

Stories of Animals

NATURE SERIES

SELECTED AUTHORS

Stories of Animals

Selected Authors

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Selections from

Wilderness Babies

by

Julia Schwartz

The Opossum
"The One with a Pocket"

For days and days the new baby opossums lay crowded close together in their mother's furry pocket. They slept and drank milk, and grew and grew till their eyes began to open. It was dark all around them, but up above their heads a faint gray line showed where light was stealing in over the edge of the pocket.

The biggest baby opossum looked and looked with his little bright eyes. He wanted to see more. So up he crawled, clambering over the soft, tiny bodies of the eleven other babies. Some of them wriggled and squirmed under his bare little feet. After slipping back once or twice he reached the edge and poked his pointed white snout outside.

He could not see anything because he was under his mother, and her long fur hung down over him. She was lying on a nest of grasses in a hollow tree. That was where she stayed all day long when the sun was shining without. Every night at dusk she climbed down the rough trunk and went to hunt for something to eat.

When she felt the tiny claws of her baby clutching her fur she looked down between her fore-paws at the little mouse-like fellow. Then with her smooth pink hands she gently pushed him back into the pocket and closed the

opening. He was not big enough yet to come out of the warm, dark nursery.



So for a week longer he cuddled down beside the others, while they all slept and drank more milk and grew stronger every hour. The biggest baby was so restless that he scrambled around and crowded the others. Once he caught hold of another's tail between the thumbs and fingers of his hind-feet, and pulled till the little one squeaked. His fore-feet were like tiny hands without any thumbs.

At last, one day, he saw the edge of the pocket open a crack. He was so glad that he climbed up as fast as he could scramble, and pushed outside. He held on to his mother's fur with all four feet. When she reached down to smell him the bristles on her lips tickled his nose. Then he climbed around upon her back and twisted his tail about hers to hold him steady.

He looked like a mouse, with his long tail, his black ears erect, his bright eyes twinkling in his little white face, and his pointed nose sniffing at the strange odors in the hollow tree. It was much lighter there than inside the pocket. Higher up over his head there was a hole leading out of the hollow. Queer small shadows were dancing and flickering across the opening. He did not know that they were only green leaves.

In a few minutes another and another baby followed the big brother and clung there on the mother's furry back. It must have seemed a noisy place to them, for while in the pocket they had noticed only the softest muffled rustling

and scratching of the old one's feet in the nest. Now they could hear a chirping and a squeaking and a rattling of branches. They crowded close together in fright at the scream of a blue jay, as it chased a chattering red squirrel through the tree-top. Then a sudden loud thump-thump-thump of a woodpecker hammering on the bark outside sent them scuttling back to the safe nursery in a tumbling hurry.

After this the whole family climbed out every day to play about on the mother's back. The biggest baby liked to curl his small tail about her large one, and then swing off head downward. Sometimes he pushed the others down just for the fun of seeing them scramble up again, hand over hand, clutching the long fur.

Of course he was the first one to poke his head out every day. Once he woke from a nap in the pocket and started to climb outside. But he stopped half-way, hanging to the edge with both fore-feet. It was nearly evening, and the old mother opossum was clambering down the trunk to go hunting for her supper.

The baby held on tightly, while she trotted away through the woods. Now and then a leaf rustled or a stick cracked under her feet. Sleepy birds were twittering in their nests. The mother pricked her ears and listened, for she ate eggs and young birds whenever she could find them within reach. She had not tasted an egg this spring,

because she could not climb very nimbly with her pocket full of babies.

Presently she came to a swamp, and splash, splash, splash! the mud went flying. It spattered the baby's white face and made him sputter and cough. Then he heard the dreadful croaking of hundreds of frogs. In a terrible fright he slid back into the nursery to hide beside the others.

The old one was trying to catch a frog to eat. Now she jumped this way, and now she jumped that way. Such a jostling as the babies felt when she finally gave a great spring for a big green fellow sitting on a log. She caught him, too, but the jolt almost knocked the breath out of the twelve soft little bodies in her pocket.

On another evening the babies awoke to find themselves swinging to and fro in dizzying jerks. They rolled and tumbled from side to side. They bumped their heads and noses against one another. When the biggest baby tried to push his way out he found the edge of the pocket close shut. Though he scratched and squeaked the mother did not open it. She was afraid that they would all fall to the ground, for there she was hanging upside-down by her tail to a branch of the tree.

Down below on the ground a big black bear was hugging the trunk and shaking it as hard as he could. He was trying to shake the old opossum off so that he might catch her and eat the whole family. But she held on so long that finally he became tired of waiting. So away he walked

to find something else for supper. Then the mother swung down to the nest in the hollow and rested there while her babies played around her.

Every day the babies stayed outside the nursery for a longer time, though they were always ready to scurry back at the mother's first warning grunt. They kept growing bigger, till one night they found that they could not all crowd into the pocket. Then they huddled together on her back, with their tails twisted around hers.

In this way they rode through the woods when she went hunting. They watched with their bright eyes while she turned over rotting logs with her snout to catch the grubs underneath. Sometimes she rooted in the ground for sprouting acorns, or nipped off mouthfuls of tender grass. Once she caught a young rabbit. Then how excited the little opossums were! And how they all squeaked and hissed together as they rode trotting home!

By this time they had cut their teeth,—fifty sharp little teeth in each hungry mouth. It was time for them to be weaned. When they tried to drink milk the mother pushed them away. Then she picked some sweet red berries, and taught the hungry babies how to eat them. They learned to chew the juicy roots that she dug in the fields.

The babies were greedy little things. When the old one caught a mouse or a mole or a toad, the young ones all rushed and snatched. Once the biggest baby gobbled up a beetle before the others could get a taste. They were so

angry that they tried to bite his nose and ears. He squeaked, and ran as fast as he could to hide under the mother.

She was a good and patient mother. Of course, as long as they were small enough to stay in her pocket she carried them everywhere with her. Even when they grew as large as rats they rode on her back through the woods. These twelve fat babies were so heavy that sometimes she staggered and stumbled under the load.

One night, when all the babies were trotting along on their own feet, they saw two gleaming red eyes in the dark thicket before them. Something round and furry snarled and sprang at them. They all ran under their mother as quick as a wink. She ruffled her long grayish hair above them. When the wildcat jumped at her she growled and hissed and scratched and bit furiously, till he ran limping away into the shadowy wilderness.

On another evening a big dog came galloping up before they could scramble into a tree. His red tongue was hanging out of his mouth between his white teeth. As soon as he caught sight of the opossums he made a dash to catch them. Instantly they all fell down and rolled over, just as if they were dead.

There they lay, with their eyes shut, their paws limber, their tails limp. They seemed to stop breathing. The dog smelled them and pushed them with his cold nose. But they kept perfectly still and did not move even an eyelash.

They were pretending to be dead. It was the one trick that they all knew without being taught.

The minute the dog walked away up they all jumped and scampered into a tree as fast as they could scurry. When the dog turned his head and saw them he ran back and leaped up to reach them. But all the opossums were safe enough now. While he was jumping and barking below they clung fast in the tree with their hand-like feet. They wound their tails about the branches above to hold more securely.

The little opossums learned to climb all sorts of trees, rough or smooth. It was easier to climb the rough trees because they could dig their nails farther into the bark. The biggest baby could walk along the springiest limb, even if it kept teetering up and down in the wind. When he felt like it he swung by his tail for the longest time without getting dizzy.

All summer long the twelve little opossums stayed with their mother. During the day they slept cuddled in the hollow tree. The old father opossum never came home, for the mother had driven him away before the babies were born. She wanted all the room in the nest for them. She could take care of them better than he could, because she was bigger and knew how to fight her enemies more fiercely. Every night, after sunset, the mother and her twelve children set off on their hunting. Down through the woods to the marsh they trotted. There some

waded into the mud to catch frogs, while others chased mud-turtles over the shore. Some hunted for berries and others nosed for acorns under the oaks.

It was beautiful there in the woods at night. When the stars twinkled overhead and the soft wind rustled in the tree-tops the little ones frisked and frolicked. They hid under the shadowy bushes or jumped hither and thither to snap at the fluttering moths. But on stormy evenings they plodded on in the rain, their wet fur drooping. With their noses close to the ground they hunted till they found a few mouthfuls to eat. Then back to the cosy hollow for a longer nap, after licking their pink hands clean and washing their white faces, just as kittens do.

One night, in autumn, the old mother opossum felt the nip of frost in the air. Then she knew that the persimmons were ready to be eaten. Away through the woods she hurried, with the young ones trotting after her. Past the marsh and over the blackberry hills she led the way to a thicket of trees tangled with wild grapevines. There above on the branches the round little persimmons were shining yellow in the moonlight.

Up the trees eleven of the babies scrambled hungrily, and, hanging by their tails, stuffed the fruit into their wide mouths. Ah! but wasn't it delicious! Better than anything they had ever tasted before in all their short lives! Then the biggest baby, who had stopped to gobble ripe grapes, heard them munching so greedily. One look sent him

clambering after the others. He was sorry enough that he had wasted any time eating wild grapes.

Night after night, till the persimmons were gone, the opossums hurried away to the thicket, and ate and ate till they could eat no longer. They grew so fat that they puffed and panted when trotting home again in the gray light of frosty dawn.

As the weather grew colder the opossums roamed farther through the woods in search of food. Once in a while one of them found a pawpaw-tree. Then from far and near opossums gathered under the low wide-spreading branches to feast on the banana-shaped fruit. That was the last good dinner that the little fellows had for many weeks.

Soon the ground was frozen hard over the juicy roots. All the fruit left in the woods hung wrinkled and frost-bitten. The worms and toads crawled into their holes for the winter. The beetles disappeared, and the spiders curled up in their hiding-places to sleep through the cold weather. Most of the birds flew away south.

One by one each little opossum wandered off by himself, and made a nest in a cosy hole or a snug hollow stump. There he drowsed away the days, and often slept through the nights without stirring out. Now and then one of them caught a mouse or dug up a frozen root to nibble. Sometimes they tore rotten logs apart to get at the torpid

grubs within. The biggest baby found a heap of nuts hidden away under a stone by a thrifty chipmunk.

In the beginning of the winter the little opossums were so fat that they could live three or four weeks without eating or drinking. When the cold winds blew, and the snow fell silently, they cuddled down in their warm nests and slept the time away. But many a night they woke up hungry. And every day their round furry bodies were a little thinner, till at last spring melted the snow and ice everywhere.

There was plenty to eat by that time, with all the green things growing. The little creatures of the woods and ponds were waking to new life. There were buds to nibble and beetles to catch. There was many a nest of birds' eggs, too, and broods of tender young field-mice squeaking in the grass. There were frogs croaking in the marsh, and berries were ripening in the fields.

The twelve little opossums were grown up now, and knew how to take care of themselves. Their mother had another family of babies in her furry pocket. Sometimes she met her other children roaming beside the marsh to catch frogs. On evening they saw, just as plain as anything, a little pointed nose and two twinkling bright eyes peeping over the edge of her pocket.

The Elk (Wapiti)
"One of the Fleetest"

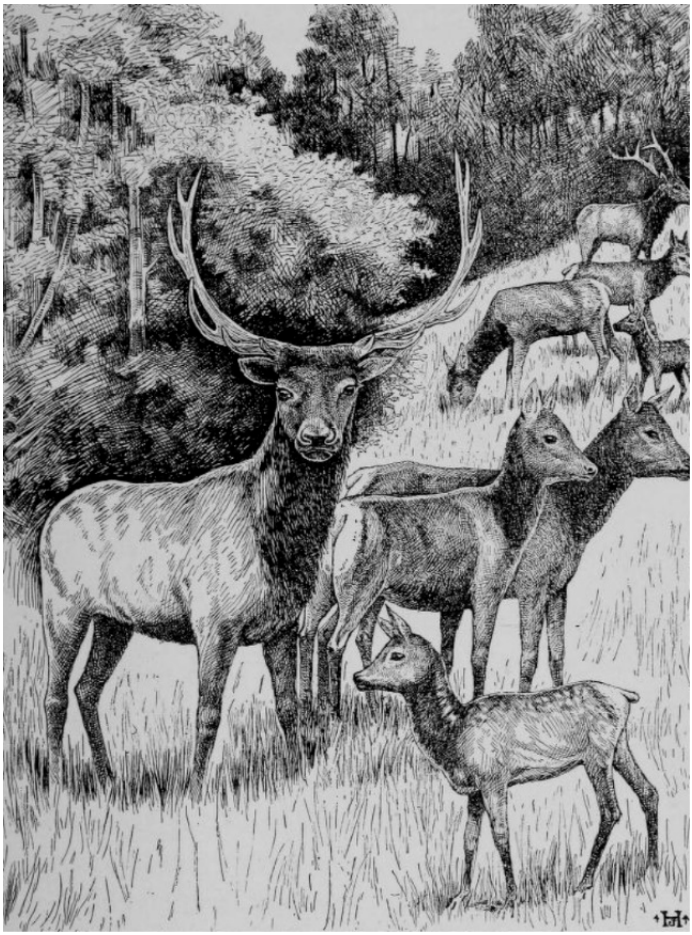
It was the most interesting thing! The big brother elk, who was just a year old, peered in through the branches, his ears pointed forward. His great soft eyes were shining, and his nostrils were quivering with excitement. There, on a bed of leaves in the mountain-thicket, lay a new little baby elk.

