavers all helping each other. These builders do not place their wooden piles upright, as men drive piles in building a bridge. They have no mallets or proper tools for any such arduous

job. They can use such tools as Nature gave them only, their paws and their mouths, together with their common sense. But these are enough. And they have found out that it is safest to work always by night.

Piling up the logs lengthwise, they bring stones and earth to weigh them down, and weave small sticks among them to keep the whole in place. These loads they carry between their fore paws and chins. The bark, which is their food, is too precious to be wasted—it is stripped from the logs and either eaten or hidden under water for food in winter. The smaller branches gnawed from the larger are also stored up.

THE BEAVER'S DAM

differs according to the nature of the stream. If the current runs strongly, the dam is made of a curved form, to break its force, so that the fall of the water forms a small model of the famous horse-shoe falls at Niagara. Some of the dams are of very great size, three hundred yards in length, and ten or twelve feet in thickness.

But when the force of the stream is but slight, the curve of the dam is less sharp, and it lies in almost a straight line across, which saves the beavers much time and trouble, for it is evident that this does not take so many logs. When it happens that a colony of beavers have been allowed to live and labour in peace for many years, untroubled by the ruthless hunter, the dam grows without their help, after a time.

Logs, sticks, dead leaves, earth and rubbish of all

sorts drift down the stream and are stopped by the dam, till a barrier rises above the surface. Seeds of birch and other trees float down the water till they reach it, take root and grow. The dam at last becomes a firm bank, covered with grass, flowers, willows and poplars, in whose branches birds build their nests.

In the same way the coral reefs, the work of humbler creatures, were turned into islands. In time the beavers clear the forest round their dams, first up the stream as far as it goes, and then to right and left. They dig canals on either side, into which the waters of the stream run, build dams and make pools across these too, and in this way alter whole tracts of country. Spots which were once thickly wooded are turned by beavers into meadow land. A great part of the city of Montreal is built upon beaver-meadows.

Beaver lodges or huts are built of the same materials as their dams, and are not quite such tidy places as some pictures represent them to be. No animal wastes its time and strength in taking more trouble than it need in building its house. Life is a hard battle to most wild creatures, and they have no time or strength to throw away. The truth is that the beaver is a burrowing animal, and his hut or lodge is just a burrow above ground, roofed over, as a good and safe place for his young, and a refuge for himself and his mate. The entrance to a beaver's hut is always either under ground, at the end of a burrow, or beneath the surface of the water.

He never trusts to his lodge only, but has burrows

in the bank as well. A burrow broken in at its upper end, and then mended with sticks and earth, would lead him on, by-and-by, to the idea of a hut with a room in it. Thus the beaver would turn his broken burrow into a hut, and be all the better off for the accident. In places where he can do without a dam or hut of any kind he makes none.

The few beavers that are still left in Europe, instead of joining together, and making towns with dams and huts, live solitary lives, in ordinary burrows. The name of *terrier beavers*, from the French *terre* (earth), has been given them. Even in America, where beavers build best, some of them choose to lurk by themselves in burrows. These are called *les paresseux*, or the idlers, and they fall an easy prey to hunters and to the glutton.

The beaver, then, is merely a burrowing animal with cleverness enough to alter his way of living, and to try improvements on his old ways. His race have been rewarded for using their talents, by finding those talents increase, just as a man who uses his brains finds them the sharper for it. In the first instance the beaver's hut was a heap of sticks laid up at the end of his burrow, close to, or in the water.

It is now a hut with walls many feet thick, doors leading into the earth or water, which allow him to feed or swim off without being seen, and a snug shelter in which he can sleep in peace. He mends it every year when the walls need patching. It took the beavers ages to improve their work thus, and geology tells us that they are an ancient family.

DRINKING WITH A TAIL.

HOW beavers found out the secret of keeping the water level by dams seems a mystery. We cannot suppose that these animals have the intellect of human engineers, we must imagine that their wonderful inborn wisdom and watchfulness taught them inch by inch, as ages rolled on, how to make ponds of the right depth. *Experience* was their teacher. Perhaps, like many human discoveries, the first beaver's dam was hit upon by some happy accident, and this discovery was afterwards improved upon.

Just as James Watt noticed that steam lifted the kettle's lid, some beaver, a sage among his tribe, may have seen how a fallen tree could turn a running stream into a quiet pool. By degrees it may have dawned on the beaver mind that one can cut down trees, and need not wait for them to tumble of their own accord, likewise that the logs could be fixed with stones when once in the stream.

Mr. Martin, a modern writer, says that it is a great shock to those who visit beaver districts when they stand for the first time before a pile of twigs, branches, and logs, heaped in disorder upon a small dome of mud, and learn that this is the famous "lodge." Inside the clay walls nothing is to be seen but a sleeping-room, not very different from that of any other animal.

But it is more interesting to trace how the small but ambitious creature learnt by degrees to turn

his gift for burrowing into one for house-building, than to fancy him born a perfect mason. We may marvel at the skill he has shown without human hands or a human brain to guide him, but cannot feel surprise that he builds no better.

In summer time the beavers leave their huts, go inland, and feed on shoots, green plants, and berries ; but the mothers, who have little ones at home in the hut, cannot leave them long. In winter they are fond of diving, to gnaw the roots of water lilies, and besides this they have a store of bark chippings always ready to be brought in by a back door made on purpose. When the hut stands on a steep river bank, the beavers make slides down it, that they may reach the water quickly in case of danger.

His paddle-shaped tail, covered with scales, makes a splendid oar, but that is not its only use. The beaver cannot exactly be said to *drink* with his tail, but he likes to keep it always wet. So long as his tail is moist he is said never to feel thirsty, but he is much distressed if it gets dry. When he rambles into the woods this water-bearing tail must be a comfort to him.

Melancholy to relate, the beaver is quickly disappearing, even from America, owing to the barbarous slaughter of these poor animals for the sake of their skins, both by Indians and white men. In Great Britain the beaver lingered till 1811, in Holland till 1825, in Switzerland till 1829, while from the Elbe basin they were all gone by 1829 though plentiful in 1801. In 1808 no fewer than 126,927 beaver skins were imported

into England from Quebec alone, while in 1827 the entire number was 50,000. The number of imported skins has been sinking ever since.

This falling off is due to two things. First, the hunters have killed all they could, so that few are left, secondly, kind and cleanly people began to find out that silk makes better and cheaper hats than beaver skins. It will be a good thing when men and women will content themselves with wool, cotton, silk, and linen clothes, instead of dressing themselves, like savages, in skins.

Unless vain, selfish, and cruel people will leave off trimming their coats and dresses with fur, there will soon be no wild animals left to be killed. It is time that our race began to hate such cruel and unclean clothing.

Miles and miles of land filled with broken dams, deserted lodges, and decaying stumps, are the only signs of all their wondrous toil left, where once the happy beavers lived and did no harm.

HORNS AND ANTLERS.

WHAT is a horn? And what is an antler? The creatures which we oftenest see with horns are cattle, goats or sheep. And those which we may see, though not so often, with antlers, are stags, though but a few of them are now left to run wild in England. On Exmoor, if you get up early enough, you may still see the proud head of a red deer, crowned with his antlers, lifted against the gray morning sky. But if

he smells you, which he can do an immense way off, he scuds away.

The difference between a horn and an antler is this: a horn is a sort of hollow shell, fitting over a bony core which joins the skull of its wearer. And it does not drop off. The cow never sheds her horns. Those cows which we see without horns never had any, or have been barbarously deprived of them.

But a stag drops or sheds his beautiful branched antlers every year. They are not made of an outside shell, and inner core, but are made of the same bony stuff throughout. When a little calf is born, two warts or tubercles may be seen sticking out from the bones of his forehead. The skin or membrane which covers them is very thick and hard.

This skin seems to have the power of making, or taking from the animal's blood, two different things. While its inner side makes layers of bone, its outer side makes a ring of horn, round its edge, and so the horn grows at last to its right length.

We are able to tell what the hollow shell is made of that grows over the inner core of bone, by looking at the only hollow-horned animal who sheds his horns. This is a curious American antelope, called the prong-horn because his horns are forked. In autumn, when his horns are newly shed, and only the small horn-core is left, this is covered with a quantity of long, straight, light-coloured silky hair. By little and little these hairs become matted or felted together, till at the top they become a hard solid point.

This shows us that hairs and horn are made of the

A NEW USE FOR HORNS.

same material, both being alike in substance and growth, but changed in form. A horn is nothing but a mass of hairs, pressed together and altered in a remarkable way.

When browsing animals are in a wild state they need their horns to protect them against lions, wolves, bears and other wild beasts. Among the antelopes, near relations of our sheep and goats, are some with long sharp horns like bayonets or spears. The gem-bok, an African antelope, is timid like all his family, but when obliged, he is not afraid to attack the lion himself.

Striking right and left with his long straight horns he often beats off the king of beasts, or even kills him. The body of a lion was found in a desert pinned through and through with the horns of a spring-bok. It was plain that the antelope, seeing the lion about to spring, had lowered his head to receive the charge on his horns. The shock of the lion's weight had killed him, and the lion died of the double stab.

Even the pretty little gazelle, though he always runs away if he can, knows how to fight bravely for his wife and little ones. And he has learnt how much better it is to have friends than to live alone. When a herd of gazelles are in danger they run together. The males stand in a circle or square with the mothers and little ones in the middle. The enemy is met with a row of bristling spears, and cannot harm the young and weak ones inside.

But it is most likely that wild animals find their horns useful in a dozen ways, of which we guess

nothing, because people are fonder of hunting them to death than of watching their interesting habits. It is certain that, when tame, the creatures turn these tools to many odd uses. A goat has been seen to jerk a bell-wire with her horns when she wanted somebody to open the door.

One cow, too clever by half, used to lift a gate off its hinges when she saw some better grass on the other side and wished to get at it, and a bull, more sensible still, found out how to work the handle of a pump and get a drink when he wanted one.

WHAT IS AN ANTLER?

IF you were to see a stag in the beginning of March, you would notice that he looked much like his mate, and he is as timid as she is then, for he knows that he has no weapon to fight with. Generally he hides in the forest when he has no horns.

Soon a little pair of knobs appear on his forehead, covered with a velvety skin. In a few days these have grown some length. If you could touch one of them you would find it burning hot,—that is because the quick blood is circulating very busily under that velvety skin, running to and fro, and as it passes, adding every moment a little particle of bony matter to build up the antler.

On and on they grow,—the stag must take great care how he knocks them against a tree now, for they can easily be broken, and the blood would pour from them fast if they were wounded at this stage. It is still at

work making those fine branches or *tynes*, and each year that he lives the stag bears one more tyne on his antlers.

So fast is it all done that in ten weeks the whole magnificent antler is finished. And then, as soon as they have done growing, the bony rings at their base begin to thicken so that no more blood can pass through to feed the antlers. The velvet is of no use now, and it is rubbed off. The antlers, now getting no more nourishment from the blood, begin to wither or decay, and by the end of February they drop off.

Besides fighting with his horns and protecting his wives, no doubt the stag uses his horns for many other things. Mr. Jesse saw red deer in a park full of old thorn trees getting at the ripe haws by shaking the boughs, in which they had first entangled their horns.

The mother red deer, or hind, cannot fight for her little one. Like many other females of horned tribes she has no weapons of defence. So if she cannot get away with her fawn, she tries a trick instead. A gentleman was watching a red deer hind through a glass. He could not make out what she was about at first, but soon saw that she was licking her new-born baby.

He walked to the place, and as soon as the old deer saw him she gave the young one a tap with her hoof. At once the little creature understood and obeyed this signal. And when the stranger came up he found it lying with its head flat on the ground, its ears closely laid back, and trying in every possible way to hide itself.

THE MOOSE.