He looked like the big brother, except for the white spots on his satiny brown coat. With his slender legs doubled under him he lay perfectly still, not even twitching his ears, as old deer to catch the slightest sound. He was looking up at his big brown mother standing beside him.

The brother elk edged nearer and nearer, till a branch crackled under his hoofs. Instantly the old mother raised her head and pricked her ears in the direction of the sound. When she caught sight of the brother she drew back her lips from her teeth and squealed angrily. Her eyes gleamed. She began to walk toward him, squealing and shaking her head to drive him away. He was so surprised that he snorted out loud. Then backing off, first one foot and then the other, he hid among some trees close by.

He must have felt very lonesome as he waited there by himself on the mountain. He listened to every rustle of a

leaf or crackle of a twig in the thicket where the baby was lying. Before this his mother had always been kind to him.



He did not know why she drove him away,—when he was not doing any harm. The reason was because every little noise made her nervous. She was afraid wolves or panthers

might come prowling around there, where the baby lay helpless on the leaves.

After a few days the baby scrambled to his feet and went staggering a bit unsteadily after his mother as she led the way out from the thicket. The big brother came timidly up to them. He smelled the little one very gently, nosing all over his soft dappled body. The mother did not pay much attention, and the baby was not afraid. He stood quite still, looking around with his shining eyes.

It was a beautiful world in May. All around him there were groves of aspens twinkling their silvery leaves in the early sunlight. Farther up the mountain-side dark evergreens grew thick among the rocks. Down the valley a brook splashed and gurgled over stones on its way to a lake lying in the cool shadow of the pines.

Very likely, although the baby elk could see well enough, he cared more for the things which he could smell. There was such a delicious fragrance everywhere of spicy evergreens and the damp sweet breath of mosses and blossoming flowers. Of course he was too young to taste the juicy grasses and tender twigs, but he surely enjoyed the tempting odor of it all. The world smelled very good to eat.

Like all little mammals he drank milk till his teeth cut through his gums later in the year. Like the buffaloes the older elk had horny pads instead of teeth in the front of their upper jaws. They tore off a mouthful of grass or

leaves with a jerk of the head and swallowed it half chewed. Then, during the heat of the day, when they were lying down to rest in the shade, or standing in pools of water, they drew up the fodder from their stomachs and chewed it again.

All summer long the little elk lived in the mountains with his mother and brother. At night he slept nestled close to them in some safe thicket. In the daytime he trotted beside them as they roamed grazing over the upland meadows and along the brooks. Though they were fond of feeding near the water they did not care so much as some other kinds of deer to eat lily-leaves.

In the early part of the summer the mother and brother looked very ragged. Their thick winter coat began to fall out. It was so matted that it clung to the body like a torn blanket. Every time they rubbed against a bush or thorny tree their old hair was torn in long strips and tatters. When at last it had all been rubbed off their fresh short, summer fur shone out bright and glistening in the sunshine.

Little by little the white spots on the baby's coat were fading. By the end of August he was all in plain brown like the older ones, with only a patch of white around his tail. Probably he did not notice the difference himself because he could not turn his head far enough to see many of the spots on his sides and neck.

Indeed he was astonished enough one day, while still in the spotted coat, to see another little spotted elk come timidly out of a thicket of aspens. At first both babies stood still, with their ears pricked forward and their big soft eyes wide open. Then the first one bravely walked up to the other and smelled him all over. After that they were friends and played together. They could both say ba-a-a, and drink milk, and gallop over the grass, with their little hoofs kicking out behind.

The next day another mother elk with a baby and a big brother joined the band. Then another family came, and another, till there were dozens and dozens of them all together. Such scampering frolics as the little ones enjoyed! While the old mothers were quietly grazing over the steep slopes the babies raced from one rock to another. Each one tried to push up first to the highest point, and then stand there, looking down at the others. Once the roughest little fellow butted another off a high rock and almost broke his leg.

When a baby butted with his round little head it did not hurt much. But the big brothers all had sharp antlers sprouting from their foreheads. In the spring the knobs above their eyes had begun to swell and grow out into bony spikes covered with a velvety network of skin and veins. These antlers were different from the horns worn by the buffaloes. Every buffalo had a pair of horns that lasted all his life. The mother buffaloes had horns, but the mother elk did not have antlers. The antlers were solid

bone instead of hollow like the horns. Each of the father elks and the big brothers had a new pair every spring to replace the old pair that dropped off during the winter.

By mid-summer the antlers stopped growing. Then the big brothers in the band pounded and rubbed their antlers against bushes and young trees, so as to strip off the velvety covering. When they had sham fights they could butt hard enough to hurt. They bumped their heads together, and pushed with all their might to see which was the strongest.

Autumn was not far off now, and the band of mother elk and young ones began to move down from the mountains to the foot-hills. In winter the snow lay so deep in the high valleys that they could not walk far or find enough to eat. Farther and farther down they wandered every day. The babies were learning to eat grass like the older ones.

One morning the smallest baby elk was picking his steps along the edge of a cliff. He halted and raised his pretty head to look far up the canyon before him. There, away off against the pine-woods on the mountainside, he caught sight of a spot of brown moving toward him. Nearer and nearer it came, till he saw that it was an animal even bigger than his mother. It was an old father elk coming down from his summer retreat in the highest gorges.

In all his short life the baby had never seen such a stately and beautiful creature. His mother was not nearly so large as this elk, and she wore no antlers at all. The big brother's antlers were only short spikes without any prongs. On strode the newcomer, leaping over fallen trees and wading through the brooks to join the band. His long black mane was waving on his neck; his nostrils were quivering; his great eyes were flashing; his splendid antlers rose, branching high above his graceful head.

The fine stranger stalked among the others and smelled them, in their way of getting acquainted. Then he began to feed with them all. The mother elk and little ones followed meekly when he started to lead the band down the mountain. He did not pay much attention to the babies. Sometimes he pushed them out of his way, or drove them hither and thither, as he pleased. He was a selfish old fellow and never thought of taking care of the others. Whenever he found a delicious tuft of juicy grass he hurried to munch it all by himself.

As the frosty days passed by another father elk appeared, and then another and another. Each one wanted to be leader of the band. Many a snowy night the baby elk huddled close to his mother as he listened to the noise of the old father elk roaming through the woods. He could hear them snuffing the frosty air. They beat the bushes with their antlers and stamped on the crackling branches underfoot. The snow lay thick on their bristling manes. Now here in the valley, now there high on the

ridge, the sound of their whistling came pealing down through the still white woods in the moonlight.

Often and often the baby trembled as he heard the shrill squealing of two old elk fighting together. Each one was trying to drive the other away from the band. They rushed together with a crash, and pushed and strained, with their antlers locked tight. Though the prongs could not cut through the tough skin of their shoulders, still the weaker one always had to give way and run. The other chased him off and then came back, whistling and barking in triumph, to be leader of the band.

In a few weeks the old elk became tired of fighting. The band settled down to spend a peaceful winter together. Their fur grew long and thick to keep out the cold. On they travelled mile after mile. They were looking for a sheltered spot to be their home during the coldest weather.

The old elk walked so fast that the babies had to gallop to keep from being left behind. Up hills and down gorges they went crashing through thickets and over the rocks. They climbed steep cliffs and went leaping down narrow trails. Even the little ones were sure-footed. They never stumbled or slipped as they bounded over the dead logs and tangled vines between the trees.

At last they found a wooded spot where the hills sheltered them from the bitterest winds. There was grass on the ground. There were plenty of young trees with

twigs and buds and bark for them to eat. A swift little brook ran over the rocks not far away.

Here in this place the band of elk spent the winter. When the snow fell deeper they trod it into narrow paths by walking from tree to tree to feed. These paths led to and fro, criss-crossing, and around in uneven curves all through the yard, as it may be called. With every storm the snow beside the paths piled higher and higher, till the baby could not see over the edges, even when he stretched up his neck.

It must have been a dreary winter for the little fellow. Night after night he huddled beside his mother to keep warm. Sometimes the stars sparkled above the white earth, and sometimes the wind sifted the icy flakes over their brown bodies. Day after day of cold and storm he walked along the paths from tree to tree. Here he could reach a bunch of dead leaves, there a cluster of twig-ends, or a mouthful of bark.

The older elk were so much taller than he was that they could reach the higher branches by standing on their hind-legs and stretching out their necks. Often he went hungry, for the fodder near the paths was all eaten before spring. The snow was so deep outside the yard that he could not touch solid ground with his feet. Sometimes he pawed through the icy crust, and dug away the snow from over the grass.

Once a pack of wolves came prowling near and tried to drive the elk out into the deep snow. Though the elk, like all deer, are the fleetest of mammals, the wolves could run better over the snow, for their broad paws did not sink in so far as the elk's slender hoofs. Instead of running away all the mother elk rushed squealing after the wolves and tried to stamp them to death. The mother elk were always very brave in taking care of their little ones. The cowardly old fathers were afraid to fight anything, now that they had lost their sharp antlers.

Spring came at last, and the snow melted from the hilltops and then from the valleys. The first tender grass began to sprout in the meadows. The elk left their winter home and scattered over the plains in search of food. The sun shone and the soft winds blew.

The baby elk followed his mother, when she left the others, and started up toward the mountains. He wandered after her, grazing as he went, till he lost her in a mountain thicket. While he was looking for her he heard a rustling of twigs. He peered through the branches, and there he saw a new little baby elk lying on a bed of leaves. The old mother was standing over him, and licking his satiny spotted coat with her long red tongue.

The Beaver
"The Best Builder"

Out in the woods rain was pouring down steadily from the black sky. It beat against the leaves and trickled over the trunks of the trees and spattered into the pond. Now and then a flash of lightning glimmered over the water and twinkled in through the hole at the top of the little round house where the beavers lived.

From the outside this house looked like a heap of old brush-wood on a tiny island in the middle of the pond. But inside of it there was a little room, like a cave, with a smooth floor and an arched roof. Along the sides of this room there were five beds of leaves and grass. On one of these beds lay three baby beavers fast asleep in the dark.

The other beds were all empty. The big one at the end belonged to the father beaver. Before the babies were born in May he had gone away for the summer. He had started off with all the other old fathers in the beaver village to have a good time in the woods up the brook. They played and feasted on roots and plants, while the mother beavers stayed home to take care of the babies.

The other three beds belonged to the mother and to her two older children. On this rainy summer night they had gone out to eat their supper under the trees by the pond.



Suddenly the three baby beavers opened their eyes with a start, and rolled off their bed. They had been awakened by the sound of a loud whack on the water outside. It was a noise made by the mother's flat tail as she dived down toward the door of her house. Her front hall was a tunnel that led from the bottom of the pond to the floor of the dark little room. Through this she went swimming, while the waves bubbled and splashed around her.

When the babies saw her round head poke up through the door in the floor they squeaked and ran to meet her. She was carrying a bundle of small sticks between her chin and her fore-paw. Each little beaver sat up on his hind-legs, with his tail propping him steady from behind. Then he took one of the sticks in his hands and began to nibble the bark with his new yellow teeth.

They were wonderful teeth. After the babies were too old to live on milk, four curved teeth grew out in the front of each little mouth. Two were in the upper jaw and two in the lower jaw. It was the strangest thing! The more these teeth gnawed the sharper they became. The inner side of each tooth was softer than the outer side. In biting together, the inner edge wore down faster, and left the outer edge as sharp as a knife.

The beaver belongs to the *Order of Gnawers*. Squirrels and rabbits and rats and many other mammals belong to this order. They all have these chisel-shaped front teeth,

which keep on growing all their lives long. If any one of them is too lazy to gnaw every day his teeth grow so long that he cannot bite anything at all. Beavers are the largest of the gnawing animals, except the water-hog of South America. They have stronger teeth than any of the others.