When he took it up, the mother stamped her foot at him as a sheep does if you touch her lamb, and followed behind while he carried the fawn. But afraid of hurting it, he placed the little one gently on the ground again. The mother then trotted up, and with every appearance of joy, examined her child anxiously all over to find out whether any harm had happened to him.

This she did without caring for the man who stood by, though she would have fled from him in terror had it not been for her helpless fawn.

The reindeer is the only antlered animal who never sheds these beautiful ornaments. He and his mate have need of weapons and tools all the year round, to keep off wolves and to use as spades for shovelling the snow from their meal of moss. The largest living animal which wears antlers is the moose or elk, still found in North America though their numbers have sadly dwindled from cruel and wanton hunting. This lordly creature stands as high as a horse and weighs from twelve to fourteen hundred pounds. The antlers of a full-grown elk have been known to measure sixty-six inches from tip to tip. But the span is usually about twenty-four inches. Elks prefer to browse on the shoots of trees rather than on grass, and in hot weather, when teased by mosquitoes, they take refuge in the water, where they stand neck deep. Also while his antlers are growing the male elk spends most of his time in swamps, feeding on the leaves and stems of the yellow water-lily.

THE LION AND THE UNICORN.

THE so-called horn which springs from the nose of the rhinoceros is not joined to his skull at all, and is rooted in the skin only. Though smooth and polished at the tip, it is rough at the base, and is split into fibres not

THE RHINOCEROS.

unlike those into which whalebone can be divided. It is nothing but a quantity of peculiar hairs, glued together by a cement produced from the skin. As the rhinoceros uses his single horn for a weapon of defence, and it is centrally placed, instead of running parallel to the nose, it would give a great shock to his brain were it higher on the head, just over his brain.

Elephants, lions, and tigers can be stabbed to death with this terrible horn, made of a handful of hairs !

Though a fierce beast when provoked, the rhinoceros takes the life of no creature for his food, but browses on roots, shoots and juicy plants. When forcing his way through thickets his horn is of great service in making his path, forcing the branches aside, and clearing obstacles away. He has been seen to cut down reeds with it almost as neatly as a mower could do with his scythe.

Like the wild boar, he loves to wallow in mud, and his way of talking is to grunt or squeal loudly. The mother has only one little one at a time, which she nurses and guards with great care. The age of a rhinoceros can be guessed by his horn, for it is very small when he is born, and goes on growing slowly and steadily till he dies.

The first ancient travellers who saw him came home with wonderful tales of the rhinoceros, and pictures were drawn in old times of a slender creature like a horse, bearing a tapering horn on his brow. This was the unicorn, a notion of the rhinoceros sketched by those who had never seen him.

Marco Polo, who visited the East Indies about 1275, writes of a kingdom called *Felech* thus : " For savage beasts they have wild elephants like the buffalo in hair, but their feet are like elephant's feet. They have one horn in the middle of the forehead and hurt none therewith, but with the tongue and knee.

" For on their tongue are certain long prickles, and sharp, and when they hurt any, they trample on

him and press him down with their knee, and then tear him to pieces with their tongue. The head is like a wild boar's head, which he carries downward to the ground. They love to stand in mire, and are filthy beasts, and not such unicorns as suffer themselves to be taken by maids, but quite contrary."

Full of nonsense as this account of the unicorn is, nobody can help seeing that the rhinoceros was the animal meant. Marco Polo, like plenty of other travellers, must have listened to the fables told him by the natives about his prickly tongue and buffalo's hair and habit of kneeling on men when he "hurt any."

The animals found on the Royal Arms of England tell something of her history.

The unicorn, which formed the prop of the Scottish arms, was said to be fighting for the crown with the lion, who was the chosen emblem of England.

At last the battle was over, and both countries agreed to support the crown between them, the lion taking the right hand side of the shield, or place of honour.

A good deal of disputing has taken place as to whether the rhinoceros is meant when in the Bible the unicorn is spoken of.

There is every reason to believe that the unicorn of Holy Scripture was a huge two-horned wild bull, little smaller than an elephant, now extinct. This creature was drawn upon the Egyptian monuments in profile, or with a side face, so that one horn only was shown. From this the idea arose that he had one horn only, and thus he was named the "unicorn."

DIGGERS AND BUILDERS.

FIRST-RATE DIGGERS.

WE need not go to foreign lands to find creatures exquisitely made and fitted with tools. Under our feet, in nearly every English field, there dwells a small shy personage, who spends his whole time under ground, hardly ever venturing above it. The mole, when one meets with him, shows at a glance that he is a little miner.

He carries tools with him which tell what his trade is as plainly as the sweep's brush, the lamplighter's staff, or the postman's bag betray their owners' calling. First of all, look at the shape of the mole's cylindrical body. Is it not exactly of the right form for pushing itself through the earth?

The body of a bird when he is flying, or of a swimming fish, is adapted for passing most easily through the air or water; that of the mole, made on the same plan, is formed expressly for passing through the earth. People have found out that a cone-shaped tool is the best for passing quickly and easily through other substances, and also through the air.

The modern rifle-bullets are made like cones, a skyrocket has a cone-shaped top, so has a gimlet, and

miners' tools for boring are of the same form. Well, the body of the mole is a living tool of this shape and kind. His nose is armed at the tip with a stout, elastic, gristly tip, with which he forces his way along.

Evidently, long limbs would be very much in his way while digging. His are so short as to be like the

A SMALL MINER.

fins of a fish, and indeed his whole action is not at all unlike that of swimming through the soil. His hands or paws are armed with broad, strong nails for digging, and their usefulness is increased by having the palms placed outwards. When the mole wishes to burrow he begins by boring into the ground with his nose, and using his fore paws to throw out the earth behind him, his hind paws kick it out of his way.

It is marvellous to see how soon he will sink through the surface of the ground and be out of sight. Burying himself alive seems as easy to him as if he were a cheese-scoop pushing into cheese. When fairly beneath, so that he cannot get rid of the earth from his tunnels, he pushes it out by a jerk of his strong back from time to time, throwing up molehills through the grass.

But, beside his shape, the mole must be different from other animals in other ways, since his life is unique. He must not only dig out a burrow for himself, as the rabbit does, to live in; unlike the rabbit, he finds his food under ground too, making fresh tunnels towards the places where he knows, in some wondrous way, that grubs, wireworms, chrysalids, and earthworms will be found.

The mole's eyes, therefore, will be very different from those of the rabbit who comes out to nibble grass, and must be able to see clearly. Being nearly always in the dark, moles have little need of eyes, and at first sight one would feel ready to exclaim that they had not any. Yet the mole has eyes which answer his purpose well, tiny as they are, and buried deeply in the short, soft fur which acts as a protection to them.

AN UNDERGROUND CASTLE.

IF it were not for his splendid plush jacket the poor little mole would suffer greatly from damp and cold in his cellar; but it is a very comfortable garment,

keeping him quite as warm as if he were wrapped in a thick coating of blubber like the whale.

THE MOLE'S HOME.

If the hair of a cat, or of almost any animal, is rubbed backwards, from the tail to the head, it is

roughened, for the hairs are set with their points towards the tail, in the same way that the feathers of a bird are placed. But the mole's fur has no "set."

It makes no difference whether you smooth a mole backwards, forwards, or sideways, the silky fur lies any way equally well. If a single hair from the coat of a mole is looked at through the microscope the reason of this will be seen. The hair bulges out in the middle, and tapers not only to the tip, but towards the root. It does not grow thicker at the base as most hairs do.

And then the hair from a mole's jacket is not straight, but twisted three or four times round like a corkscrew. This is why the fur is so closely knit, for the hairs are linked into each other in such a way that they are not easily parted. As the little miner must run backwards as well as forwards in his tunnels, the want of bias or "set" in his coat saves it from being rubbed the wrong way.

One might suppose that a creature living in darkness and under ground would be dull and lifeless, but the mole is just the reverse. He is both brisk and animated, and no doubt as happy in his own fashion as the skylark is in his. He is well dressed, well furnished with implements for digging, and uses his tools in forming a wonderful underground castle which no creature need be ashamed to own. The mole's palace generally consists of two galleries, one above the other, joined by several passages. But the little architect keeps to no regular pattern.

In the middle is a chamber, to reach which the

mole can pass into the upper corridor, then down one of the passages, and thus into his inner room. It has one other entrance from below. Many tunnels branch out on all sides, leading to his hunting grounds and to the little wells which he sinks for himself that he may drink, for he is a very thirsty creature.

When he has a wife and family he takes care that their nursery shall be placed where two of his tunnels meet, that his mate and little ones may have a double chance of escape in case of danger. When frightened the mole rushes at once into his castle, where he is able to choose whichever tunnel seems to lead away from the sounds which have alarmed him.

Many learned men have puzzled themselves to find out why the mole makes this curious labyrinth for himself with its winding passages. It seems that its mazes are meant to afford him a chance of escaping his enemy the weasel, who can follow him into his burrows. Also, as no animal can live without air, it may be possible that the mole has invented a ventilator for his network of tunnels.

DON'T KILL THE MOLE.

FARMERS make a great mistake in having moles killed on their lands, for they are most useful in destroying the wireworm and cockchafer grubs which infest the roots of crops.

The money spent on killing moles would be better laid out in sending lads or women with spades to scatter the molehills which the farmer dislikes to see.

A farmer named Mr. John B. Clark once wrote to the Rev. J. G. Wood as follows: "I have farmed, and still farm from a thousand to fifteen hundred acres of land, and have noticed that when you try to exterminate moles, rooks, sparrows, etc., you have proportionate destruction from the creatures they feed upon."

"An old mole-catcher once came and asked me if I would have the moles killed on my land. I said to him, 'No, if I had no moles, I should have no crops.' He replied, 'Sir, you are the first I have ever heard say that, but you are right.'"

"He then went on to say, 'I killed moles once for a gentleman who had a field with a large hill in it. The soil was sandy and full of moles, and yet it used to grow nice crops. I killed the moles and it never grew anything to speak of afterwards. The wireworms and cockchafer grubs used to eat the roots of everything that was sown, and the young plants died off.'"

Besides his usefulness in destroying grubs, the mole's tunnels drain the land. They ventilate the soil also, making it dry and light, and throwing to the surface heaps of fine soil which act as a valuable top-dressing. Yet the poor mole's wages for all this good work are the cruel trap, and he is hunted and killed whenever he shows his nose above ground for a stroll in the light of day.

Strange and solitary as this animal seems in his habits, and little as he knows of men and their ways, except that he is persecuted by them, he is able to feel that power of kindness which makes the sunshine

of life. A mole which once made his way into a garden by burrowing under the wall, was in a sort of way tamed and made a pet of by the family, instead of being chased out or put to death.

His freedom was not interfered with, but Barty, as he was named, would come when he was called, to receive pieces of raw meat placed at the entrance to his hole. If he happened to be asleep, or at some distance from the mouth of the burrow, his friends above could bring him out by stamping upon the ground, a signal which Master Barty obeyed as punctually as boys and girls attend to the dinner bell's welcome sound.

Of all the wonders connected with this queer fellow, of whose ways we can know comparatively little because we cannot burrow as he does, the manner in which he goes in a perfectly straight line through the earth, or digs out a circle in the dark, is the most marvellous. If you try to cross even a small room with your eyes shut, you will soon find how difficult it is to steer yourself straight.

By what power he does it we cannot tell, perhaps in the same way that migrating birds, without chart or compass, direct their course through the midnight sky and never swerve from their invisible chart.

INSECT GRAVE-DIGGERS.

OTHER remarkable diggers are to be found everywhere on balmy summer nights, or in early autumn twilight.

Of these, the most peculiar and interesting is a smallish beetle, called the sexton or burying beetle. He and his mate actually dig graves in which they bury the bodies of any small creatures, such as moles, rats, mice, birds, and frogs, which they find lying on the ground in need of an undertaker.