Not long after this stormy night the mother beaver decided to take the three babies out with her into the woods. She chose another rainy evening because then their enemies were not likely to be wandering under the dripping trees. Bears and foxes and wild-cats hate to get wet, but beavers enjoy feeling the cool water trickle over their fur and splash on their tails.

Except for their broad, flat tails, the three little beavers looked like rats covered with silky brown fur. The mother seemed like a giant rat, about three feet long from her round nose to the root of her tail. Instead of fur her tail was covered with thick skin. This skin was so creased and dented that it looked like scales.

What an exciting evening it was for the babies! One behind the other they trotted down the dark tunnel after their mother. At first the floor was dry and hard. After a few steps their feet touched something wet. Soft mud oozed between the fingers on their forepaws. Their hind-feet were webbed up to the toe-nails, and so did not sink in so deep as their fore-paws. Beavers are the only mammals which have webs on one pair of feet, and not on

the other pair. They are half land animals and half water animals.

This was not the first time that the three little beavers had ventured into the tunnel. More than once before they had crept down as far as the water and waded about at the edge. But now they kept right on, splashing in farther and farther. The water grew deeper and deeper. In the dark they felt it wash up to their knees, and then up to their chins, and finally away over their backs and their heads to the roof of the tunnel.

Away went the three babies swimming after the old mother. They held their breaths, and shut their ears tight. Their small fore-paws hung down by their sides. They paddled with their webbed hind-feet, and used their broad tails as rudders, to send them now this way, now that.

It seemed the longest time to the last little beaver before his head popped up into the fresh air above the pond. He blinked his light-brown eyes, and winked away the drops on his eyelashes. Now and then a flash of lightning glimmered on the trees around the pond. Of course he did not know yet that his food came from those tall, shadowy things at the edge of the water.

Half-way to the shore a round, dark spot was ploughing through the water, with two ripples spreading out behind it. It was the head of the mother beaver. Behind her followed another head, and then another. The last little beaver swung his tail around and started after

them. He puffed and sputtered when a wave washed over his nose. But he did not mind that at all, because this cool water was much pleasanter than the stale air in the warm room at home.

There, under a bush on the bank, he saw his older brother and sister sitting on their tails, while they nibbled the bark from some sticks beside them. When the baby reached his hand toward the pile they grunted and sniffed at him. Just then a flash of lightning gleamed on their long, yellow teeth, and frightened the little fellow so much that he scampered after his mother and the two other babies.

They followed a path into the woods. The father beavers in the village had made it by cutting down trees and bushes and dragging them out of the way. It was a straight path, and more than wide enough for the fattest old beaver. But the last baby was so much afraid of being left behind that he ran without looking on the ground. He stumbled over two low stumps, and bumped into a trunk at one side, before he caught up to the others.

He saw the mother beaver standing on her hind-legs under a tree. She reached up as high as she could with her mouth and gnawed off a branch. When it fell crackling and rustling she called the three babies to come and learn how to cut their own sticks to eat. She showed them how to set their teeth against the bark, and tear off a chip with a jerk of the head. Another chip and another was gnawed out till

the branch was cut in two. The mother could bite through a small stick with one snip of her jaws.

After that, every night all summer long, the three babies followed their mother out through the tunnel and across the pond to feast in the woods. They ate tender grasses and roots as well as bark. Sometimes they went out before dark to romp and play tag in the pond. The biggest little beaver thought that it was the greatest fun to push the others off floating logs. He chased them round and round, splashing water in their faces and making them duck their heads. They enjoyed the fun as much as he did, especially after they all scrambled upon the bank to rest.

On land, the biggest baby was too fat and clumsy to move as fast as the other two. They danced about on their hind-legs, and pretended to step on his tail or pull his fur. It was beautiful fur, so fine and thick and soft that water could not soak through to the skin. The babies did not have a coat of coarse outer hair like the old beavers. When tired of play they sat up and scratched their heads and shoulders with the claws on their hairy forepaws. Then, after combing their sides with their hind-feet, they curled down in the grass for a nap.

There were plenty of other little low houses in the pond, and in each one lived a family of beavers. The three babies made friends with all the other babies. Together they explored every corner of the pond, from the brook at the upper end to the dam at the lower end.

Very likely the little fellows believed that the dam had always been there. But in fact the old beavers had built it themselves. When they first came to that spot in the woods they found only a brook flowing over a hard, gravelly bottom. They first cut down a bush and floated it along till it stuck fast between a rock and a clump of trees. Next they cut other bushes, and carried down poles and branches, till they had a tangle of brush stretching from one bank to the other. Upon this they piled sticks and stones and mud, and then more sticks and stones and mud, and then still more sticks and stones and mud.

At last the dam was so high and solid that the water could not flow through. So it spread out in a pond above the dam till it was deep enough to trickle over the top and tinkle away in a little brook under the trees.

Tiny islands were left here and there in the pond. The old beavers built their houses on the islands or on the bank. First each mother and father dug two tunnels from the bottom of the pond up through the earth to the floor of their house. One tunnel was to be used when going in and out during the summer. The other tunnel led to their winter pantry under the water. This pantry was to be a pile of fresh sticks cut in the woods every autumn.

Around the two holes in the floor the beavers laid logs and stones in a circle. Upon this foundation they piled sticks and sod to form walls and a roof. Then they plastered the house all over with mud. At the top of the

roof they left a small hole, covered only with a tangle of sticks. This was for fresh air. Last of all they swam inside and made the walls even by gnawing off the sharp ends of the wood. Then the house was ready to be furnished with beds of leaves and grasses.

Perhaps during the happy summer the babies believed that play was the most delightful thing in the world. But soon the father beavers came strolling back to the village to cut down trees for the winter. Then the little fellows found that work was even better fun than play.

One night the three babies followed their parents into the woods and watched them cut down a tree. The father stood up on his hind-legs, propping himself with his tail, and began to cut a notch around the trunk. The mother helped on the other side. They gnawed upward and downward, digging out huge chips with their chisel teeth. The circle grew deeper and deeper, till the father's head was almost hidden whenever he thrust it in to take a fresh bite.

When finally the wood cracked and the treetop began to sway all the family scampered away to the pond. They dived for the tunnel and hid in the house for a while. There was danger that some hungry wild-cat had heard the crash of the branches and had hurried there to catch them for its supper.

As soon as it seemed safe to do so the beavers paddled out again and trotted away to the fallen tree. The parents

trimmed off the branches and cut the trunk into pieces short enough to carry. The father seized a thick pole in his teeth and swung it over his shoulders. As he dragged it toward the pond he kept his head twisted to one side, so that the end of the pole trailed on the ground.

The biggest little beaver tried to drag a smaller branch in the same way. When he rose on his hind-legs, so as to walk along more easily, he forgot to brace himself with his tail. The branch caught on a stone and tipped him backwards, heels over head. The two other babies were rolling a short log by pushing it with their noses. At the sound of their brother's surprised squeals they gave the log a last wild poke. It seemed to make a jump over a bump, and then tumbled into a hole. There it stayed, though they pushed and pulled and puffed and grunted in trying to get it out again.

It happened that the father beaver reached the pond just in time to help mend the dam with his thick pole. A pointed log had jammed a hole in the dam. The water was beginning to pour through the hole with a rush. If the pond should run dry the doors of the tunnels would be left in plain sight. Then probably a wolf, or some other enemy, would hide there to catch the beavers on their way from the woods to their houses.

The old father pushed his pole into the water; then he jumped in, and, taking hold of it with his teeth, he swam out above the hole. When he let go the water carried the

pole squarely across the break in the dam. The other beavers cut bushes and floated them down to weave across the hole. After that they scooped up mud and stones to plaster the dam till not a drop trickled through the mended places.

The next work to be done that autumn was to gather food for the winter. Some of the trees with the juiciest bark grew too far away to be easily dragged to the pond. All the grown-up beavers set to work to dig a canal. They dug and scooped and gnawed off roots, and dragged out stones, till they had made a long canal more than a foot deep. The water flowed into this from the pond. Then it was easy enough to float wood from the juicy trees down to the beaver village.

Even the babies could help in towing the wood down the canal and across the pond to the different houses. Some of the wood became so heavy with soaked-up water that it sank to the bottom beside the doors, and could be packed in a solid pile as easily as on land. Most of the wood, however, kept light enough to float. Instead of heaping new sticks on top, the beavers pushed them under the top branches. Then more was pressed under that, and more under that, till the pile reached to the bottom. In the winter, of course, the top sticks could not be eaten, because they would be frozen fast in the ice.

The autumn days were growing frostier and frostier. After mending the dam and gathering their woodpiles, the

beavers plastered a last coat of mud all over the outside of their houses. The mud froze hard and made the little rooms inside as safe as a fort, with walls two feet thick. The babies carried leaves and grasses for their fresh beds. With a bundle tucked between his chin and forepaw, each one hobbled along on three legs, "working like a beaver," as the saying is.

One cloudy night, when the beavers were busy out in the woods, something soft and cold began to float down through the chilly air. The biggest baby felt a sting on his nose. When he put out his tongue to lick it he touched only a speck of water. Bits of white sifted on his fur and melted in drops. Presently the ground began to look lighter colored. Something fluttered about his head and settled on his eyelashes. He winked and sneezed and squeaked to the other babies. They had never seen a snowstorm before.

When they jumped into the pond to paddle home something sharp and brittle cracked and snapped in the icy black water. One of the little fellows caught a bit in his mouth. It smarted on his tongue and then it was gone. It was the first time that he had ever tasted ice.

The next night, when the beavers swam to the top of the pond, they bumped their heads against something hard. It cracked all around them. They pushed on, with the water lapping at the jagged edges. After they reached the shore they found it very tiresome to wade through the

snow. Before the night was quarter past the old father hurried back to the pond. He was afraid that the ice might freeze too thick for them to break their way home again. He arched his back and slapped his tail on the water with an echoing whack to call the babies after him.

All winter long the beavers lived quietly in their little homes under the snow. Most of the time they slept, each on his own soft bed in the dark. Whenever they were hungry they paddled down the tunnel which led to the woodpile. Gnawing off some sticks they swam back with the bundles under their chins. They used the middle of the room for a dining-table. There they nibbled the bark. Then they carried the peeled sticks back into the pond. They did not like to have rubbish left on the floor.

Sometimes the babies grew restless and tired of staying still in the room. They swam out into the pond and moved about under the ice. They hunted for roots of the yellow water-lily. It must have been hard to hold their breaths long enough to dig up the roots and paddle away back into the house. Once the biggest baby almost had a fight with one of his playmates over a juicy root. They pulled at it so roughly that it was torn to pieces.

So the winter months slipped away. At last spring melted the ice on the pond. Here and there in the black water little brown heads came popping up. They went plowing toward shore, leaving v-shaped ripples stretching out behind. Up the banks scrambled the beavers,—

mother beavers and father beavers, big brother beavers and big sister beavers, and all the little beavers who had been babies the year before.

Away roamed the fathers up the brook, to have a good time travelling all summer long. The grown-up brothers and sisters started out to build dams and houses of their own. The little fellows wandered into the woods to find their dinners of tender buds and twigs. The mothers ate the bark from fresh sticks, and then hurried back to carry milk to the new baby beavers, asleep on their soft beds at home.

The Rabbit (Hare)
"The Timid One"

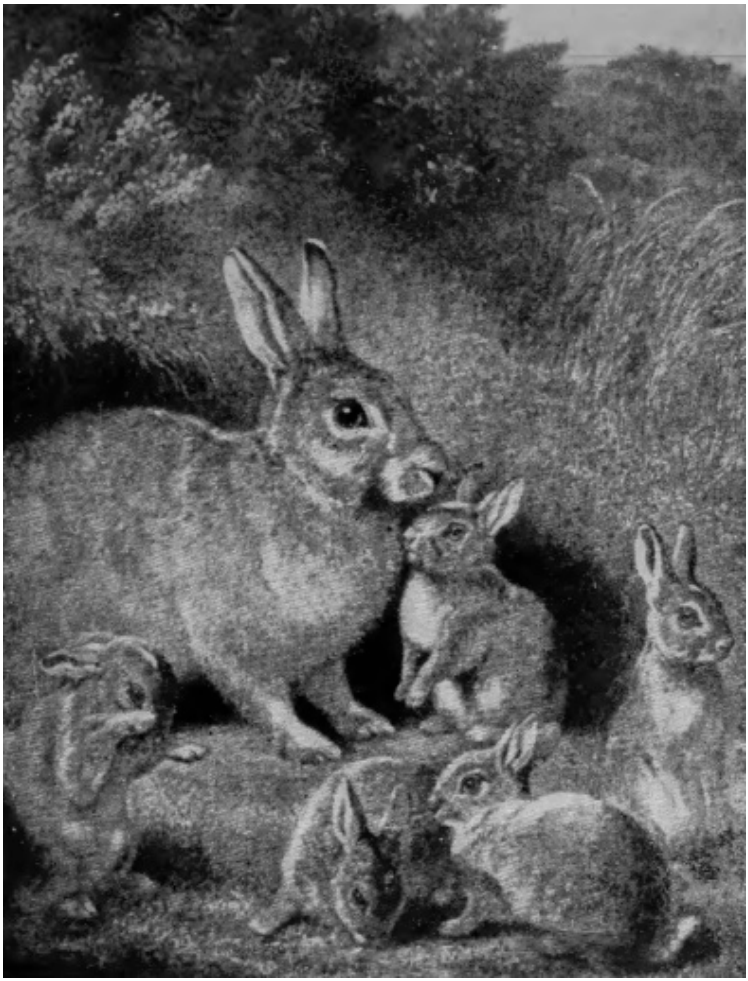
The nest was a small hole scooped out of the turf and lined with bits of fur from the mother bunny's breast. The five baby bunnies lay packed close together. Their long ears were pressed flat on their furry backs, and their hind-legs were doubled up under their round, little soft bodies.

Over them rested a blanket of dry grass and fur matted together. The sunlight outside shone through tiny holes here and there. Once the bravest bunny poked up the cover and tried to look out. All he could see was a little roof of green grasses interlacing above the nest. The grasses rustled in the summer breeze.

During the day the babies cuddled down fast asleep. Sometimes a red ant wandered into the nest. It clambered down from wisp to wisp of dead grass and scurried across the bunnies' faces. That tickled so that they screwed up their pink noses and opened their round bright eyes for a drowsy minute. Once a big spider crawled upon the edge and stared at them with all its eyes, till the bravest bunny scared it away with a flap of his ears. Another time a bird flew down to the nest and pecked at the blanket till its bill stuck through and almost pricked one of the babies.

Toward evening the bunnies began to wake up for the night. They squirmed about, curling their toes, stretching

their long legs, and cocking their ears to listen for the mother bunny's step. At last they heard the soft thump-



thump-thump of her furry paws as she came leaping over the grass from the bushes where she had been dozing. How joyfully the babies wriggled at sight of her! As soon as she had lifted the blanket and crept underneath they snuggled close to her. They were hungry for the warm milk which she had always ready for them to drink.

As the days passed the little bunnies began to grow too big for the nest. Their hind-legs felt stronger and stronger for jumping. Indeed, the bravest bunny had a naughty way of kicking his brothers and sisters. He set his heels against their soft sides and pushed in hard jerks, for the fun of making them squirm and squeal. Sometimes they kicked back, but not very often, because they were afraid to make much noise.

Their mother taught them to be as still as they could while she was absent. The only way for such helpless little creatures to escape being eaten by their many enemies was to keep out of sight. Snakes would not notice them if they stayed quiet in the nest. Hungry hawks and owls could not find out where they were hidden if they did not move. The bit of a blanket looked like a patch of dead grass. Foxes and wild-cats and the rest could not smell them so long as they lay still.

They were timid little things, and their ears seemed to be always twitching to catch the least sounds. On some warm afternoons they woke up early, and waited for the mother to bring their supper of milk. Outside they heard

the plop of grasshoppers jumping from stem to stalk. The flutter of butterflies and the buzzing of bees over the clover-blossoms sounded loud enough. The shrill whirring of a locust made them tremble and quake. Perhaps they were afraid that it was something coming to eat them up.

When the bunnies were strong enough to leave the nest they went to live in the brush with their mother. Away they all galloped over the grass. Their long ears flapped up and down, and the furry soles of their hind-legs twinkled behind them. They did not stop to look around till they were safe in the shelter of the bushes. Then every one of them turned, and sat up on his haunches with his little fore-paws in the air. With their ears pointed forward, and their round eyes shining, they looked back at the grassy spot where they had lived in the hidden cosy nest.

At that very minute, when they were all so excited and happy, the old mother caught sight of a fox stealing after them. At a sign from her the little bunnies sat as still as if they were made of stone. They were almost the same color as the sticks and dry leaves around them. Nobody would notice them unless they should move.

But that sly old fox was not looking for them with his eyes; he was following their tracks, with his nose close to the ground. He smelled his way nearer and nearer. The trembling babies could see the sharp white teeth between his lips. His narrow eyes gleamed hungrily. Finally he

crept so near that he could smell them in the air. They saw him lift his head and snuff in their direction, one of his fore-paws raised for the next step.

Suddenly the mother bunny sprang out before his face and darted off helter-skelter into the woods. She wanted to lead the fox away from her little ones. Away she dashed under the bushes and over the logs, up slopes and down gullies, dodging now this way now that. Once he was so close that he opened his jaws to seize her. At that she turned like a flash, and ran right between his legs. Then into a swamp she went bounding in great leaps. There the fox lost sight of her, and could not find her scent in the water. She left him nosing hungrily back and forth, while she hurried back to her babies. They were sitting as still as stones just where she had told them to stay.

Almost the first thing the mother bunny did, after gathering her family in the woods, was to find different holes for hiding-places. One hole was in a hollow stump, and another was in an old woodchuck-burrow. She told the little ones that they must not go near the holes, except when they could not escape in any other way. If they went often they would make a path, and then their enemies could find out their hiding-places.

It was pleasant there in the underbrush of the woods. They felt almost safe with briers above them to keep away their hungry enemies. The smell of the mossy earth was warm and sweet. The buds and leaves and bark were spicy

and fragrant. The bunnies sniffed hither and thither, twitching their noses and jerking their ears.

When they stopped living on milk they learned to feed on grasses and juicy roots and twigs. The old mother showed them what was good to eat. Like the beavers and squirrels the bunnies belonged to the *Order of Gnawers*. Each one had four little nibbling teeth in the front of his mouth, and grinding teeth in the back. They did not have such strong teeth as the beavers, who could cut down trees, or the squirrels, who gnawed hard nuts.

Though the bunnies could not fight well, because they had no sharp claws and teeth, they could jump higher and farther and faster than any of their cousins. They soon found out that the best way to escape when chased by their enemies was to trust in the nimbleness of their legs.

Of course when they saw any hungry animal looking for something to eat it was best for them to lie perfectly still so as to avoid being seen. But if the animal caught sight of them they must run and dodge and double and hide for their lives. It was generally wiser to keep on running till the other lost the scent rather than to creep into a hole. If the hungry hunter happened to be a mink or a weasel he could crawl in after them and kill them.

The bunnies did not try to dig their own holes. They were really hares, though they were so much like rabbits, who were true burrowers. Once in the woods the bravest bunny saw a true rabbit. This rabbit had a family of little

ones in a deep burrow. They had been born blind and naked, but the little hares had been born with their eyes open and fur on their bodies. True rabbits were brought to America from across the sea.

In spite of their dangerous adventures the bunnies enjoyed the long summer. Every morning at earliest dawn up they hopped from the forms. The spot of flattened grass where each furry body had been resting was called a "form." Away to the clover-field they went leaping, one by one. There they drank the dewdrops, and ate a breakfast of sweet green leaves. They took a nibble here and a nibble there. Then they sat up on their haunches and looked around to spy out a possible enemy. Their round eyes twinkled this way and that, and their long ears twitched nervously at every sound.

The twittering of the birds did not frighten them. They seemed to know that there was no danger-signal in the rustling of leaves on the trees, or the splashing of frogs in the pond. Even the crackle of twigs under the footsteps of a deer did not send them running. They must have known that grass-eating animals would not harm them.

But the stealthy wriggling of a snake in the grass sent them scurrying wildly into the thickest underbrush. When they heard a stick crack under the trees they seemed to know at once what kind of animal was creeping near. At the soft tread of a fox or a wild-cat they sat as still as stones,

unless they knew that they had been seen. If that happened they bounded away in a race for life.

When the sunshine fell bright on some sandy hillside the bunnies went there, and stretched out like kittens in the pleasant warmth. They squirmed and blinked and turned slowly over and over. They lay on their backs and waved their paws in the air. They had five toes on each fore-paw and four on each hind-paw. Even then, while twisting and stretching in enjoyment, they were on the alert. At the sound of a caw from a neighboring tree, or at the sight of a hawk hovering far above, they all leapt to their feet, and scampered out of sight in a twinkling.

Then for hours they sat on their forms in the shade of the bushes and dozed, half asleep, but ready to bound away at the first hint of danger. The scream of a blue jay startled every bunny wide awake in an instant. The jays always saw everything in the woods. The bunnies waited, without stirring, till they could find out what the trouble was. Sometimes it was a dog hunting for rabbits; sometimes it was a snake coiled in the sun, or a baby fox playing with his own tail; sometimes it was only a red squirrel chattering and scolding at the blue jay.

On warm afternoons the winged ticks hovered about, biting the bunnies on the tips of their ears and sensitive noses. Then the bunnies hid under skunk cabbages in the marshy spots. The bad smell kept the ticks away. It was cool and pleasant there. The five babies lay still, listening

to the soft whirring and drowsy buzzing of insects, in the hot sunshine beyond the marsh.

After the sun went down the bunnies scattered to find their supper of tender twigs or grasses or roots. Always, while they nibbled, they kept twitching their ears forward and back. Every minute or two each one paused to sit erect, and roll his bright eyes in all directions. All the time his little jaws were working busily. Then perhaps they dressed their fur coats, combing their ears with their paws, and biting the burrs from their vests and socks.

Off with a hop, skip, and jump for a frolic in an open space in the woods! What a gay time the five little bunnies had there with their friends! They went leaping, one after another. Some tore through the ferns and hopped over the logs, with their long ears flapping. They sprang straight up into the air, kicking out their hind-legs. They jumped over each other, and scurried wildly round and round. One whirled about like a kitten, chasing his own short tail. The bravest bunny danced on his hind-legs all alone in the moonlight.

When summer was over the cool days of autumn found the bunnies friskier than ever. They had half a dozen smaller brothers and sisters by this time, because the old mother had two or three nestfuls of little ones in a year. There was plenty for everybody to eat in the woods and fields. The little creatures feasted on roots and apples and soft-shelled nuts till they grew round and sleek. The

bravest bunny became so fat and lazy that he hated to run. Whenever he was being chased by any enemy he slipped into the first hole he saw. He would certainly have been caught one day if the weasel behind him had not happened to have a lame foot from his last fight. When he stopped to untangle it from a strawberry-vine the bunny had time to escape.

Winter was hard on the bunny family. They could not run so fast through the soft snow as on the firm ground. Their enemies could see their footprints, and follow more easily; Often and often, when a little fellow had gone out to nibble twigs and buds, he heard something move behind him. And there, not far away, he saw a fox ready to spring on him.

The bravest bunny slept under a rotten log. He always slept with his legs doubled under him, fixed for a great jump away, in case any hungry animal came nosing around. He did not mind the cold, for his fur was fine and thick and warm. Even inside his mouth the soft fur grew, as well as on the soles of his feet.

When spring came the bunnies were more glad than any of the other small creatures in the woods. It was a joy to feel the warm breezes blow their fur. They did not care so much for the warmth as for the tender buds which it opened on the trees. Green leaves came peeping out of the ground, and flowers blossomed in sheltered nooks.

Birds were singing, and frogs began their croaking in the meadows. The woods were busy with the hurry-skurry of little feet. Now once more there was plenty for everybody to eat. The bunnies were glad because of that. But perhaps they were even more glad, because now their hungry enemies could hunt many other animals besides the timid bunnies.