The sexton beetles hunt in couples, and scenting their prey from afar, come wheeling through the air towards it on booming wings. They prefer to do their work by night. These little sextons need not be at the trouble of bringing a spade with them, nor does the burying beetle need a hoe or fork to break up the hard clods.

His six feet and forehead answer the purpose of these tools well. On coming close to the dead body of an animal or bird, the female settles on it while the male creeps beneath it. He will not permit his wife to do any of the hard work, but he himself begins hollowing out the ground under the carcase, butting out the earth on all sides with his head and pushing it with his feet till a bank of ground is raised all round the body.

Looked at from above, the dead animal seems now to be sinking mysteriously into the ground of its own accord. Now and then the beetle underneath gives a tug to get it down, or mounts to the top and tries to tread it into the earth. From time to time he takes a rest.

Very great, indeed, is his toil, it is as if a man were to try to bury a house, all by himself, in a few hours. The weary sexton drops into a deep sleep standing

beside the corpse, and he looks like a silent mourner watching it. At the end of about twenty-four hours the funeral is over, and the body may be found five

A RAT'S FUNERAL.

inches beneath the soil. The female beetle then lays her eggs in it, after which she and her mate partake of a feast upon the flesh.

We cannot be thankful enough for the services of such creatures as these beetles, since, without their

aid, the surface of the earth would be covered with evil-smelling remains of what were once living beings. When we think of how many millions of small animals, birds, and reptiles must die every day, it seems an enigma what becomes of their corpses, since they are so seldom to be seen.

The explanation is that a host of scavengers are always at work getting rid of unsightly and unwholesome things. When the burying beetle does his kindly office he is thinking not of us, but of his own family. He means to turn the carcase which he finds into a nursery for his future brood.

He and his mate take good care that their young shall be born in the midst of plenty. If they were thinking of themselves alone, they might just as well satisfy their hunger, leaving their prey as they found it ; but they wish to put the meal, which their children will afterwards enjoy, in a safe place.

A wonderful instinct teaches them that sun, rain, or attacks of other creatures, would deprive their offspring of the food, and so they bury it. They are useful scavengers for men, while thinking only of their own young. The food provided for the grubs lasts just long enough for them ; till the time is come that they must change into complete beetles, and then, without being told how to do it, they set about the same helpful work as their parents did before them.

STRANGE BEAKS.

UNLESS one knew the habits of the flamingo, one would fancy his beak to be a great trouble to him. But when we understand how this bird feeds, turning his head upside down at the end of his long neck, and dabbling in the sand and water for his food, it is easy to see that it forms a capital spoon.

Of all the amazing beaks in the world, that of the rhinoceros hornbill is the oddest, and even now its use is not clearly known. Upon his forehead this curious bird carries, besides his great bill, a sort of second beak, like a helmet.

Though it looks heavy, it is very light, being made of thin horn outside, and filled with light cells, so that he carries it easily.

HORNBILL.

As he builds no regular nest, but scoops out a hole in some rotten tree, some people have supposed that the hornbill's huge helmet helps him in doing this; nearly all birds which use holes in trees enlarge the openings with their bills. Others have said that the loud noise which he makes is caused by the helmet, which acts like a sounding board. Again, naturalists have supposed that the nerves which run throughout his helmet enable the hornbill to scent his prey, for he is partly a scavenger, feeding on dead animals.

The most natural conclusion seems to be that the hornbill kills the small creatures which form part of

his food with his huge weapon, and that he also defends himself from his enemies therewith. Some day careful observation of this strange bird might tell us more of his habits, if travellers would leave off shooting him and watch him instead.

Dr. Livingstone gives a very interesting account of the Korwé, a sort of hornbill, which he saw in Africa. When the proper time has come for making a nest, the male bird makes a point of shutting his wife up in the hole where she is to sit. She is willing enough to consent to this imprisonment.

The future mother retreats into some hollow in a tree, chosen for the purpose, or scooped out, and already partly walled in with clay, all but the doorway by which she enters. Her husband then plasters up the entrance with cement made by himself, leaving only a narrow slit of such a size and shape as to admit his own beak. Through this slit he feeds her. In the meanwhile she does her duty inside, making a bed out of her own feathers.

It is said that she stays within for two or three months, and for a part of that time her hard-worked mate is busy, attending not to her wants only, but to those of his new-born little ones. The lady hornbill becomes very fat during her stay in prison, but the devoted bread-winner outside gets so lean and weak that he is unable to face the least cold, and should a sudden change in the weather occur, he sometimes falls down and dies from exhaustion.

The female hornbill often breaks down her cave door with her useful beak, as soon as a couple of her

children are old enough to fly. The opening is then again sealed up, and both parents wait on the imprisoned infants. The eggs are not all laid at the same time, so that one brood is hatched before the other.

The imprisonment is said to be undergone for the

THE TOUCAN.

sake of safety from snakes, tree-lizards, monkeys, and other enemies, which would attack the defenceless young. The exit of the curious bird from her dungeon with her newly-fledged young takes place when the corn is ripe, and she can easily supply herself and them with plentiful food. Another huge-billed bird is the toucan, whose great but lightly made

beak acts as a sheath for his feather-like tongue. He is a native of America. The word "toucan" means *feather* in the language of Brazil.

MAKING A DOOR.

THE beaver is not the only creature who shuts himself and his family up in a sort of clay-built burrow. There is a little bluish bird, rather larger than a sparrow and common in most parts of England, who shows a trace of the same habit. His name of nuthatch is from a French word *hacher*, to chop; we get our word hatchet from the same. And he is so called because his favourite food is nuts, which he chops or breaks open in a clever way with his beak.

In France this bird is named the mason woodpecker because his nest is partly a hole burrowed out in rotten wood with his beak, partly a building of clay and gravel. If this little mason chooses for her nursery a hole in a tree ready made, and if it is larger than she likes, she narrows the doorway with clay or soft earth. Into this she kneads small stones to strengthen her little walls. Should her mud door be broken down, she will mend it. It is supposed that this method of making the entrance as small as possible keeps out enemies, and also prevents the little ones from tumbling out when they begin to get restless in the nest and want to fly too soon.

Though the nuthatch cannot hew out a hole in sound solid timber, she can use her pick-axe beak with great effect upon rotten wood. A nuthatch was

once wounded by accident, and being picked up, was

HOW TO CRACK A NUT.

placed in a cage to be nursed and fed till he was able to fly again.

He remained quiet all the first night, but the next morning he began to batter the cage with his wedge-shaped beak. He took his meals well, but set to work again the moment his hunger was appeased. In hammering he did not perch as other birds do, but, grasping the cage with his large feet, turned himself upon them as upon a pivot and struck with the whole weight of his body; thus his entire form took the shape of a hammer's head, and his feet represented the handle.

The parts of his prison to which he directed most attention were the wooden pillars at the corners; at these he worked with fury; he seemed to think that if he could break through one of these the whole cage would fall to pieces and let him out. Then he found out the door and beat it open with his bill, but it was closed and fastened again more firmly, lest he should escape in his wounded condition. His quick *rap, rap, rap*, sounded like a footman's double knock at some grand mansion in a fashionable London square.

Next he tried to enlarge the hole that had been made for the former occupant's head when drinking. He pushed his head out, but when he found that his body would not follow, drew it back and began digging, hammering, and banging at the circle to make it wider. And he hardly left off for a moment all day.

It was hoped that when the sun went down he would rest, but no, he could not forget that he was in a prison. At intervals of ten minutes the knocking went on, till at last there was a flutter—he fell dead, with dim eyes and ruffled feathers, to the bottom of the cage!

Can anyone doubt the distress felt by a wild bird on being shut up? This poor little thing longed, wounded as he was, to get back to his mate, his little ones, and the green trees. For this he strove till he could strive no more, and died fighting for freedom.

NUTCRACKERS.

PLENTY of empty nutshells are always to be picked up in a wood where hazels grow, even though no boys and girls have been nutting there. It will be seen by carefully examining these that the little people who ate the nuts always broke the shells in one of three different ways.

Either the shells are neatly and equally split into halves, or they have neat round holes drilled near the thicker end, or else they have a jagged hole in one side. Where the split halves are found the squirrel has been at work with his chisel teeth. The dormouse has nibbled out the tidy round holes, and the nut-hatch has broken the ragged ones.

Having picked a nut from a bough or from the ground, the nuthatch flies away with it to some rough-barked tree, fixes the prize in a crack, and, clinging to the trunk above it, deals a shower of sharp blows on the shell. Quickly he cracks a ragged hole, through which he can get out the kernel piecemeal. When he has done he goes away to get another, leaving the broken shell still wedged in the crevice, where one may often find it.

If he should drop his nut, the little fellow catches

it in his beak before it reaches the ground, deftly as a boy would catch a ball. It is wonderful that the nuthatch should have found out that nutshells have something good to eat inside them, it is more wonderful that he should have found out how much more power he can throw into the strokes from his bill by hanging head downwards, while hammering a hole. You may prove this by noticing how much easier it is to drive a nail into the floor than into a wall over your head. A single blow struck at the floor will probably produce an effect equal to three or four struck at the wall. For in the first case you would have to overcome the gravity of the hand and hammer, in the last, the same forces would help the blow.

The nuthatch did not learn the laws of mechanics at school, but in the greenwood he has learnt to profit by them. Plenty of birds can run up a tree, like mice or rats, with the aid of their claws, but very few can run *down* a tree with equal ease and speed. Every experienced climber knows that it is easier and less dangerous to climb up than down a steep place. Some few birds can run a short distance downwards, but the nuthatch is said to be the only British bird who always hunts and rests, by choice, in this inverted position.

Creeping by fits and starts, one might say running about the trunk, he rids the bark of many harmful insects, which his sharp eyes and beak find out. And so, though he may now and then rob a filbert or walnut tree, he does much more good than harm. It is possible to creep so close to a nuthatch at work as to

watch all he does, for he is so much taken up with what he is doing that he does not notice a quiet bystander.

He seems at ease in any position, as he dodges round and round the tree, with a quick flirt of his wings, and glides about upside down or sideways as if he were a fly. His note is very melodious, and has been described well as sounding exactly like that made by a pebble thrown so as to bound along ice.

WHO TAUGHT BRUNEL?

ABOUT three-quarters of a century ago, Mark Isambert Brunel, the great engineer, was standing one day in a shipyard. He was watching the movements of a little animal known as the naval shipworm, *teredo navalis*. A brilliant thought suddenly struck him. This creature was boring his way into a piece of wood, by means of a very wonderful tool, which, like other animal tools, was a part of his own body.

"Why should I not take a lesson from this worm?" thought the ingenious man; "He seems to do easily just the sort of work I am trying to plan." Looking more closely at the shipworm, through a microscope, Brunel found that at one end of his long worm-shaped body he carried a small shell, made of two valves or lids joined together. Between the valves was the creature's foot. Pushing this foot forwards, the shipworm continually gave the shells a twist round.

In this way the shells acted upon the wood like a

gimlet, boring a little tunnel or burrow for the shipworm's body. As the sawdust was scraped out, it passed into a hole in the foot, through his long body, and out at the other end. "Here is the sort of thing I want," said Brunel, "cannot I make something of the same sort?"

At once he set to work, and after failing a good many times, hit upon the famous boring shield with which the Thames Tunnel was dug out. The shipworm is one of the many creatures appointed by Nature to get rid of wooden or vegetable fibre when found in the wrong place. On land many wood-boring insects attack a fallen tree, in order to hasten its decay, that it may make room for new growths.

Under water many creatures also attack timber, and greatly hasten its destruction. The labours of such creatures are not harmful in Nature's world, but helpful, in making old things new. To the works of men these animals might bring ruin. But man can protect his own works, having sense enough to outwit lower creatures of this sort. He can prevent the mischief which shipworms do. In order to stop them from spoiling boats, piers, and woodwork of all kinds lying in salt water, it is only needful to let the wood first lie for a time in water which is filled with iron rust. The shipworms will not touch it after this.