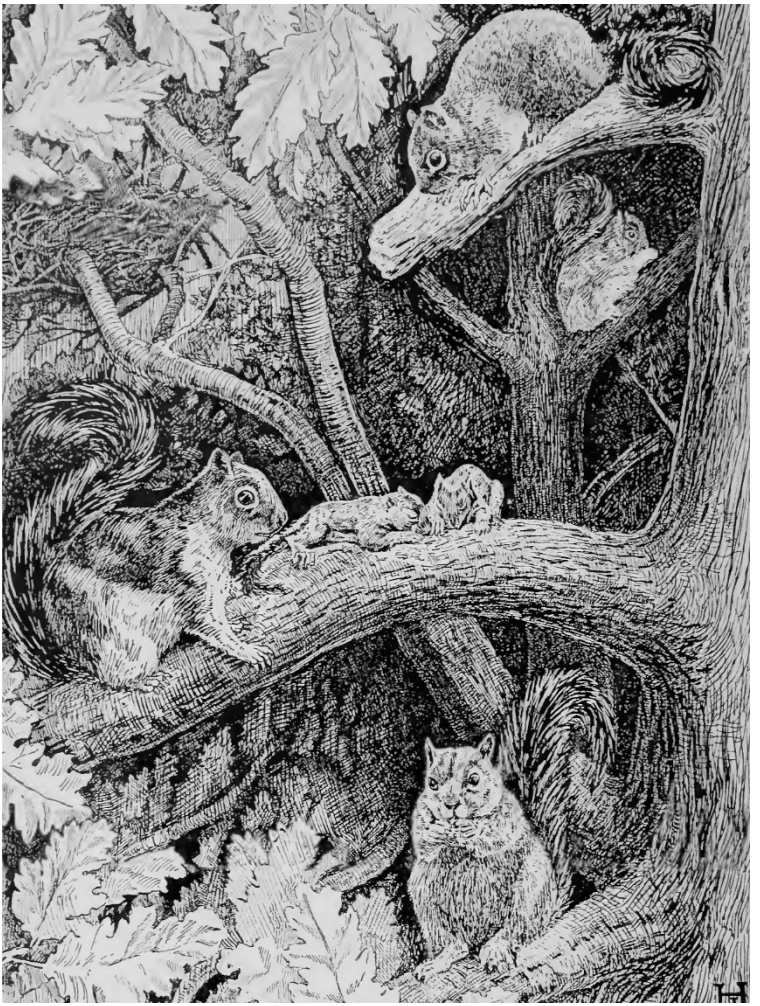
The Squirrel
"The One with the Prettiest Tail"

The four baby squirrels were tired of staying in their soft nest in the hollow tree. They wanted to find out what was going on in the world outside. As they cuddled together in the shadowy hole they could hear the queerest sounds. They cocked their heads curiously at the rustling and whispering of the wind among the leaves. They heard chirping and singing and a silvery tinkle, tinkle from the brook. Once a bee flew buzzing right over their heads, and made them clutch one another in terror.

One morning, when the old mother squirrel was away hunting for birds' eggs to eat, the smallest baby crept to the mouth of the hole and peeped out with his round bright eyes. All around and above him there were wonderful green things flickering and fluttering. Twinkles of sunlight danced through the leaves and dazzled him. Something soft and cool blew back the new bristles on his lips and ruffled his satiny red fur. He was so much interested that he sat there, staring and staring, till the other little ones began to squeak and scold him for shutting out the light.

After he crept down again to the nest the others climbed up, one by one, and looked out. They winked and blinked at each wonderful sight; they sniffed the strange

odors, and twitched their eager little heads at every new sound. The scream of a blue jay in the treetop above sent



them scampering inside again, to cuddle close together in the darkest corner. It was fun to see something new and exciting, even if it did make them shiver all over.

Soon the mother squirrel came springing from branch to branch to reach the hollow. How the babies squeaked and chattered in welcome! Very likely they told her about the wonderful sights and sounds and smells in the strange world outside the hole. The smallest one clasped his fore-paws around her neck, and coaxed her to let them all go out to find more interesting things. It was stupid there in the dark nest, with nothing to watch except the patch of light across the opening above them.

The old squirrel knew that the little ones were not strong enough yet to leave the nest. To be sure, they had grown and changed very much since the first days. Then they had been ugly little creatures, like tiny pug-dogs, with big heads, no fur, and their eyes tight shut. Now they were half as big as she was herself. Their eyes were like jewels, and their red fur was smooth as satin.

But their tails, with only fringes of hair along the sides, were not nearly so fluffy as the mother's. Her tail was long and plumy. It curved so gracefully over her back that she seemed to be sitting in its shadow. One name of the squirrel is "shadow-tail."

For a few weeks longer the four babies scrambled about the doorway and looked longingly out at the wonderful green tree-world. They did not dare to step out

upon the slender branches, for fear of falling off. It made them feel dizzy to look away down to the ground below. They did not know how to cling to the limbs with their feet while they balanced themselves with their tails.

When the young squirrels were almost strong enough to learn to run and climb in the tree, the mother began to build an airier home higher up the trunk. The old nest was growing too warm for comfort, as summer brought the long sunny hours. The squirrel father was not there to help his mate. She had driven him away before the babies came. She thought the tree belonged to her, and that she needed all the room in the hollow for her little ones. She chased him off to live in the woods with all the other squirrel fathers till the babies were big enough to take care of themselves.

The mother squirrel worked on the new nest in the early morning. She bit off leafy twigs and carried them to the top of the tree. There, where two branches forked, she packed the sticks and leaves together in a loose ball. Then she pushed a doorway through, at one side or another, just as she happened to be standing. This was not such a neat home as one in the next tree. That other mother squirrel built her new nest of strips of bark tied together with ribbons of soft fibre. Over the doorway she hung a curtain of bark, and lifted it up carefully whenever she went inside.

At last the new home was ready. The old mother hurried down to the hollow and called the babies to come

out and follow her. They stepped out, one after another, just as carefully as they could. The smallest baby came last. He dug his claws into the bark and hung on. The branch seemed so narrow that he trembled from fear of falling. The tree swayed in the wind. The branch bounced up and down, and a leaf blew in his face. The poor little fellow shut his eyes, because everything seemed to be whirling round and round.

When he opened his eyes again he saw the three other little ones climbing up the trunk above him. They clutched the bark with their claws and moved forward, one paw at a time. The mother was running on ahead of them. Every few steps she turned around to coax them on faster.

Finally they reached a narrow branch which led over to the new nest. They crawled out on it, lifting one foot and then setting it down before lifting another. The farther they crept the narrower the branch grew under them. Their little paws began to slip over the smoother bark. The one in front tried to turn around, but he was afraid of losing his balance. So they all three scrambled backwards to the safe trunk.

The mother ran back to them, and chattered and scolded. Again and again they started out over the branch, and then went scrambling back. When at last the mother had coaxed them across to the nest she looked around for the smallest baby. There he was away down at the door of

the old nest. The old squirrel was tired out. Her fur was ruffled and her ears drooped. She ran down to the nest and began to scold the little fellow. He sat up and put his paws around her neck, as if he were begging her to let him stay there. But she started him up the trunk and pushed him along to the branch. Then she took hold of him by the neck and carried him across to the new home.

After that the little ones were taken out every morning to practise climbing. Little by little they learned to balance themselves on the branches. Their tails were fluffy enough by this time to be of use in balancing. First to one side, then to the other, each baby tilted his tail as he crept along, step by step. Every day they could move a little faster. Finally they were able to chase one another up and down, from branch to branch. They went running around the trunks, skipping and leaping from slender twig to twig, and jumping from one tree to another, even through the air.

Sometimes one or another missed his footing after a reckless jump. Often he caught hold of a branch below by a single toe and lifted himself up to a firmer foothold. Or if there was no branch within reach, he spread out his fur, and flattened his tail, and went sailing down to the ground, almost as if he could fly. They never seemed to get hurt.

The little squirrels appeared to be always doing something. They turned summersaults in the grass, or swung by one paw from the tip of a tough branch. There was always something to do or to see. Now they chattered

at a blue jay, or chased a toad for the fun of watching him hop. Now they caught beetles to look at, or, safe in a tree, they scolded at some fox slinking along through the woods. And every day there was the excitement of finding something to eat.

The babies lived on milk till they were almost as heavy as their mother. Then she began to feed them with fruit and buds and grubs, which she first chewed for them. Like the beavers and the hares and rabbits each had four chisel teeth in the front of its mouth. They needed to gnaw hard nuts or bark every day to keep these teeth from growing too long.

When the young squirrels were three months old in July they were big enough to take care of themselves. Away they scampered from the old home tree and found new homes in stumps and hollows. The smallest one used to curl up in an old robin's nest to sleep at night. All day long they were just as busy as they could be.

There were cones to be gathered from the evergreens. The little squirrels ran up the trees in a hurry, and, cutting off the cones with their sharp teeth, tossed them over their shoulders to the ground. Every few minutes they scurried down to bury the cones under the pine-needles for the winter. Sometimes a drop of sticky pitch from the cut stems was rubbed against their fur. That made them so uncomfortable that they had to stop and lick it off.

The squirrels loved to be clean. Ever since they were tiny babies, with their new red fur, they always helped one another with washing their faces, and combing their tails with their claws. They were careful to run along logs over a muddy spot. If one happened to get wet he dried himself with his fluffy tail.

When they were tired of eating seeds and twigs they hunted for grubs. Clinging to the bark of a dead tree they listened till they heard something gnawing beneath the surface ever so softly. Then, tearing off the bark in ragged pieces, they pounced upon the flat whitish grub beneath and ate it up. They were fond of mushrooms, too, and seemed to know which were poisonous and which were good to eat.

But the best time of all came in the autumn when nuts were ripe. Then what fun the little squirrels had! Early every morning out popped the little heads from the hollow stumps and logs. The big round eyes twinkled eagerly in every direction. Then, whisk! they were out, with a bark and a squeak! Scampering to the top of a tree each one took a flying leap to a branch of the next. Up and down, on and across, they followed the squirrel-paths through the woods till they reached the grove, where the nuts were ripening.

It was a busy place, with little wings fluttering and little feet pattering, and yellow leaves drifting down in the sunshine. All the squirrels scurried to and fro, picking one

nut here, and another there. They sat on the branches, with their bushy tails curving over their backs, and held the nuts in their forepaws to nibble. The smallest baby could open the hardest walnut, and clean it out in less than a minute. In the oddest way he seemed to know exactly where to bore through the shell so as to strike the broad side of the kernel.

All the while the blue jays and the thrifty chipmunks were gathering nuts and corn, and hiding their stores away for the winter. That seemed so interesting that the squirrels gathered some too. The smallest one stuffed his cheeks full of nuts and scampered back to his latest home in a hollow stump. The next mouthful he brought was hidden in a fork of a tree and covered with leaves. Then he tucked away a few chestnuts in the cracks of the bark on an oak-tree. By that time he was tired of working at this, so he scurried around to find out how many nuts the other young squirrels were saving for the winter.

Autumn passed away, and the days grew colder. In the woods the leaves were all fallen and the branches were stripped bare of nuts. Every morning when the squirrels poked out their heads the air nipped their noses. Frost sparkled on the dead grass. The chipmunks had crept into their holes for the winter, and most of the birds had flown away south.

The squirrels were not quite so gay now as in the autumn days, when they danced upon the branches and

whistled and chuckled over the good things to eat and the curious sights to see. They slept with their warm tails wrapped over their noses. They still ran busily through the tree-tops, except when snow or icy rain kept them shut within their holes. They ate all the nuts they could find, and dug up the buried pine-cones. They climbed the hemlock-trees and ate the seeds. Sometimes they found a delicious frozen apple or some forgotten acorns. Once the smallest squirrel happened to dig up a heap of chestnuts from between two stones under the snow. He could not remember whether he had hidden them himself or not. How he snickered and danced when he saw them!

Late in the winter the squirrels had eaten all the nuts and cones within reach. They were so hungry on many a day that they tried to creep into a chipmunk's hole and steal his store of food. However he was smaller than they were, and he had wisely made one bend in his tunnel too small for them to pass. Then they had to live on buds and barks and seeds as best they could till spring started the tender green plants to growing.

The squirrels gnawed the bark of the maple trees and drank the sweet sap that came oozing out. Later there were elm buds to nibble and birds' eggs to suck. The woods were once more green with juicy leaves. All the squirrels went to housekeeping. Soon in almost every tree there was a new family of wondering little squirrels peeping out of their hollow with their round, bright eyes.

The Bear
"One That Sleeps All Winter"

Out in the woods the snow fell deeper and deeper. It piled higher and higher around the hollow tree in which the mother bear and her two little bears were sleeping. The snow had drifted over the opening and made it all dark inside.

Once in a while the two babies woke up and whimpered for more milk, as they tumbled clumsily about on the bed of leaves. Then the old bear opened her sleepy eyes and licked their glossy little black bodies while she nursed them. After that they all fell drowsily quiet again, and slept and slept.

So the weeks slipped away while the babies sucked milk, or slept, snuggled close to their big, warm, furry mother. She had been sleeping all winter. The autumn before she had crept into the hollow tree to stay until spring. She did not eat a mouthful in all that time.

Now as the days grew warmer outside the old mother bear began to feel more wide awake. One morning she pawed a hole through the snow at the opening of the hollow and crawled out to find something to eat. The two little bears had their eyes open at last. They lay still on the nest and blinked at the light that shone dimly in through the hole.