As a rule modern ships are sheathed with iron or copper which is a complete protection. Into fresh water the shipworm never comes, so that inland bridges and river-boats are safe from him. This animal is not a worm, but belongs to the *molluscs* or

mantle-covered animals; thus he is more closely related to snails, slugs, and oysters than to worms.

To another burrowing mollusc, the common piddock, we owe the fact that England is an island. To the fact of its being an island we owe our freedom from foreign invasion. How marvellous that the horrors of war should be prevented by a shellfish! Who could believe that a little creature inside his double shell could dig out the straits of Dover!

THE PIDDOCK'S TOOLS.

Yet it is certain that by turning the chalky soil into a sort of honeycomb by their burrows, the piddocks made it easy for the sea to wash away that part of the land, until our country was separated from the Continent. The piddock's shell works like a steel file, being armed with stony points at the smaller end. The animal works his way into the rock by giving his body a half turn to the right, and then a half turn to the left, as a carpenter uses his bradawl.

He gets rid of the loose chalk by the aid of a syringe inside his body, with which he washes it out at the mouth of the hole. Do not these wondrous workers teach us what great things may spring from very humble toil?

BORING FOR A DINNER.

THE starling is one of our most useful, interesting, and beautiful British birds. Handsome is that handsome does—but he both looks handsome and does handsomely. And he is so good as to give us plenty of chances of watching him, for he comes to dig boldly for grubs on our garden lawns, as well as in the fields.

Running along the ground he seems to listen for what no human ears could hear—the tread of an insect in the grass, or the rustle of some grub moving under the roots. In a moment down darts his sharp beak, he bores a hole in the earth with the speed of lightning, and, pulling out the grub, either swallows it or takes it away to his little ones.

Though at a distance he looks but a smutty fellow, a nearer view shows that his neat glossy feathers glitter like shot silk—each one of them, no matter how small, is tipped with a tiny light spot, as if dipped into cream. These specks shine out like pearls through the rainbow colours which glitter on his neck and back. If you want to watch a starling at his work of boring holes, you must either do it through a telescope:

or field-glass, or else, if you are near him, you had better pretend to be doing something else.

Standing still to stare at him will never do, he finds out in a moment that you are not minding your own business but *his*, and he will be off with a loud impatient shriek. But he allows a quiet passer-by to approach him.

There are no better parents than Mr. and Mrs. Starling. They often build in chimneys or in sheds

“I DIG FOR MY DINNER.”

close to houses, and if they build at all low down, they seem most anxious to prevent anybody from knowing where the home is. This attempt is absurdly futile sometimes, as bundles of rubbish or long straws poking out tell plainly where the furniture has gone in. If the father bird comes with a beakful of caterpillars for his family and finds you standing near the nest he will not go in.

Making an angry croaking, he seems to say, “Aren’t you ashamed of yourself, to spy out a gentleman’s private affairs like this?” And one departs feeling

snubbed. Then he will pop into the cosy bundle of stuff he calls a nest, and either give Mrs. Starling the caterpillars as a token of affection while she sits on her five pale blue eggs, or hand them round to the children. After which he comes out in a great bustle to fetch more.

Very often starlings will share the dovecote with its inmates. From seeing starlings flying in and out of pigeon-houses, people have imagined that they steal the eggs of their gentle neighbours ; but this is a false charge, the pigeons, mild as they are, would not welcome thieves to their abode.

Empty rabbit burrows are sometimes taken as lodgings by starlings.

The affection of these birds for their young is very great, and this was shown a few years ago in a touching way. The barn in which a poor starling had built took fire. She had a nestful of young birds in the thatch, and when she came home and saw the danger, she was in a terrible state of mind. As the flames crept nearer and nearer to her babies' cradle she fluttered in agony round it.

But at last her great love taught her a way to save them. Making a dash at the nest she extricated one of the young birds and carried it away to a safe place. Then she came back for another, and before the fire reached her nest she had rescued all her five children.

These birds are among the farmer's best friends. This is a list of a starling's dainties through the year. January : worms, grubs of cockchafers, and grubs in dung. February : grubs, snails, and slugs. March :

grubs of cockchafer and snails. April: the same. May: the same and grasshoppers. June: flies, and grubs of flies. July: grubs and fresh water shellfish. August: flies, glowworms, and beetles, green locusts, grubs of carrion beetles, and worms. October: worms and beetles. November and December: snails, slugs, and grubs, with hips and haws. To horses, sheep, and cattle, the starling is a benefactor. Perching on their backs he rids them of ticks and stinging flies.

FOLLOW YOUR LEADER.

IN summer, when he cannot get water, the starling sometimes wets his whistle with fruit, but since he does so much to save our crops, gardens, and orchards, we must not be hard on him for this. In fruit gardens lying near streams, the birds scarcely touch the fruit, if at all. Their sense of taste is not keen, they eat it for the sake of moisture.

If pans of water are set near fruit trees in time of drought the birds will drink and will then eat less fruit, or perhaps none at all. They suffer more from thirst in drought and during long frosts than from hunger. As soon as the young are all reared and winter draws near, the starlings collect together in great flocks, and so vast are these armies that, when on the wing, they often darken the air like a cloud.

A most wonderful thing it is that, like a human regiment, the starling army is under the command of one leader, whose voice they all obey. When he drills his

countless troop, they wheel as skilfully as any trained band of soldiers, turning this way or that in exact obedience to some mysterious watchword or signal given by the commander-in-chief, and alighting on the ground just when, where, and how his wisdom sees fit.

When food fails in one part of the country, the starling host migrates to another, always under leadership. When telegraph wires were first put up, many birds bound on these migrations or journeys were killed by flying against them. But with the marvellous power of learning by experience which all animals have, they now know how to fly under or over the wires and escape danger.

Professor Romanes tells of a gentleman living on the north-west coast of Ireland, who noticed large flocks of starlings crossing over every year from Scotland. They always arrived in the morning twilight.

After a time telegraph wires were put up along a road skirting the sea, which the starlings must cross. The first winter after the wires were stretched along the coast, numbers of starlings lay dead or wounded on the roadside, having in their flight at the dusk of dawn struck against the wires. But, strange to say, during the next winter and those that followed it, hardly a single death happened among the flying squadron.

This showed that the starlings had deeply felt the fate of their fellow travellers the year before, and had resolved that no such bad luck should overtake more

of their numbers. Steering clear of the fatal wires they saved themselves. Curious to tell, the young birds who make journeys for the first time seem as expert as their elders in avoiding telegraph wires, though they cannot know that accidents have happened.

This is not supposed to be because they are born with ready-made wit or instinct to avoid the wires, but simply because they are always led by older birds who have made the trip before. "Follow your leader," is their motto, and they find safety by placing implicit trust in him.

Sometimes starlings linger near our houses instead of migrating, and we ought to welcome them for the mixture of odd, sweet, laughable notes which a starling calls his song, if for nothing else. If but a gleam of sun steals across the dreary snow, he begins his cheery music, ruffling his throat as if bursting with delight. After a little stammering and stuttering as if he had a sore throat and were making an apology for not singing louder, out will come a couple of melodious whistles, one up the scale, the other down, as if he were asking himself, "How are you?" and then answering, "Very well, thank you."

When he is tired of that, he will make a noise as if he had a clock inside him which wanted winding up, and then, in soft, mellow, bell-like tones he strikes one! two! three!—on to twelve or twenty o'clock. All the while he shakes his wings, and looks so funny that you cannot help thinking he is making jokes. After his performance, throw him a handful of crumbs!

It is hard to be merry with an empty crop—and he has earned a trifle.

A FLY'S BRADAWL.

EVERYBODY knows Daddy, a kind of crane fly, who, if he should find himself indoors by accident, hardly knows what to do with his long legs and seems anxious to leave them behind him. But everybody does *not* know how useful these giant-stride limbs are to him and to his wife in the open fields. Though Daddy can fly a good way when the sun is hot, as a rule he merely straddles over the grass.

And then his long legs, like half-a-dozen stilts, help him to pass over the blades of grass without losing himself among them as in a thick forest. He can tread on six different blades at once, so that his slight weight hardly bends down their tips, and he keeps well above them as he half flutters, half gallops along.

Belonging to an order of insects called *diptera*, or two-winged flies, the Daddy has but a single pair of wings on his shoulder, but below them are two curious little knobs, named balancers. These are the hinder wings in a changed form, and as they look very much like the weights which the Greek athletes used while leaping, they are named by learned men "halteres" (Greek : *halteres*, weights).

In some unknown way these balancers, small as they are, assist the insect's flight. When Dame Daddy wishes to lay her eggs, she stands nearly upright on her hind legs, which are three times as long as her

body. Then, with the sharply-pointed tubular spear, *ovipositor*, or egg-placer, at her tail, she bores a hole in the ground, turning her body from side to side as a carpenter uses a bradawl. In a little while the end of her body is buried in the ground, an egg passes down

DADDY LONGLEGS AT HOME.

the hollow spear, and lies in the earth. Then she draws out her spear and does the same thing over again till all her eggs are laid. By-and-by they are hatched, and grubs covered with a tough hard skin creep out and begin to burrow. They have no legs or limbs of

any sort, but a pair of strong jaws which enable them to cut their way through the roots of grass and plants. In time the leather-jackets, as these grubs are named from their tough coats, grow to be about an inch long. You may fancy that it is not good for the grass to have quantities of these underground creatures always gnawing at its roots, and sometimes whole acres of pasture are made brown and bare by them.

It is doubtful whether they *eat* the roots. The great naturalist, Réaumur, thought that they lived as earth-worms do, by swallowing earth. But in places where the birds and animals that prey on them have been foolishly shot, or scared away, leather-jackets lay the fields waste by burrowing here and there. A square foot of turf taken from a field was found to contain 210 grubs of a crane fly.

After remaining under ground for about three months, the grub sleeps awhile in the form of a pupa or chrysalis, after which it pokes a long nose or beak upwards into the light of day, and comes out a winged fly. At this period the grub has legs and wings like its parent, but its jaws have been changed into a long snout or beak for sucking juices.

If kept well in check by the rook, starling, sparrow, hedgehog, and mole, such grubs as these would do little if any harm. In a world without men they would do good by pruning the roots of plants, letting in air, and loosening the soil. What seems *destruction* is a needful part of *creation*. Plants will not thrive unless pruned and weeded out, the old, rank, worn-out ones must be removed to make way for the new.

Where men grow crops, grubs are not wanted, and the birds will get rid of them if allowed. A rook was once shot, and in his beak were twenty-one leather-jackets, which he was carrying home to his little ones. So the farmer lost a good friend. Whole crowds of sparrows, though they cannot dig for the grubs, are of immense use in the fields, where they may be seen chasing and killing the daddy-longlegs on the wing, thus preventing eggs from being laid by the full-grown insects.

CRAWLERS AND LEAPERS.

THE VIPER'S POISON BAG,

which he carries in his mouth, is filled with a liquid that stupefies and quickly kills the creature on which he intends to feed. He is our only poisonous English snake, and may at once be distinguished from all others by the curious marks on his head. One of these markings looks like a capital "V"; thus the viper carries his initial stamped over his brow.

The tail of the viper is blunter at the tip than that of other British snakes, and he is the only one which has a broad zigzag line traced down the whole length of his back. When the viper meditates an attack, he raises his head, and then, with a blow rather than a bite, plunges his poison fangs into the flesh of his prey. The poison tooth is hollow, and at its root lies a gland or bag filled with venom. When pressed, the gland causes a little drop of the poison to run down through the hollow tube of the tooth, and thence the liquid passes into the wound through a small slit in its side near the point.

Though awful and thrilling tales have been told touching the dangerous nature of this snake, his bite is far less deadly than is supposed, and it is even

doubtful whether we have a single proven case of a death having resulted from it. Though the dose of poison is sufficiently virulent to kill a small animal, it would take a great many doses to destroy a *healthy* man, woman, or child. The poison is a juice used as a digestive fluid. All animals possess some of it in their saliva, you and I included. But the viper has this

THE VIPER.

juice in a strong or *concentrated* form. In the first place the creature always prefers to glide quietly away if allowed to do so, and, secondly, the ill-effects of his poison may easily be guarded against should the viper be brought accidentally to bay.

Those who are obliged to walk where vipers abound, or to work in places which they frequent, run the risk of stepping on them ; otherwise, they are not likely to be attacked. These individuals ought to wear stout

boots and high leather leggings, also to carry a small bottle of liquid ammonia in the pocket.

Should a bite occur, the place must be well sucked and the ammonia thoroughly rubbed in. Little harm is likely to follow after these precautions. The poison of this despised reptile has been used by homeopathsists as an opiate or sleeping draught, and is called "Lachesis." It is likely, therefore, that it lulls the pain of the creature upon whom it is used.

Much good is done by all snakes, for they destroy small enemies to the crops, such as mice, rats, beetles, etc. All other snakes which we are likely to meet in the fields are not only harmless, but are of great service also.

The movements of snakes are most beautiful, owing to their exquisite structure. The spine of a serpent consists of a delicate, tapering chainwork of bones, fitted together in a perfect way. Its graceful, gliding motion is accomplished by means of a series of levers, the ribs and backbone combining to form them, while the scales, by gripping the ground, prevent the creature from sliding backwards, for they are placed with their outer edges turned all one way—towards the tail. It is all but impossible for the enemy of a snake to pull him out of his hole when he has gone down into it head foremost. He has the power of clinging to its sides by sticking out his scales.

HARMLESS SNAKES.

ONCE a year, or oftener, the snake sheds his skin, and it may be found, like a thin clear coat of mail, hanging in the place which its master chose for changing his clothes in. Not long ago I found one of these cast

A HARMLESS SNAKE.

skins sticking in a piece of wire netting, through one of the holes in which the creature had crawled on purpose to disengage himself from his coat.

It was nearly as transparent as glass, and even the two thin plates which covered his eyes were there, looking like a pair of spectacles. It was clever of the snake to have found out quite a new use for wire

netting. Generally, he will creep through a prickly bush, and leave his old garment behind him, sticking to the thorns.

In some places countrymen and lads pick up the cast-off mantle of the hedge snake and twist it round their hats as an ornament, where it glitters like a band of silver lace. I met my friend the owner of the old skin not far from the wire netting with which he had chosen to undress himself. He looked fresh and clean in his new suit, and he was over a yard in length.

As soon as he saw me near, he gave a gentle hiss, as if to say, "Don't step on me, please, or break my poor back with a stick, or throw stones at me. I only hiss because I have no other way of talking; please let me go by, for I do nobody any harm." And so I stood still for a moment to let him cross my path, for his home lay on the other side, and he was afraid to go to it while I was passing along. Snakes will always travel in a straight line towards their hole when frightened, if they can. The best thing to do on finding one is to stand aside and let it do this.

WAKING UP.

ANY person who is walking on the first warm spring morning in the country will most likely hear, beside some sunny bank, a soft rustle now and then among the dry grass and leaves. Sometimes the whole hedge-side will seem to be agitated and alive with small living creatures, who have just awakened after their long winter sleep. They are feeling gay and merry now,

and as they find their tools ready for use, are all looking out for something to eat, or to build houses with.

Among these happy creatures there are sure to be plenty of snakes, and also of those pretty and graceful little animals called blindworms. Though he looks like a small snake, the blindworm is not a serpent at

THE BLINDWORM.

all, but is a kind of lizard without any legs so far as we can see. The bones of his spine, however, show traces of limbs for walking.

His family, perhaps, never took much exercise, or travelled far, and formed stay-at-home habits instead. Creatures and men are alike in this. Every power which is not used is apt to leave us, while, as everybody

knows, the more we exercise ourselves in anything, the more proficient we become. The muscles in the legs of a man who walks much will be twice as large and strong as those of a man who sits down the whole day, or who lies in bed.

It may be, that once upon a time, the blindworms had legs like other lizards, but that some of his tribe began living in a hole, and feeding on the slugs which crept in and out, instead of hunting for flies like the rest. Their young ones kept to the same habits, and by degrees, as they did not use their legs, these limbs gradually dwindled away, as the wings of the ostrich have almost done.

Let it be a warning to us to make use of our hands and arms, yes, and of our brains and hearts too, lest we find that by degrees our power of working, thinking, and loving is becoming less instead of greater.

But doubtless it is for a useful reason that the limbs of the pretty little blindworm fail to carry him far, and that he is a tranquil, quiet, contented creature. He is exactly modified, so as to do his work, which seems to be eating slugs all day long. His tool is his tongue, and he uses it well. He has no defensive weapons, nor is he able to move fast, so nature has taught him a very wonderful way of preserving his life.

THE BLINDWORM'S PLAN

is to break himself in two, and try to deceive his enemy into the idea that the tail-piece is his whole body, while he softly steals away in the opposite

direction. If he is in great terror his whole body will become stiff, and his tail as brittle as if it were made of glass.

At the least touch, or even with a sudden twist or jerk of his slender frame, the blindworm breaks off a portion of his tail. The broken piece wriggles and dances as if it were alive, in such an extraordinary way that you cannot help looking at it, and while you are wondering at the funny capers which the bit of tail cuts, its master steals cunningly off and saves his head with the rest of his body. He soon grows a new tail in the place of the old one. The body of this little reptile is covered with a coat of very fine silvery scales, and he has a pair of most lovely bright eyes, which sparkle like jewels. The little fellow feels the least cold very severely, and should he be overtaken by frost before he has found a winter refuge in which to slumber, will have to lie benumbed by the roadside.

Should cruel people find him in this helpless state, and without power to use his simple little trick for getting away, his life will be in great danger. Should he, however, fall into merciful hands, he may soon be tamed, and after being hospitably sheltered through the bitter months, may again be allowed to go free.

Often he will establish himself in the garden, where he is most useful, but as no creature is happy alone, he is likely to rove unless his wife and family are with him. The little scarlet forked tongue of the blindworm has no poisonous office, and he swallows his slugs whole, as a boa-constrictor would swallow a deer.

His jaws and his tongue, which acts as a sort of

feeler, are his tools, and by means of them he earns an honest living without troubling anybody. Those creatures which are vegetable feeders have their tools *modified* in order to enable them to obtain the sort of food which suits them best, and, as they are mostly of a timid disposition, they are either fleet of foot or gifted with keen senses, so as to be warned in time of the approach of danger.

So perfectly are the tools which an animal carries suited to his needs, that by looking at them we can form a very good guess what his mode of life is.

HOP, SKIP, AND JUMP.

THE hind legs of all leaping animals are made on the same plan, from the kangaroo to the flea. The largest leaper who gives suck to her young is the kangaroo. She can hop over fifteen feet of ground at one leap, carrying her little one in her pouch, and using her tail as a sort of balancing pole.

The smallest jumper who suckles her young is the jerboa ; she leaves her babies at home inside her sand house. The poet Browning says of the three-toed Egyptian jerboa :

“There are none such as he for a wonder, half bird and half mouse.”

Indeed this little fellow looks like a mouse on stilts, or a small bird without a beak dressed in fur, not feathers. He can clear three yards at one leap, about

sixteen times the length of his body, and it is said that he can keep pace with the swiftest horse.

But there is one little friend of our own to be found in almost every moist meadow, whose jump is equal to any of theirs. Froggy, with his bright eyes, graceful shape, and damp, cool skin, does very well too without any tail to act as prop, a spring or balancer. If you and I were as nimble as he is, it would be nothing for us to jump over the house, leaping up from the back garden, and come down to squat comfortably in the front, staring calmly at the sky as if nothing had occurred.

All through his life very wonderful things are happening to him. He under-

THE JERBOA.

goes as many changes as a butterfly, but keeps awake all the time. First he is an egg, next a tadpole, very like a little fish, and after that he is a quadruped. The frog's way of travelling across dry land, by long leaps, prevents his skin from parching up. If, when his ditch is dry in summer-time, he were obliged to crawl slowly over the hot ground he would suffer much and then die.

His skin can absorb a good deal of water, as blotting-paper does, and, as he scarcely touches the ground in travelling and always chooses a dewy evening for his journey if he can, he manages well. The toad does

not mind crawling over dusty roads because he carries little sacs or bags of liquid in his skin to refresh it.

There are about one thousand different kinds of frogs, found in all parts of the world, the largest living in tropical lands. Dr. Livingstone, when passing through Southern Africa, was surprised one evening to hear the loud croaking of big bull-frogs, in the midst of a dry sandy desert. "They were merry on nothing but a prospect of rain," he writes.

But how could such creatures keep themselves alive in such a spot? These patient frogs dig holes under the bushes, and sit in them till a thunderstorm comes to fill the pools. Then they rush out to get a bath and enjoy life. When one of them is once at the bottom of his hole, he does not often come out, and a large kind of spider is fond of spinning his web across the hole.

Thus the frog gets a window or screen for nothing, and few of his enemies would think of looking for a frog in a hole across which a spider had spun. He must often owe his life to the spider, who helps to hide his doorway by drawing a silken curtain across it.

Though the common English frog may well feel vain of his jump, it is nothing to what some of his foreign friends can do. His own toes are pointed, the hind pair being webbed, but other members of his family have taken to living in the trees, and they have grown a little round sucker at the tip of each toe, so that they can creep and climb as easily as flies.

FROGS AT HOME AND ABROAD.

MOST of the tree-frogs are bright green, and match the colour of the leaves so closely that it is very difficult to distinguish them. And many of them have the power of changing colour, like the chameleon, when it suits them to alter their dwelling-place.

Sir Emerson Tennant says that a frog who is as green as a leaf to-day will be gray, spotted with black, to-morrow. One of these beautiful little creatures came into his room, and sat on the gilt pillar of a lamp. This frog turned golden in a few minutes, so that he looked just like a bit of the ornament to which he clung. Our own common frog has the same power, though in a less degree. Frogs living in the dark turn nearly white, and become greener or browner, more or less mottled with black, to match the tints among which they dwell.

This is a protection to them, and where frogs are very brightly coloured and cannot change their tint, they taste so nasty that nothing will eat them. Darwin speaks of a little frog seen by Belt in La Plata, which was dressed in a bright suit of red and blue. He took no trouble to hide, but hopped boldly about in broad daylight. The moment that Mr. Belt saw him, he felt sure that he was uneatable. And so it proved, for a young duck who snatched him up dropped him at once, and went off shaking her head, as if to get rid of the horrid taste in her mouth.

Not content with mere climbing, one ambitious frog has learnt to fly, or rather, to take flying leaps from a high tree to the ground. When a Chinese workman in Borneo told Mr. Wallace, the traveller, that he had just seen a large frog fly down from a tree, the tale was hardly believed, but the Javan flying frog is now well known.

His body is about as big as that of our common frog, four inches long, and in jumping he spreads out his large webbed feet. The four webs taken together cover a surface of twelve square inches, so that they offer much resistance to the air, and make a good parachute. Though they try to imitate birds, all frogs are born in the mud, and know that their young must be born there too. So they descend to lay their eggs.

A tree-frog of Brazil builds nests in the water, or rather, makes little round pools, surrounded by a regular mud wall. On a still evening masses of mud, carried by frogs, are seen to rise above the pool's surface, pushed up by them. At first two mysterious hands holding and smoothing mud is all that can be seen.