Now and then they heard the soft plop of a bunch of snow dropping from the evergreen trees in the woods. The bare branches of the aspens clicked together in the March wind. They heard the gurgle of water lapping over melting ice. The tap-tap-tap of a woodpecker on the bark of their hollow tree sounded like thunder inside. Once a red squirrel ran squeaking over the snow outside.

Before very long they heard footsteps thumping softly up to the hole, and their mother's big black body came scrambling in. The two cubs whined for joy, and rubbed against her legs. They were hungry again, and wanted their dinner. The thin old bear had not found much to eat herself. It was too early in the year for berries, and the ants were still in their underground homes. She had caught a frog in the brook, and found a few blades of grass to munch.

After that she went out every day, for it seemed as if she grew hungrier and hungrier. Once she found a frozen deer. After eating all she could of it she covered the rest with leaves until the next day. Sometimes she caught a chipmunk under a log. It was only in the early spring that the old black bear ate much meat, for usually she liked fruit and roots and nuts better.

Meanwhile the two little bears stayed safe in the den till their teeth were cut and the claws grew sharp and strong. Then they played outside for a little every day. They wrestled together and tumbled about in the

sunshine, like clumsy puppies. They were careful not to creep too far away from the den. At any strange sound or smell away they scampered head first into the hole, with their little wrinkled black feet kicking out behind them.

At last they were strong enough to set out on their travels with the old mother. Very likely she gave them each a good washing and combing before they started. She could use her fore-paws like hands. When the cubs squealed and tried to bite, while she was brushing them, she slapped them with her big paw. She could use her paws for digging, and for carrying food to her mouth. With the sharp claws she could tear meat or logs to pieces.

The two little ones must have been delighted to think of leaving the tiresome den in the hollow tree. Like all bears they loved to travel. Down the valley they ambled, stepping clumsily on the flat soles of their feet. Bears do not walk lightly on their toes, as do the graceful animals who belong to the cat family.

The old mother moved on with her head held low, while the babies waddled after her. They did not look around much at the wonderful mountains, with the dark evergreens and rocks scattered over the yellow gravel. They did not notice the blue sky above, for their close-set eyes were rather nearsighted. Though they could not see very well they sniffed keenly at every strange smell.

There were many new delicious smells of warm earth and green plants and furry rabbits and squirrels and birds

and strawberry blossoms. The cubs imitated their mother in everything she did. They stepped in the same foot-tracks, and jumped over the same logs at the same places. Whenever she stopped to sniff they rose on their little hind-legs and twitched their pointed brown noses in the air.

Once they came to a footprint in the gravel. It was a footprint of a grizzly bear ever so much bigger than the old black bear. The cubs looked at their mother to see how she was acting. Then they copied her. They drew back their lips from their white teeth and growled baby growls, while their little eyes gleamed, and the hairs on their backs ruffled up stiffly. Grizzlies sometimes killed black bears.

Soon they reached the spruce grove where the red ants lived. Scattered over the gravel there were rounded hills, with tiny red creatures hurrying in and out of their holes, and around and to and fro. The little bears looked at the ants and then watched their mother as she sat down beside a hill and licked up a mouthful. After a minute down they sat, and scraped their pointed tongues over the ant-hills.

The ants tasted as sour as vinegar, and made the young ones wrinkle their noses just at first, because they were used to drinking sweet milk.

More than once a fierce little ant gave a nipping bite to the red tongues that squirmed over the gravel. That made the babies squeal, and rub their mouths with their paws.

When some ants crawled up on their fur the bears licked them off without getting any gravel mixed in.

As the morning sunshine grew warmer the cubs began to feel tired and sleepy. It had been such an exciting day ever since starting out from the old den at sunrise! The mother walked off to a shady spot under thick evergreens, and they all curled down for a nap. The babies snuggled close together, curling their paws and tucking their noses into their fur. Closing their eyes, while their fat little sides heaved in a long sigh of content, they fell fast asleep. Those ants had tasted so good!

Very early every morning the two cubs set off with their mother to find something to eat. In the heat of the day they took a nap. Late in the afternoon they went out again and feasted till dark, or even later, when berries were plenty. Sometimes they slept in a hollow log, or in a cave, or in a sheltered thicket.

Before lying down the old bear was always careful to walk several hundred yards in the same direction in which the wind was blowing. If any enemy happened to follow their trail while they were asleep they could smell him in the wind and get away in time. One night they really did smell a wolf coming nearer and nearer. They stole off through the woods. The old mother showed the cubs how to step softly, setting down each big padded foot where it broke no stick and rustled no leaf.

The bears learned to eat all sorts of food. There were the delightfully sour ants in their hills or hidden under rocks and old logs. The cubs soon grew strong enough to turn over the rocks and logs for themselves. Leaning on one fore-leg, each little fellow raised the stone with the other fore-leg, and gave it a shove backward, so that it would not fall on his toes. Away rolled the stone, and down went the greedy head to lick up every ant in sight. Then a sweep of a paw uncovered the beetles and worms and crickets that had run to hide deeper. Sometimes the old mother gripped her claws in both sides of a rotten log and tore it open. The little bears gobbled up the worms and insects inside as fast as they could.

All the spring and early summer the three bears hunted for worms and insects in this way. They dug up wild roots with their noses, just as pigs do. One day the cubs smelled a delicious smell near a flat stone. They hurried to push the stone away, and there they found a heap of nuts. They stuffed their mouths full at once, while the little chipmunk, to whom the nuts belonged, squeaked angrily at them from under a heavy rock.

Later in the summer the berries were ripe. That was the time for little bears to be happy! First the fragrant red strawberries grew red in the fields. The berries were so small, and the hungry mouths were so large, that many a bite was mixed with leaves and grass. However, the cubs did not object to that, even when a fat white grub or two was pulled up with the roots of the strawberry plants.

After the strawberries other berries ripened along the bank of the river at the edge of the woods. The mother bear knew just where the biggest ones grew. Many a happy day they spent picking the fruit. When the weather was cloudy and cool they did not stop for naps. Each one walked along from bush to bush, raising his head and wrapping his tongue around a branch. Then with a downward pull he stripped off leaves and berries and all, and munched and munched. They could stand on their hind-feet to reach the higher branches.

The bears had broad grinding teeth in the sides of their jaws, and so they could chew their food. Animals like the cat and the dog have only cutting teeth. They tear their food into pieces small enough to swallow, and then gulp it down without chewing.

At noon they went down to the river for a drink. First they snuffed around carefully, and then lapped up the water. If the day was very warm the cubs waded in and lay down to cool off. Sometimes the old mother took her nap lying in the water. Once in a while they caught a frog or a live fish by giving a jump and quick slap before it could swim away.

In late summer the wild plums ripened in the woods. The old bear shook the trees and sent the red fruit hailing down upon the scrambling cubs. On one specially delightful day they found a hollow tree in which bees had been storing honey for the winter.

They saw the bees buzzing around a hole high up on the trunk. One of the cubs climbed up. Wrapping his hind-legs around the tree he held on with one fore-paw, while with the other he dipped out the honey and stuffed it into his mouth. All about him the air was gray with bees. They stung him on his nose and ears and eyelids. He did not mind that much, except when one bit his tongue. Then he thrust out his tongue and mumbled and growled for a moment. He had never before eaten anything so delicious as honey.

After the pleasant summer came the frosty autumn with its ripening nuts. The cubs climbed trees and sat on the branches, with their black legs dangling. The old bear shook the trees to bring down the nuts. Once she shook so hard that one of the little bears lost his hold and fell. He tumbled down in such a limp soft heap that he was not hurt at all, but bounded up again like a rubber ball.

At another time the mother saw a big grizzly bear coming through the woods. When the cubs heard her warning grunt they shot up the tree like jumping jacks, and hid in the thick leaves near the top. There they were safe, for the grizzly was too heavy, and its claws were too long, for climbing. Grizzly bears are the largest beasts of prey in the world. Sometimes when very hungry they will eat their cousins, the black bears.

The days kept growing colder little by little, and twilight came a few minutes sooner every evening. The air

was frosty at night, and somehow the three bears felt drowsier and drowsier. Their naps lasted longer every afternoon. On some cold days they curled up on dry ledges in the sunshine and slept from morning to night. They were sleek and fat from their feasts of acorns and nuts.

All this while the old mother bear was becoming more and more cross. When the cubs tried to play with her she slapped them, and pushed them away whimpering. It was time for them to take care of themselves. Very likely she did not want to be bothered with them all winter long.

So one day the two little bears walked off by themselves. They roamed through the woods, looking for some place which would be a warm den. One of them dug a cosy hole under a big root and curled down for his winter's sleep. The other crept between two rocks that almost touched over his head.

Outside the snow began to fall. It blew in through the cracks and powdered down upon the little bear's thick fur. Very soon it had stuffed all the cracks and drifted higher over the rocks and logs. It went whirling from the ledges into the valleys; it fell deeper and deeper over the three dens and shut out the cold.

The little bears breathed more and more slowly, with their noses warm in their furry fore-arms. Their little fat sides rose and fell ever so faintly. Their hearts beat more

softly. They were fast asleep for the winter, while the snow fell and the icy winds blew on the mountains without.

The Fox
"The Wisest One"

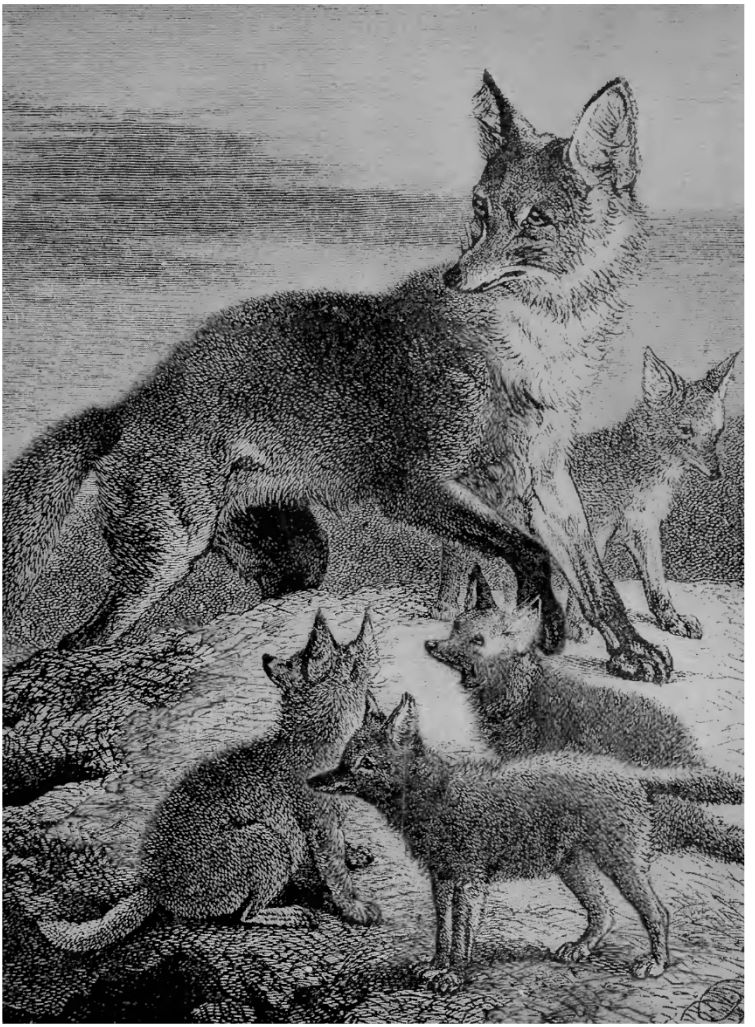
Almost the first thing that the smallest baby fox remembered was being carried in his mother's mouth from one den to another. His woolly little red body hung limp between her long white teeth. That was the safest way; for if he had held stiff or wriggled she might have closed her jaws tighter and pinched him.

It was very early in the morning, and the rising sun was just lighting up the tops of the trees. The birds were singing their gayest May songs. Here and there dewdrops sparkled, where the level sunbeams glinted across the leaves. Under a bush a rabbit sat up very still, and stared with round, frightened eyes at the mother fox.

The mother fox did not see the rabbit. She stepped along swiftly. Her slender paws hardly rustled a leaf or snapped a twig. She looked like a graceful red dog, with pointed ears and yellow eyes and beautiful plumy tail. This plumy tail seemed to float out in the air behind her, as if she were blowing lightly before the wind.

When she reached the new den she did not stop an instant at the front door. The freshly dug earth was scattered around there in plain sight. In digging this new burrow she and the father fox had left the dirt there on purpose, to make their enemies think that this hole was

the real entrance to the den. A few feet underground they had closed the tunnel with a heap of earth. At the other



end they had made a new opening hidden behind gray rocks in a thicket.