It is the mother frog who builds, patting and daubing her round wall as well as a mason with his trowel. The ring of mud which is the rim of the nest, rises four inches above the water, and then she must come further out too. It is, of course, meant as a protection from fishes, etc., for the eggs which are to be laid inside. The bottom of the nest is smoothed and shaped by the body and hands. All the time that she

busy, her mate, though he does not put a finger to the work, insists on sitting upon his wife's back as if to superintend.

But there are frogs who are capital fathers. What would you say to a father frog who nursed his little

THE COMMON FROG.

ones in a pouch inside his throat? There is such a frog. He swallows the eggs as soon as they are laid, hatches them in his throat, and sends them out into the world as tadpoles when they are fit.

Darwin found this nursing father in Chili, and he is named after the great man "Darwin's frog." From the giant bull-frog of Africa and America, with a body

nine inches long, to the tiny tree-frogs, the smallest of which measures barely one inch and a half, all are alike in one particular. They all prey on living insects and small creeping things, which they catch with their long tongues. One large Indian frog is said to capture little birds. We cannot be too grateful to the race of frogs, they are among the most precious of the world's workers. If the insects, grubs, and worms eaten by frogs were allowed to live, they would make this globe unfit for our abode.

MERRY MINSTRELS.

SOME insects are formed, as one may say, on the same pattern as the kangaroo or the jerboa, that they may save themselves from birds and other enemies by leaping beyond their reach.

The thigh of a grasshopper is a splendid example of the way in which the fore limbs of an insect may be suited to its needs. When he wants to leap, the grasshopper draws up his long jumpers till the shank and thigh nearly or quite touch each other, making an acute angle or point like a very sharp elbow. And at the same time he plants his little hooked feet firmly.

Then, suddenly straightening the legs he springs forward, often to a distance of two hundred times his own length. Carriage springs, made to imitate the way in which a grasshopper holds his legs when drawn up for a leap, are called "grasshopper springs."

He is a pretty merry little minstrel, and though,

like his small dusky relation, the house cricket, he has no voice, the male insect contrives to make music without one. His mate has nothing to do but listen in silence, she cannot say a word in any way whatever.

The cheerful "Grig-grig-grig" which tells where the cricket is hidden among the ashes, or where the grasshopper perches his light weight on a grass stem in the sunshine is made by the same instrument. It might be called a tiny fiddle, a file, or bow, being drawn across a sounding-board.

When he wishes to strike up a tune, the grasshopper or cricket slightly lifts his folded wings beneath their covers, and quickly rubs them together. Each wing has raised ribs, with a toothed file-like surface, and when these scrape each other they make a

JUMPING FOR JOY.

noise. And under them lies the sounding-board, which is made of a clear round plate, also part of the wing. The noise of the files makes this plate vibrate or tremble, and thus the sound is made louder, as the parchment of a drum makes the blow of the drumstick resound.

The mother grasshopper carries a spear at her tail, with which to pierce the ground and drop in her eggs. Her little ones when hatched look much like herself, only very small. At the first touch of frost she dies.

As the young grow up they change their skins

several times, and this is a severe task for the poor little things. Creeping into a quiet corner the young grasshopper twists, turns, struggles, and puts out all his feeble strength to get rid of the old tight coat. At last, if he does not die in the effort, he comes out freshly dressed in green.

By-and-by a pair of wings begin to show themselves under the skin of the back ; after the last moult the grasshopper can fly ; but he never makes protracted flights. Like the flying fish, he merely lengthens his leap through the air. It is perhaps because the grasshopper is a short-sighted insect that he flies so little.

Those insects which fly far, like the dragon-fly, have large rounded eyes, set so that they see for a great distance. Others, like bees, can fly best *upwards*, *downwards*, and *forwards*, but not so well from side to side. This is because their eyes are long and narrow, seeing well what is above, below, and in front, but with a limited vision at the sides.

Some near relations of the grasshopper's—the earwigs, who fly little and crawl much, have very small eyes set on the top of their flat heads. Some other cousins of his, the locusts, are terrible destroyers. The grasshopper also would be harmful to grass, trees, and crops, if birds did not keep him in check. Where his enemies have not all been killed he does no harm, and certainly adds a charm to the fields where “all the summer with a tuneful wing,” he

“Makes merry chirpings in his grassy nest,
Inspired with dew to leap and sing.”

WINGS OR FINS?

TO save their lives from other creatures, to procure food, or to protect their young, animals are often found doing things which seem against their will and contrary to their habits. Some of the ways which birds, animals, and fishes have taken up, would seem im-

A LONG LEAP.

possible did we not know how marvellous a power works in their bodies to shape and alter them for new surroundings.

There are birds who, like the penguin, seem quite at home under water, swimming after their prey like fishes. There are mammals like the bat who have learnt to get their living in the air like birds, there are fishes who have found out that they can, for a time, live out

of water. The fins of these air-loving fishes have grown long and strong, like a swallow's wings. The pectoral or breast fins are those by which the common flying fish supports himself awhile in the air after taking his leap from the waves. There are about forty species of flying fish, and they differ much in the length of their breast fins. In some fishes these reach as far as the tail, and long-finned kinds can take better flights than fishes with shorter fins.

It is most likely that these fishes learnt to fly in the first case by just taking a little jump out of the sea to escape big fishes of prey who were chasing them. They leaped out in despair, and found that by leaping and trusting themselves to the air, their lives were saved. Little by little their fins grew as they were thus used, till their owners were able to skim along for longer and longer distances. This showed great discretion on their part. Mother Nature helps those who help themselves, she always rewards *effort* in man, woman, child, or beast.

At last it would appear as if the flying fish learnt to *enjoy* his trip through the air, for nowadays they seem to take wing without any other reason than a wish to disport themselves. In fine weather, the flying fish is able to clear three hundred yards by his leap, upheld by the parachute-like wings. The fins are not flapped, but act as supports to the body as it cuts its way through the air, sent onwards by the force of the first leap from the sea.

Some careful observers who have watched flocks of flying fish with a telescope, have noticed a quivering

or vibration of the wing-fins, this may or may not assist flight. Whether it does or not, this quiver of the fins is most likely the movement made by them while swimming. It does not last long after the fish leaves the water, he holds his fins still when fairly started. When sea-birds try to pounce on flying fish, they drop down again into the sea, far enough from the spot where their watery foes saw them disappear. It must astonish the other fishes to see their meal suddenly take wing from between their very jaws, and some of them try to spring out after it. But the flying fish has powers which his larger finny relations have not. Besides the long fins, he has a very big air-bladder, which, when he likes to puff it out, will hold a large quantity of air. It fills a great part of his body. Also he has a *membrane* or skin in his mouth which will hold much air, and this he can fill from his gills. In this way his whole frame is made light, as that of a bird is by his air-cells and hollow bones.

THE SKIP-JACK BEETLE.

AMONG the many creatures useful in lands not inhabited by man, but harmful to his crops, is the wire-worm. This is one of the farmer's most dreaded foes, though, strange to say, he is often so foolish as to kill the rooks, starlings, and moles who rid his fields of them. The wire-worm is the grub of a curious beetle, one of the skip-jacks.

These beetles are so called from a peculiar habit of

leaping or skipping from the ground. They are not good flyers, nor active runners, their legs are short and their bodies slender and weak. Life, however, is sweet to them, and in order to save it they drop down to the earth and lie upon their backs when frightened. It is difficult for birds or any other enemies to discern them lying still among the dry herbage, dead leaves, or other rubbish which covers the ground.

But the skip-jack, when he is tired of pretending to be dead, and thinks the danger gone, finds himself in a predicament. His legs are so short that when once on his back, he cannot get up again. He would be obliged to stay there for the rest of his life, kicking them helplessly in the air, if it were not for a useful tool which he carries in his chest.

This is a wonderful tool indeed, a sort of spring, which consists of a short dagger-like spike or spine sticking out from the surface of his thorax or chest, and fitting into a little sheath made on purpose for it, between the middle pair of his six legs. This dagger is called the *mucro*. When he wants to get up the ship-jack uses his *mucro*.

First he arches his body as much as he can, till nothing but his head and tail or abdomen touch the ground. This pulls the dagger from its sheath. Then he suddenly twists himself just in the opposite way, the *mucro* springs back into its sheath, and in doing this the bases of his wing-cases strike sharply and strongly against the ground. The end of the abdomen and the wing-cases now act as a lever, and jerk his body into the air. As he is coming down, he manages

to turn round so as to fall on his feet. But if he has the misfortune to find himself on his back instead, he goes on skipping till he comes right.

On a quiet summer evening the ticking sound made by these beetles may plainly be heard, and has earned for them the name of click beetles. There are some kinds of click beetles who lay their eggs in rotten wood, but the parent of the terrible wire-worm pierces the ground and deposits them beneath its surface.

The destructive grub that comes from them lives five years underground, burrowing darkly among the roots of nearly every crop which affords food for man and beast. There is hardly any cultivated plant which he does not destroy. Lands infested with

GETTING UP.

wire-worms should be often ploughed up and allowed to lie fallow, given over to the moles and birds for a time. These worms must starve without vegetable food, and they become a plague only where the soil is never cleared or disturbed.

Besides welcoming digging birds to his fields, who can detect the grubs in the ground where no man can either hear or see them, the farmer should be grateful to those which kill the full-grown beetles, preventing them from laying eggs. Some skip-jack beetles are busy by day, others at night. Magpies, jays, kestrels, sparrows, and a host of other birds, foolishly persecuted by gamekeepers and farmers, feed on them.

By night the hedgehog, owl, and nightjar devour all that they can find.

LEAPING FOR LIFE.

WHEN an old Greek poet (Aristophanes) wished to make the great and good Socrates appear ridiculous, he accused him of "measuring the leap of a flea."

The days of feeling contempt for any living creature, or for those who study it, have long died out, and many scientific men of modern times have done this very thing without being laughed at.

Nobody is scorned nowadays for knowing that this wonderful insect is able to leap about one hundred times its own length. This, supposing it to be a full-sized or *female* flea, for the *males* are smaller, would mean jumping one foot into the air. If a man were made in the same way he would be able to spring over the dome of St. Paul's Cathedral.

This insect leaps for his life, not for pleasure. Nature has given this power to his race to protect it. —Yes, Nature protects even the flea, because she has a use for him; just as she has for the clothes-moth, the bluebottle fly, the cockroach, the rat, and many another creature despised and misunderstood by man.

The office of the flea is that of a scavenger. But this work is done in the early stage of his life, his only duty afterwards being to provide for a future family.

The female flea lays her eggs in dust and dirt. She chooses, in particular, carpets, mats, and rugs that are seldom or never swept and shaken. Why? Just as

the mother butterfly knows on what plant her children will feed, and takes care to place her eggs on no other, the mother flea knows that her young feed on such bits of dry animal matter as hairs, morsels of skin, and other dust which have once been part of a living creature.

Larva.

Pupa.

Perfect Insect.

THE COMMON FLEA GREATLY MAGNIFIED.

Thus unclean skins and furs of slain beasts, often used as hearthrugs, etc., are a fine nursery for her. A store of food, in the shape of little grains of dried blood, is found among her eggs. This she lays up for her young to eat when first they come from the egg, in case they are not able to find enough near at hand.

These little balls she gets from her own inside, after her own meal, as a sea-gull or a pigeon ejects food for its nestlings.

She is the only insect who makes so intelligent a provision as this for her offspring.

From the eggs are hatched not brown leaping fleas, but whitish, footless, wormlike maggots, whose bodies are covered with long hairs. In this stage young fleas were seen by Rösel, a naturalist, who watched them with great interest, to feed on dead flies.

In about twelve days the maggot or larva spins a little cocoon of silk, in which, as a pupa or chrysalis, the creature is to undergo its change into a perfect flea.

It soon loses the maggot form, and signs of a jointed body with strong spiny legs appear. There are also traces of wings, but these never grow.

After a fortnight the full-grown flea comes out. And then, for the first time in his life he thirsts, like the gnat, for human blood.

His jaws are gone, and instead of them he has a most peculiar mouth, complete as a surgeon's case of lancets. The flea cannot bite: he *stabs* with a sort of beak. This beak is made of an outside jointed sheath, with a tube inside it. Underneath this pricking instrument are two long sharp lancets, with cutting saw-like edges. With these the flea cuts or tears open the skin and irritates it to make the blood flow.

The body of a flea is divided into thirteen joints or segments, covered with shelly skin, and each of his six legs is exquisitely made, ending in a little five-

jointed tarsus, or foot. Under the microscope he is a beautiful object.

Though gifted with sense enough to take care of their own lives and that of their young, no fleas can be trained, as people used to think, to be performers of tricks.

The silly and vulgar exhibitions of "learned fleas" were got up by means of invisible wires. In their struggles to escape the insects appeared to waltz, play on instruments, draw carriages, fight duels, and do many other impossible things. The people who wasted time and much cleverness on these fleas might have made a better use of their talents.

The history of the flea teaches that *Nature hates dirt*. If men and women will not keep themselves and their homes clean, she sends a messenger to do it for them, and punishes them at the same time for their sloth. An old rhyme says :

"Where wormwood hath seed get a handful or two
To save against March, to make flea to refrain.
Where chambere is sweeped and wormwood is strown,
No flea for his life will abide to be known."

But it is the *sweeped chambere*, not the *wormwood*, that frightens the fleas.

TOILERS AND SPINNERS.

A BIRD'S NEEDLE AND THREAD.

THE pair of pincers with which the little feathered father and mother weave their neat and pretty cradle

A BIRD'S NEEDLEWORK.

is as good as a needle and thread, thimble, and scissors, all in one. There is a bird who really and truly knows how to sew. This is the tailor bird, a native of India.

She finds a leaf of the right size and shape, and laces the two sides together till they form a pointed hollow cup, shaped like an old-fashioned extinguisher. Using her beak as a shoemaker might use his awl, she first pierces a row of

holes down each side of the leaf, and then, fetching a tough piece of fibre from some plant to use as her thread, the industrious little seamstress passes it through the holes, drawing the edges of the leaf together.

When her cup is finished, she fills it with soft down, like cotton wool. Thus she forms a warm bed, which is well hidden among the green leaves, since its outer part is formed of a leaf and swings in the breeze like the rest. In spring-time swallows may be seen making use of their beaks as a mason uses his trowel, to daub the mud walls of their nests, erected against our own dwellings.

But more curious still are the great umbrellas of clay built round the trunks of trees by the Cape birds, who like to live together in great companies under the same roof.

A BIRD'S UMBRELLA.

WRAPPED UP IN A BLANKET.

WONDERFUL tools, wonderfully used, however, do not belong to out-door creatures alone. There is a tiny visitor to our own cupboards, never welcome there, yet persistent in coming to take up his abode wherever stores of woollen goods are put carelessly away and neglected.

In Nature's great household nothing is allowed to lie about and decay. In earth, air, and water alike,

even in our own houses, there are fitting scavengers who get rid of what is not wanted, and if we carry portions of the hair, wool, and skin of animals indoors to keep, we shall find that these scavengers will follow to clear up what it would be their duty to consume elsewhere. Nobody is glad to see the clothes-moth in the wardrobe, yet little as we may wish him to nibble our garments, we cannot help admiring the wonderful manner in which he wraps himself up in a small warm blanket of his own making.

The eggs from which these clever caterpillars creep are laid by a very small moth, dressed in a tippet of silver-gray, who hurries away to hide as fast as she can when she sees you coming, but does not often fly. She has sense enough to place her eggs where her young will find plenty to eat when they are hatched, and, as she is able to creep through the keyhole or under the door, she is likely to find her way easily among the housewife's stores.

A grub of a dull whitish colour, and with a reddish-brown head, comes from each egg, and makes for itself a little case or covering by cutting the wool or hair from the cloth on which it was born, mowing it as a man might cut grass. With these fibres it weaves a sort of little rug, with a lining of silk which it spins from its own mouth.

Its jaws act like a pair of scissors, and having made a little coat for itself the creature begins to feed on the same material as it used for building, by which it is surrounded. As its case matches the cloth upon which it browses, it is not easily seen.

After taking all this trouble to make itself a coat, the sagacious little grub is, of course, anxious to keep it in good repair, and as he is always growing, his suit is constantly becoming too short and too narrow. Before he has been alive many days the grub is obliged to patch up his clothes, because they have become too tight for him.

- a. Caterpillar feeding in case.*
b. Caterpillar and case.
c. Case cut open by the insect for enlarging it.
d. e. Moths in perfect state.

A RUG-MAKER.

And he is quite competent to set about this task. No clumsy or careless work will do for him ; the neatest possible job must be made. The case must be made both longer and broader, and if he hastily split the little blanket in which he is wrapped all the way down at once, his body would be left exposed to cold and other dangers.

GRUBS THAT CAN SEW.

JUST as a well-taught needlewoman might do, the grub begins to let in what dressmakers call "gussets"—that is, three-cornered bits of cloth. With the scissors which he carries in the shape of jaws he first snips one side of his case halfway down as far as the middle, and then puts in a patch, or gusset, woven by himself.

When this is done, he repeats the process, beginning from the other end of his case, so that he has now let in a strip of new cloth the whole length of it, for the two patches meet in the middle. His gussets are broadest in the middle, for he will need most space there to turn round in.

But he is not content to widen his tent by a single stripe of new cloth; he now begins to make a second stripe in the same way on the other side, so that he lets in four gussets altogether. The case being now wide enough, he next adds a bit at each end in the form of a ring, mixing the shreds always with silk from his inside. The shreds themselves are taken from the cloth.

While at work, the little inmate of the tube never leaves his dwelling. His body is so elastic that he is able to stretch it out to either end of the tube while some of his legs still cling to it inside. By moving one of these grubs to cloths of different colours, he may be induced to make his little rug look like a tiny

Scotch plaid, for he will patch it from time to time, using whatever cloth he finds himself upon.

While walking about browsing on wool as a sheep does on grass, the grub keeps his head and the three first joints of his body, bearing his walking legs, outside his house; the rest of his body, and the other feet, or "claspers," are kept inside, being utilized for dragging the case along.

After a while this skilful caterpillar changes into a small chrysalis, and then into a moth, which lays eggs and dies. Other grubs very like this one attack wool, feathers, carpets, and horse-hair, as well as the dried-up skins and portions of animals' bodies which they find indoors or out.

They are among the most useful of Nature's scavengers, clearing away much dry rubbish which would cause unwholesome dust. Such things as furs, skins, stuffed birds, and cabinets filled with dead insects have no business in our houses; and if people insist on keeping them they must not blame the moths and Nature's other servants who come to do their duty by eating up the refuse which is unhealthy.

Even the little chaffinch, who finds a shred of cloth nailed to a garden wall and steals it to line her nest with, often finds a tiny destroyer in the shape of a clothes-moth grub eating her scrap of upholstery. The nests of birds are not free from these little robbers, but they are quickly snapped up by the birds' beaks when found.

In time, perhaps, we may learn to do without wool,

since of late so many beautiful, cheap, and good fabrics, such as that called flannelette, are woven out of cotton. As no grubs ever infest cotton goods, our houses may then be free from these little intruders. As men become more and more civilized, the need for using the coats of animals for human dress seems to become less and less, since silk and cotton goods grow cheaper and better.

A HOUSE BUILT OF SHELLS.

BY no means unlike the house of the clothes-moth grub is that built by the caddis worm, that interesting creature who, for a few summer weeks, may be seen creeping about over the bottom of a stream or pool, groping eagerly as it goes for the food it needs.

But he is not exclusively a vegetable feeder. The caddis worm preys on small living creatures, and by clearing the water of them, he helps to purify it. Sometimes this strange grub may be seen climbing the stem of a weed, seeming to be a good deal troubled by the case which he carries on his back, which is not unlike the tube of a clothes-moth grub, but is made of different materials.

In reality, the caddis is *helped* instead of being *hindered* by his tube, for it acts like ballast, or as a weight to sink its little master to the bottom when he wishes to go there. Again, his home is a sort of anchor to the caddis, preventing him from being swept away by the current, as well as a protective armour to his soft body.

Without his house he is but a feeble-bodied creature, and like the snail he retreats into his shelter in time of danger. The caddis uses the building tools which he has in a very adroit manner, and always contrives to build his house out of the materials which he finds scattered around him.

His little home looks just like a bit of the mud, or weed, or gravel in which he lives. There are several kinds of caddis worm, and each likes to build after his own fashion. One species will cut short neat bits of

HOUSES OF CADDIS WORMS.

crow-foot stem, and fasten them round himself till he looks like a tiny walking faggot.

Another will cover his tube with bits of duck-weed, and stroll about like "Jack-in-the-green." Some caddises will stick small shells to their backs, bringing glue from their mouths, and always weaving first a little vest of silk as a lining for the tube.

But the most remarkable thing about the caddis worm is that, if by any accident he should find himself in a new place, he at once sets to work with frantic haste to patch his quaint dwelling so that it may not look different from the new country.

Should violent thunder showers swell his little ditch or streamlet till it becomes a torrent and sweeps him far away from his native land, he begins to pick up bits and scraps of straw or whatever he finds in the strange place to disguise himself with. He disguises himself thus as a safeguard against being eaten by fish or other water creatures bigger than himself, and also as a means of enabling himself to feed.

He would soon die of starvation if he were not able to creep close to his prey so as to pounce on it without being seen, for he cannot move fast, carrying his house on his back.

When his life as a grub is over, he drags his case close to the top of the water, seals up the door of his room with a little grating of silk, and after sleeping within for about a fortnight comes forth a slender and beautiful winged insect called the caddis fly or water moth.

The rest of his life is spent in a gay and giddy dance over the water, into which the female drops her eggs to become new caddis worms. Enjoyment and pleasure are always mixed up with the toils of animals, except when they have hard human masters. Even the smallest insect has its task set for it and must work before it can feed, yet the labour is not cruel, and the joy is great.

TONGUE OF THE HONEY BEE.

PEOPLE talk a great deal about the industry of the "busy bee," and fancy that he goes to and fro in a

careworn and anxious fashion, laying up honey for a rainy day which other people take away as fast as he makes it. But, as a matter of fact, this little honey merchant amuses himself and enjoys life quite as much as the butterflies, whom some folk call idle.

There can be no doubt that this little fellow delights in sucking the juice from the flowers, which he visits, by means of his wonderful tongue or trunk, and putting it down his own throat, which is the first part of his honey-making. His life is passed in sipping sweets, which he carries to the hive and then disgorges.

Except when he is building cells, the bee is nearly always feasting. The tongue, which is a perfect box of tools all

TONGUE OF A BEE.

in one, is very curiously divided. The two outside parts are little lancets, and are used by the enterprising little fellow to push aside those parts of folded flowers which he wishes to open.

The two shorter feelers, closely joined to the long middle portion, are used, it is thought, for storing up the flower-dust, which the bee carries home in his pocket or basket. The middle part of the tongue or trunk, which is the longest, has the power of swelling at the root, so as to hold flower juices or nectar, which the bee licks or sucks up.

When this end is full of sweets, these are passed to the root, and thence into the first stomach of the bee, where the flower juice is changed into honey. The end of the tongue tapers off, and then swells into a little bud

at the tip, and he can move this quickly and easily, as an elephant moves his mighty trunk.