To this secret door the mother fox carried the baby, and set him down on his four thick legs. He looked like a little red lamb with yellow eyes. Into the hole he scrambled, and crept through the tunnel to the dark den at the end. On the nest of leaves inside he found his four brothers and sisters snuggling together. The old mother had carried them there one by one.

The day before, when a big dog came nosing about the old den, the father fox led him away through the woods. He could run the faster, and so he kept on, with the dog chasing him, till the dog was tired out. Then he and the mother hurried to dig this new den and move the babies before the dog came back to the old place again.

In going from one den to the other the old foxes were careful not to walk in a straight path. If they did that of course the dog could follow them by smelling their trail. They took a roundabout path every time. They trotted around a swampy meadow and crossed a brook by stepping from stone to stone. The wet ground hid the scent of their paws.

This journey to the new den was the first time that the young foxes had been outdoors. As they were carried by the neck they could not twist their heads around to see very much. But still, they must have enjoyed the light and the fresh air. They did not want to keep on staying all the time in the dark den. So early one morning they came scrambling out after their mother.

The smallest baby fox crawled out last of all. For a moment he stood very quiet on all four paws. Then he sat down and cocked his little head on one side while he looked around. The old father was lying down in the sunlight just outside the thicket. Two of the babies trotted over to him and began to play with his tail. Two others climbed upon the mother's back and pushed each other off. There they wrestled, rolling over and over in each other's paws.

The smallest baby wanted to make the others pay him some attention. He lifted his sharp little black nose and opened his mouth and began to bark—bow-wow-wow, bow-wow-wow—till the others stopped playing. They came running over to ask what was the matter. He told them something in the fox language by rubbing his cool wet nose against theirs. Then they all five trotted about and explored the thicket by smelling of everything within reach.

They poked their noses into the grass and against the trees and bushes and over every stick and stone and leaf on the ground. To their keen nostrils everything had a different smell. When the smallest baby smelled a stick he could tell which little brother or sister had been smelling it just before him.

As the sun rose higher and the air grew warmer the little fellows sat down and rested, with their tongues lolling out of their mouths. Like all foxes and wolves and

dogs they perspired through the tongue and the soles of their feet. After a while the mother gave a low growl to say that it was time to go back into the den. In they scampered head first, and curled up for a nap, with their fluffy tails over their noses.

When the babies cut their teeth the mother stopped feeding them with milk. After that she and the father fox were kept busy hunting for food for the hungry young ones. Sometimes they hunted in the daytime as well as at night. Oftener, however, the old mother stayed near the den to keep guard when the little foxes came out to play every afternoon.

Such fun as the five little ones had together! They ran round and round, chasing their tails. One hid behind a tuft of grass and jumped out to scare the others. Another climbed upon a rock and then was afraid to slide down. One went rolling down a small hill while another capered beside him and pretended to snap at him.

Once the smallest baby saw a grasshopper whizz past. He saw where it was hiding under a leaf. He crouched down as low as he could and crept toward it. Without making a noise he crawled from bush to stone, from stone to tuft of weeds, till he was near enough to spring and catch it in his paws. All the others ran to see what he had caught. The mother came, too, from the place where she had been watching him. She was proud of him because he was learning to hunt while so young.

As evening came on and the shadows lengthened under the trees the mother fox sent the babies into the den and walked away to hunt for a supper. The smallest fox happened to be the last one in. He turned when just inside and poked his pointed nose out to watch her as she trotted away into the woods.

A few hours later, when they heard her low call at the mouth of the burrow, out they came tumbling. Sometimes she had a rabbit hanging in her mouth, with its long legs on one side and its long ears on the other. Sometimes she had a young turkey thrown over her shoulders, or a fringe of field-mice hanging by the tails from her lips. Once she brought a woodchuck, and at another time a string of little chickens held by the necks.

The babies always ran and snatched for a piece. Then each trotted off alone to eat it. When they were not hungry they played with the food. They nibbled the bits, first tossing them into the air and then springing to catch them. They could not use their fore-paws so freely as animals like the cat. They growled and shook the mice to and fro in their mouths. Sometimes they snatched from one another and snapped and snarled crossly. Once the smallest fox had a fight. Every time he flew at his brother the other whisked his bushy tail in front of his face, and all the little one got was a mouthful of fur.

By and by the young foxes were taken out to learn to hunt for themselves. There was ever so much to learn

because every different animal must be hunted in a different way. The main lesson was to keep their eyes open and their ears alert and their noses keen for smelling. They must be quick to jump and wise at all sorts of tricks.

They learned to catch chickens by hiding near the place where the flock was feeding. When a chicken strayed near enough quick as a flash out jumped the fox and caught it by the neck. They chased rabbits and pounced on busy squirrels. They hunted meadow-mice in the grass, and stole silently upon careless woodchucks.

The smallest baby caught a chipmunk in almost the same way as he had caught the grasshopper. He saw the little brown animal feeding near its hole. Very slowly and carefully the fox began to walk up to it. Every few moments the chipmunk sat up and looked around. When he did this the fox stood still, and so the chipmunk did not notice him. As soon as the chipmunk dropped down on all four feet and began to nibble again, the young hunter crept several steps closer. He held his tail pointing out straight behind. At last, with a rush and a jump, the fox had the chipmunk between his teeth.

All summer long there was plenty to eat in the woods. The five young foxes grew as strong and tall as their parents. They left the old home and scattered to dig new dens here and there in the woods and fields. They all knew how to take care of themselves.

Even as babies they had learned to hold still as a stone at any strange sound. If they heard it again they ran to the den as fast as they could scamper. More than once while they lay blinking comfortably in the sunlight they saw the old father fox spring up with his ears pricked forward and his eyes gleaming. With his tail erect, his fore-feet planted in front, and his hind-feet on the spring, he listened to the sound that had startled him. Perhaps it was the bark of a dog or the scream of a blue jay over a newcomer in the woods. It was always safer for grown foxes to run from an enemy than to try to fight, for they were swift-footed creatures.

Once the smallest fox was really chased by a dog. The dog smelled his trail near a flock of chickens. He ran on with his nose to the ground till he saw the fox sitting under a tree with his tongue hanging out of his mouth. At the sound of the bark the fox looked back. Then off and away he ran lightly over the hills and through the fields. His fluffy tail floated in the wind.

Now and then the fox stopped to listen to the baying of the dog far behind him. Two or three times he whirled around, chasing his tail and capering. He knew that he could run the faster. He picked his way from stone to stone across a brook because he did not like to wet his feet. Then he ran up a tree that had fallen in a slant. He jumped from the end far over to a dead log and scampered across a rocky field. From the top of a hill he looked back and watched the dog trying to find the scent over the brook

and around the slanting tree. When he was tired he hid in a hole.

When autumn came the young foxes gathered on many a frosty night for a romp before going to their hunting. They galloped to and fro, jumping over one another and springing from log to log. It was almost the same as if they were puppies again, frisking before the old burrow. They wrestled and rolled and whirled around after their tails. Then away to their silent hunting!

When the snow fell and the cold winds blew life was harder for the foxes. Through the day generally they slept in their dens, with their tails curled over their noses and forepaws. Out they crept at sundown to hunt for a rabbit or unwary squirrel, to trap a partridge, or snatch a squeaking mouse at the edge of a stone.

Many a night some young fox went home hungry. Often he lay in the snow hour after hour till his legs were stiff, while he waited for a rabbit that stayed safe in its hole. More than once he made a dive into the snow after a partridge, only to see the bird flutter up before his very nose and fly into a tree. Very likely, as he sat looking hungrily up to the branches, he wished that he could climb trees. Undoubtedly the partridges and the squirrels did not wish any such thing.

Before spring came at last the foxes were hungry enough to eat anything. Indeed one day in early March, while the smallest one was roaming through the woods, he

happened to spy a garter-snake coiled on a rock in the sunshine. He jumped for it and gulped it down in a hurry. The next day he caught a turtle and a frog. The frog was so stiff and sluggish from its winter's sleep that it could not hop at all.

By that time it seemed that spring was really at hand. As the foxes never ate grass or leaves they did not care about the fresh green plants and buds through the woods. Nevertheless they knew very well that rabbits liked roots, and squirrels nibbled twigs, and field-mice were hungry for the sprouting seeds. When these small animals came out to eat, the foxes could hunt them more easily than in winter.

Once more the soft winds blew among the branches and the leaves flickered in the sunlight. The birds were singing overhead in the tree-tops. And here and there in the hidden thickets new broods of little red foxes were frisking together at the mouths of the burrows.

The Wolf
"The Fiercest One"

The old mother wolf came home from her hunting, licking her black lips. Her four woolly babies scrambled out of the den among the rocks, and ran to meet her. They wagged their little tails, and barked joyous baby barks. They rubbed against her legs, and reached up their little faces to kiss her on her cool nose.

After smelling them all over the old wolf lay down beside them in the den to give them their dinner. The strongest little wolf was getting tired of milk. When he had nursed for a few minutes he began to play, climbing up his mother's shaggy back and rolling down again, with his legs waving in the air.

Soon he pricked up his ears at the sound of a footstep outside the den. Then he sniffed the air. Sure enough! It was the father wolf coming in with something furry in his mouth. The cubs ran to smell it. Somehow the smell made the strongest little fellow feel so hungry that he tried to bite it with his new sharp teeth. He snapped and snarled when the old wolves dragged it away from him.

Very likely this reminded the parents that they must now teach the young ones to eat meat. So on the next evening they left the babies safe asleep in the den and trotted away together. They looked like two fierce dogs, with shaggy gray and black hair, pointed ears, and bushy


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tails. Their yellow eyes were set more slanting than the eyes of dogs.

They caught a rabbit by taking turns in chasing it till it was tired out. Then they trotted home. At the mouth of the den the mother gave a low call. There was a rustle of woolly bodies over the leaves and grasses of the nest back in the dark. And out tumbled the cubs, wriggling with joy. The father wolf, with his big teeth glittering behind his whiskered lips, tore the rabbit into pieces, and showed the young ones how to eat. Each snapped at his piece, and ran to one side alone to gnaw and pull it into bits small enough to swallow. They did not chew their food, because like other flesh-eating animals, except bears, they did not have any grinding teeth.

After the strongest baby had finished his piece he tried with a rush and a snap and a snarl to snatch from another little fellow. But the other cub held on tight with his little jaws. Then, growling and rolling his yellow eyes to watch his greedy brother, he dug a hole with his nose in one corner and buried the rest of his piece. He did this without being taught at all. Every wolf that ever lived knew enough to bury his food when he did not want to eat any more.

After their dinner the mother led the babies down the valley to lap water from the brook. It was dark by this time. Stars were twinkling in the sky. The shadowy trees swayed to and fro in the night wind. One little cub sat down on his haunches, pointed his nose at the sky, and howled. The

little ones trotted here and there, smelling every stick and stone. The scream of a far-away panther on the mountain made the old wolf growl and bristle the hairs on her back. She hurried back to the den and sent the cubs in to sleep, while she stole off to hunt for her own supper.

In the morning the little wolves crept out to play about in the sunshine. They rolled and tumbled and wrestled in much the same way as the young foxes. Like the foxes the wolves belonged to the dog family of flesh-eaters. The little wolves were stronger and larger and fiercer than the little foxes. They did not have such bushy tails.

One young wolf found bits of the rabbit's fur. He tossed and worried them, and gnawed so hard that the fur flew in his throat and nose and made him sneeze. Another saw a butterfly, and went plunging after it on his unsteady little legs. He jumped up at it, and opened his mouth to snap at it. He did not try to slap at it, as a little panther might have done, for he could not use his fore-paws like hands so easily as animals of the cat family.

All summer long there was plenty to eat. The deer in the mountains were fattening on the green grass. They could not fight very well then, because their new antlers were too soft. There were flocks of sheep on the plain. The old parent wolves prowled about every night, and often hunted in the daytime. It kept them busy enough to supply the four hungry cubs.

The two hunted together. Sometimes one hid beside a deer trail, while the other chased the deer nearer and nearer. When the deer passed the spot where the first wolf was hiding he sprang out and caught it from behind. Sometimes they took turns in chasing a deer till it was tired out. The deer could run the faster, but it always lost time by looking around to see how near the wolf was getting. Once in a while one escaped by running into the middle of a patch of cacti. The wolves could not follow there without getting their feet full of thorns. But the deer's tough hoofs protected its feet.