Close to the root of the trunk are a pair of strong short mandibles or jaws, used in building the waxen cells. Sometimes the whole body of the bee is covered with flower-dust, and this he carefully collects from his back and sides, using his legs as brushes. Their inner sides are hairy and are adapted for doing this. Or he licks up the dust of blossoms with his tongue, passes it to his first pair of legs, which send it on to the second, and at last to the third pair, where it is stored in the pouch or basket, which is as useful to a bee as the pocket of a school-boy is to him.

THE BEE'S
POCKET.

Each hind leg of a honey bee has a triangular depression on the outer side, shaped like the palette of a painter. This slight hollow has a border of stiff hairs standing all round it like the sides of a basket. Into it the bee pushes the pollen or flower-dust, and as soon as he has got as much honey and pollen as he can carry, he goes home to the hive to unload himself.

The quantity of honey collected in one day by a single hive of bees is said to be at least one pound ; it would take an industrious chemist many years to convert flower juices into this amount of honey after collecting them, even if he could do it at all.

MORE INSECT NEEDLEWORK.

THE clothes-moth grub is by no means the only insect who knows how to sew. Many small caterpillars understand the art of needlework, of their own simple kind, and can make a tent for themselves, binding it with cords of their own spinning. Nobody can have passed under the spreading boughs of an oak tree without noticing that some of the leaves are rolled up, in a very neat way, into little tubes, these tubes being made on several plans.

In some of them the leaf has been curled from the top downwards, in others one side is rolled till it nearly meets the other. But all the little tubes are carefully fastened with what we might call *stitches* or bands of threads. Each band is joined by one end to the surface of the roll, and by the other to the flat surface of the leaf.

Now this would be difficult work even for human fingers to do so neatly; and it is more wonderful in a little caterpillar. Inside the tube he lives, and it was he who curled it up for a hiding place, and fastened so many cords to prevent the leaf from springing open again.

Sometimes there are more than ten of these bands, each being made of a multitude of white silk threads. When he has made this convenient little house, the caterpillar sets to work and eats his rolls, which lie inside each other, beginning at that end of the leaf first curled up. He eats roll after roll, till by the time he

has come to the last it is also time for him to change into a chrysalis. It is a great hardship for him to be turned out of his roll, but if this happens he will make another. He always keeps his head so as to look out at the same end; there is not much room to turn round inside the roll. And he keeps his tiny house very clean, always dropping out everything that would soil it at the opposite hole.

In some years these caterpillars swarm in great numbers, and if birds and predaceous insects did not come to eat them, we should have no oak trees left. The oak would be none the worse for grubs in moderation, and in the old times, before men pruned timber and cleared woods, such insects were useful in preventing over-growth of leaves.

But now that men have killed so many of the birds, nearly all insects of a destructive kind have over increased. At times countless myriads of leaf-rolling caterpillars appear on the oak, and if you strike the trunk smartly hundreds of them come dropping down, each hanging by a very slight line to his roll. He thinks it safer to come out, because of that dreadful noise, and determines to let himself down to the ground.

This little rope-dancer seems able to stretch out his thread to almost any length, and afterwards he will climb up it again and go home. One moth into which a leaf-roller changes (*Tortrix Viridana*) has upper wings of a beautiful pea green, and if a number of them are startled from the oak, they come fluttering out exactly like animated scraps torn from the leaves.

The chief enemy of this moth is a kind of fly, the *emphis*, which destroys large numbers of them. Wasps too are great foes to leaf-rolling grubs. They are often inquisitive enough to pry after the little hermit in his cell, and, in spite of all his care, to carry him off for their own young.

STITCHES WITHOUT FINGERS.

A naturalist was once examining an apple tree when a wasp perched on a leaf forming a caterpillar's nest, neatly rolled up. The wasp examined both ends, and finding them closed, soon clipped a hole in the leaf at one end. He then went to the other end and made a buzzing noise, which frightened the caterpillar, who came rushing out of his hole and was immediately seized by the wasp. Finding him too large to carry

all at once, the wasp cut him in two, went off with one half and then came back for the other.

WEBS AND THEIR WEAVERS.

THERE is hardly any place in which a spider will not make himself at home. Some spiders live in the ground under our feet, others spin their wonderful snares in our houses or gardens. There are spiders in the water and spiders in the air ; sea spiders and shore spiders ; spiders that hunt their prey, leaping on it like little wolves, and spiders who sit patiently waiting till it is caught in the silken traps they have fabricated.

There are spiders who have learnt how to construct diving-bells that they may feed, live, and rear their young in a ditch or pool ; while on the surface of the same water their relations float on little rafts or boats of their own making. From the size of a small bird to that of a grain of sand, they inhabit almost the whole globe, land, air, and water alike. But no matter whether he soars through the air, making his web serve as wings, or dives, or floats, or jumps, or spins nets, the spider depends for a livelihood upon his thread.

Most people have watched a silkworm bringing the thread from his mouth, not so many have taken the trouble to watch a spider bringing a thread from his tail, although this sight is even more interesting than the other, and can be seen anywhere for nothing. Aristotle, who wrote of the spider before magnifying

glasses were invented, said that he made his rope out of wool stripped from his body !

But we can see for ourselves now that the thread comes from little teats at the end of it. All spiders have either four, six, or eight of these teats or *spinnerets*. Upon each teat is placed about one thousand little points, and these are hollow, tiny tubes in fact. Inside the spider's body is a store or reservoir of gummy liquid, which, as soon as it is squeezed out through the little tubes, hardens into silk.

Now every rope-maker knows that those cords formed by twisting many strands together are far stronger than such as are made in one piece. The rope to which the spider trusts his light weight is made of four, six, or eight

SPINNERETS.

strands ; and each strand is composed of about one thousand threads. A German was watching a little spider, no bigger than a grain of dust, through his microscope. He counted the threadlets from one of its teats or spinnerets, and found that it would take four millions of them to make a hair as thick as one of those in a man's beard ! When the tiny gossamer spider wishes to chase winged insects, he can shoot out his web into the atmosphere. The breeze carries it, or it floats, till the other end, which is sticky,

touches and clings to a branch, making a suspension bridge for him. The little creature, after testing its strength by a pull, runs boldly across, and should the wind break his line he will go flying along at the end of it till with his outspread claws he catches hold of something.

Wolf-spiders which stalk their prey, before making a sudden dart, fix a line of web as an anchor to the surface over which they are creeping, then they leap without fearing to fall. One of these spiders has been seen stalking his own reflection in a looking-glass, and laying a deep plot to catch himself.

As for the raft spider, he must have learnt gradually how to become a sailor. Not content with hunting insects on the bank, he must have longed for those that sported on the top of the water, and ventured upon dead leaves or sticks floating there. These he soon began to bind together with his silken threads to make his footing safer. At last a rough platform, upon which he drifts over the pool, has been perfected by this brave boatman.

As all spiders breathe air, no matter whether they live under water or not, the diving-bell of the water spider is so closely woven as to shut in the bubbles of air which the little owners fetch down from the top, hugging them in their arms and entangled in their hairs.

• TRAP-DOORS OF SILK.

LIFE is a great struggle for the spider. He cannot get his food without his silk, and he cannot obtain his silk without his food, any more than a silkworm can spin without mulberry leaves. This has made him both patient and industrious, taught him to keep those spinnerets, his bread-winning tools, always at work, and shown him how to turn that work to many different uses.

If life had been easy to him he would never have learnt thus to perfect his work. It is so with all animal races, and with ourselves. We grumble a great deal about hard work and pressing needs, but necessity is the mother of invention. The struggle of life has taught men and women, and children too, to do their very best—not to let their tools grow rusty or their limbs idle.

Perhaps the most perfect invention which necessity has taught the spider is a trap-door. The nest of the trap-door spider is a tube, dug in the ground, about three inches deep and about one inch across. The walls of this little cave he lines with a thick tough web of silk, but the most curious part of it is the opening.

This house has a door, about as big as half-a-crown, with real hinges, and the spider with her family must open and shut it whenever they go in or out. The use of the trap-door is to hide the nest, and so it is carefully made to resemble the ground. Bits of moss, grass,

leaves, or whatever lies near, are woven into the outside of the door, so that it matches the surroundings amid which it is placed. Unless you happened to be passing just when Mrs. Spider was popping in or out, you would hardly find her abode.

About a dozen layers of the same web that lines the nest form the door, and the hinges are elastic, so that it slams of itself as soon as the inmate has left home. This mother need not say to her children "shut the door after you and you'll never be chid."

If any enemy should find out the trap-door while she is indoors, the spider turns her claws into bolts, and holds it down fast.

Nothing will separate the mother spider from her eggs—she is one of the best parents possible. A very common kind of wolf-spider may be seen on garden lawns, and she is a nimble creature since she depends on speed for a living. About June, this mother has made up her little bundle of eggs, wrapped in a ball of snow-white silk. She carries this burden about with her wherever she goes, fighting for it with other insects if she is molested.

Should her bag be taken away by force, she rushes about in great distress, and if she finds it again pounces on it almost fiercely, so glad is she to get it back. There are about one hundred eggs inside, and she will part with her life rather than with these.

A foreign cousin of hers carries her egg-bag in the same fond way, and tears it open when she hears the little brood moving inside. As soon as they are fairly out of the bag they climb on to their mother's body,

where they cling to her in such numbers that she is almost buried alive by her swarming young—she certainly has so many children she doesn't know what to do.

But she acts as their perambulator wherever she goes, till they are strong enough to run, when they troop after her like a flock of chickens after a hen. For a whole year this goes on, but ultimately she teaches them that young spiders ought to earn their own livings, and then they leave her.

It is fortunate for the world that spiders are a thrifty, widespread, and hardworking race, since they prevent swarms of insects from overwhelming it. They are, in their way, as useful as insect-eating birds. There is not one spider too many in the world, for even when they come into our houses it is for the purpose of freeing them from more troublesome creatures still. The web of the house-spider is often found filled with the wings of clothes-moths, and spiders have been seen clearing bedsteads and beds from yet more unwelcome visitors.

New, well-swept, and clean houses offer no temptation to the spider, and so in these he is seldom found.

NEST OF MASON SPIDER WITH DOOR.

SPIDER COMING OUT.

We may be quite sure that he can live nowhere without food, and that his food *always* consists of living insects. If, therefore, we wish to get rid of spiders from our houses we should get rid of their living food. Out of doors they are nothing but a boon.

HUMAN FINGERS

are not made for such uses as these ; whole bands of lowly dumb workmen, from the splendid elephant and horse to the tiny velvet bee, each with his set of perfect tools, supply our needs by their work. Let us be kind and gentle masters to our valued servants, and never harsh tyrants !

The human hand is nature's most wonderful tool after all, for it can form other tools in endless variety, though never a living thing. Nothing can be more remarkable than the manner in which the delicate apparatus of the palm and fingers have been planned for use, and are guarded from injury.

The strain put upon the hand as it grasps—when, for instance, a sailor lays hold of a rope to raise his body in the rigging—would be too great for mere muscles, tendons, nerves, and blood-vessels to bear. They would be cracked, were it not that every part of the hand which has to bear pressure of any sort is defended by a cushion of fat, as elastic as that in the foot of the camel or horse.

By means of this wondrous hand, man earns his own living, and turns his thoughts into acts. With this marvellous tool he paints pictures, carves statues,

plays sweet music, writes history, builds stately churches and palaces, makes himself master of the world, and all other created beings in it.

“Some animals have hoofs, some teeth, some talons, some claws, some beaks,” says the great naturalist, Ray: “man is born with no such things; but is weak and feeble; sent unarmed into the world; why, a hand, and reason to use it, supplies the use of all these!”

Let us be careful that those wondrous hands of ours are laid upon no living creature save in the way of kindness.

“Love makes all things equal; I have heard
By mine own heart this joyous truth averred:
The spirit of the worm beneath the sod
In love and worship blends itself with God.”

SHELLEY.

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