Later in the summer the young wolves were taken out to learn to hunt with their parents. Their legs were so long that they were good runners, though they could not climb or spring very well. The nails on their toes were short and blunt from walking, for they could not be drawn back and so kept sharp, like the claws of animals belonging to the cat family.

The cubs wore thick coats with soft underfur beneath the coarse shaggy hair. Their yellow eyes were keen, and their sensitive noses were quick to catch every smell of the wilderness. Their jaws were strong for snapping, and their many teeth were sharp for biting and tearing. They could scent the wind and howl when a storm was coming.

About sunset, one summer day, the little wolves followed the old ones away from the den. Down the canyon they trotted silently, winding in and out among

the rocks like gray shadows. Far up the mountain-side a flock of wild sheep went leaping away in terror at sight of the wolves.

On the plain below rabbits scurried off, bounding from hillock to hillock. Prairie-dogs dived, squeaking, into their holes. A fox looked around in fright, and dodged into a clump of underbrush. A small herd of buffaloes, on their way to the river, ran close together and stood with their horns outward, while the wolves skulked past.

Perhaps, just at first, it seemed strange to the cubs to see all other animals afraid of their parents. At home the two shaggy old wolves were gentle and warm and soft toward the little ones. They fed them and watched over them and taught them all they knew. The babies whimpered when the old wolves left them alone in the den; and they barked and frisked with joy to see them come home again.

Out here on the plain it was different. The sight or smell of a wolf sent all the timid wild creatures flying in a scramble and hurry-skurry to get safely out of the way. The sound of the hungry howling made them tremble with fear, for they knew what it meant. It meant something shaggy and gray, with gleaming eyes, galloping swiftly nearer and nearer. It meant the glitter of long teeth behind grim black lips. It meant a spring and a snarl and tearing pain, and then a crunching of bones.

The first lesson that the young wolves learned was to take the trail and run it to earth. The father wolf showed them how to do it. He led them over the plain toward a cluster of trees along the river. He lifted his nose and snuffed the air. He smelled something in the wind that was blowing toward him from the woods. It was not the smell of trees or grass or flowers or birds or squirrels. It was the smell of deer.

The four cubs followed the old one as he galloped under the trees. They saw him stop and go sniffing here and there with his nose to the ground. Yes, he could smell the place where the slender hoofs had been pressing the grass a few minutes before. He ran on, with his nose to the ground. The others galloped after him, their heads low, their tongues hanging out, their tails held straight behind.

Once the father wolf howled. The young ones looked up for an instant. There, far away in the dusky woods, the deer were bounding lightly over the dead logs. They turned their pretty heads now and then to look back, till they vanished from sight. The wolves kept on for a few miles, learning to pick up the scent on the run. Then they found a half-eaten buffalo in a hollow, and stopped there for supper.

Through the late summer and early fall the young wolves hunted with their parents. During the day they stayed up in the mountains and slept in sheltered places. Sometimes they were scattered miles apart. At nightfall

they called to one another with piercing howls, till they finally gathered about the old father wolf. Then they all set out to hunt together.

Sometimes they moved single file, stepping in one another's tracks. They swam across the river and stole noiselessly through the woods. The timid sheep were easiest to kill because they could not fight. When they found a calf or sick old buffalo one sprang at his head while the others attacked from behind and bit his hind-legs. If the wolves went too near a herd the old buffaloes tried to hook them. Once a cub started to catch a young elk, but he was chased away by the old mother elk. They butted at him with their heads and struck at him with their sharp hoofs, while he ran with his tail tucked under him.

Autumn was pleasant enough with its bright days and frosty nights. The busy little creatures of the woods were gathering in their winter stores. Buffaloes and deer were fat from their summer's feeding, and could not always run fast to get out of the way when chased by the wolves. Plump rabbits and prairie-hens were everywhere for the catching. Many a night the cruel wolves killed more than they could eat.

But soon winter came with its shortening days and gray storms lowering above the horizon. Snow fell, and icy winds blew across the frozen land. The deer and elk and antelope gathered in sheltered valleys. The wolves

wandered down from the mountains, and roamed far and wide, hunting for food.

So long as the fresh snow lay soft and powdery in the gullies they could not run fast enough to catch anything, but when the snow packed hard, and an icy crust formed over the drifts, their spreading feet did not sink in deeply. Then they could go out and hunt the elk and the deer, whose small hoofs cut through the crust at every bound.

The young wolves felt hungry all the time. Sometimes, when a blinding storm shut them into their den among the rocks, they went without eating day after day. The fine snow sifted down upon their glossy winter coats as they lay close together, snuggling their cold noses into one another's fur. Many a night they dreamed of eating, and snapped and swallowed greedily in their short, uneasy sleep. Once, in nosing about hungrily, the strongest little wolf happened to find a bone that he had hidden and forgotten weeks before. With a spring and a snarl he crunched it between his white teeth and gulped it down in a hurry.

One winter evening the four cubs, with their parents and five or six others, were following a herd of buffaloes. On galloped the buffaloes over the frozen plain. Behind and around them the dark forms of the wolves seemed to rise from the bushes and follow noiselessly. There was not a sound of a snap or a snarl. Now on this side, now on that,

now lost in the shadows, the wolves galloped tirelessly on and on.

Here and there two eyes gleamed in the dim circle of a head, or bared white teeth glittered for an instant. Then again lost in the dusk, without the patter of a footfall on the snow, they edged nearer and nearer. Finally there was a sound of snarling and yelping. The wolves were fighting together over a dead buffalo. They ate him, and then broke away over the plain at a full jump, howling as they went.

Winter was over at last. The wolves were thin and fiercer than ever. Their grim black lips were always ready to curl back over their teeth at the smell of food. They felt such a dreadful gnawing emptiness inside that they were frantic to eat anything. When they began to grow weaker and weaker from hunger the welcome spring brought them new life.

Now in the time of pleasant weather and the plentiful food it was no longer necessary for the pack of wolves to hunt together. They were strong enough to look out for themselves. So the wolves scattered to make their summer homes in the loneliest spots among the mountains.

The weeks passed by, and soon there was many a new family of woolly little cubs frisking about the rocky dens. The fathers and mothers watched them lovingly. The black lips seemed almost smiling and the fierce eyes grew

soft. They were gentle and happy there together, though so cruel and hateful to all the world outside.

The Mole
"The One that Digs the Best"

Deep down in their dark room underground the five mole babies lay fast asleep on a soft bed of leaves and grasses. The bed was not much bigger than a robin's nest. The little moles cuddled together, with their pointed pink snouts resting on one another's satiny bodies. Their little hind-feet sprawled behind them, and their big flat hands, with the pink palms turned outward, were spread close to their necks.

Presently the fattest little mole opened his black specks of eyes, though they were not of much use down there in the dark. He wriggled his pointed snout as he sniffed the air. The faintest of breezes floated toward him through one of the round openings in the wall. It was a breeze caused by something running toward the nursery. Tiny feet came galloping nearer and nearer. There was a light rustle of fur brushing along the tunnel. It was the mother mole hurrying back from her hunting.

All the little moles jumped wide awake in an instant when their sensitive bodies felt the quiver around them. It seemed to them that the earth shook under the mother's pattering feet. Of course they were not afraid, because they knew from the smell who was coming. And then, just as soon as they smelled the worm that she was carrying in

her mouth, they began to tumble over one another to snatch at it.



The greedy young ones shoved and pushed and fought as if they were starving. They pulled at the worm with their claws, and snipped off bits with their sharp teeth. Even after it was all eaten they went nosing around in the dark and squeaked for more. The fattest little fellow crawled so far into one of the tunnels that he almost slipped into the tiny well which the parent moles had dug when they made this underground home.

The poor old mother lay down to rest for a few minutes. It seemed as if she did not have time to eat or sleep since the babies had cut their teeth and learned to eat worms. They were always hungry. As for herself, though the old father helped her hunt she was really growing thinner every day. The young moles were six weeks old now, and it was time that they learned to hunt for themselves.

The babies were eager enough to learn to dig and hunt. They were tired of staying in that dark nursery, even if it was so comfortable, with its domed roof and soft, dry bed. Perhaps they wished to poke their heads above ground just once and find out what the world was like. They did not know the difference between day and night yet, for where they lived it was always dark.

When at last the five young ones started out to learn to dig they followed the mother in single file along the main tunnel. This main tunnel was long and straight. Its walls were pressed smooth by the bodies of the old moles in

their many journeys to and fro. Branching off in every direction from the main road there were side tracks zigzagging and curving hither and thither. These side tracks had been dug by the parents when they were chasing worms or hunting for grubs and beetles.

The babies scampered on to the end of the main tunnel. There the ground happened to be soft enough for their little claws. They crowded against one another, and squeaked and twitched their short tails impatiently. Their pink snouts were already bending and twisting in eagerness to be a-digging.

The fattest little fellow was in such a hurry to begin that he did not wait to be told. He nosed along the wall till he found a good place to start. Then planting his small hind-feet down flat, to brace himself, he set his tough snout against the dirt and pushed as hard as he could. At the same time he dug his claws into the wall and shovelled away with both his big broad hands.

There they went—the five babies—digging five little tunnels in five different directions. The dirt flew thick and fast as they shovelled it out and tossed it aside. But the specks of eyes were safely hidden under the fur, and the invisible ears and nostrils were kept closely covered too. When the dirt clung to their satiny gray fur they shook it off clean with a quick shrug of the skin. The hairs of the fur grew straight out, and so it made no difference whether it

was rubbed one way or another. It was never bristly or rough.

It must have been fun to go scrambling through earth almost as birds fly through air or fishes swim through water. The moles had such tough snouts and strong arms and powerful hands that they could burrow better than any of the other mammals.

One little mole burrowed on till his arms were so tired that he gave it up. He crept backward down his new tunnel to the spot where the old mother was waiting. Another kept on digging faster and faster till he ran his pink snout bump against a stone, and almost made it bleed. A third pushed on and on till he reached a patch of slimy mud that caved in over his back and sent his feet slipping and sprawling. The fourth dug till he came plump upon a fat white grub curled among some roots of grass. The little mole gave a jump and gobbled it down quick as a wink.

The fattest baby burrowed farther and farther till he felt the soil crumbling above him. Something warm was shining on his gray fur. He lifted his head and poked his long snout up into the sunlight. He blinked his twinkling, tiny eyes and sniffed the strange fresh air. But he stayed there only for a minute, because he did not like it the least bit. The light dazzled him, and the warmth dried his cool, pink hands and made his head ache and his snout twitch uneasily. So after that one disagreeable minute he turned

and kicked up his little hind-feet as he dived back into the moist, cool, dark, delightful places underground.

After this first lesson in digging the five young moles were running in and out of the nursery every few hours, night and day. It was easy enough to burrow away in search of the stupid white grubs or the beetles lying sleepy and still in the soil; but it was harder and much more exciting to hunt earthworms, because they always tried to wriggle off as fast as they could go.

Then how the dirt flew as the little hunter burrowed madly in pursuit! Now in this direction, now in that, he chased, pushing with his snout and tearing with his claws. Once in a while he stopped quiet to listen and feel the ground for the faint quivering caused by the worm in its squirming hither and thither.

An hour or so of such lively work was enough to tire even a stout young mole. After eating what he had caught, sometimes he ran back to take a nap on the soft bed in the nursery. Sometimes he lay down in the main tunnel to rest; but that was not so pleasant, for it seemed as if one or another of his brothers and sisters was forever trying to scramble over him.

The busiest time for hunting was at night, or in the early morning, because then the worms began to move about after lying quiet all day. In dry weather the worms went deeper into the ground to find moisture. In wet weather they wriggled toward the surface, swallowing bits

of dirt as they went. The little moles liked rain best because it was much easier to push through the light soil above than to tunnel through the hard ground below.

After the young ones learned to hunt for their own food it was not long before they had found and eaten every worm and grub and beetle anywhere near. The old and new tunnels ran in every direction, curving, zigzagging, and criss-crossing through the ground. There was hardly a spot of solid earth under all the grass in that meadow.

Now and then on cool nights the whole hungry family crept outside and prowled about, looking for lizards, snails, or frogs. Once in a while one of them found a dead bird or mouse or small snake. He sprang on it and tore it to pieces in an instant. The moles always ate as if they were starving. Drawing back their heads and hunching their backs they stuffed the food into their mouths with their clawed hands.

As summer passed on the young moles began to grow discontented. They were tired of staying at home. They were too big to crowd upon the nest in the nursery. Whenever two met in any of the narrow tunnels one had to back into a side track to let the other pass. The water was stagnant in the wells. Food was getting more and more scarce. Many a time there was a sound of scratching and fighting in the long dark halls of that underground home.

Soon each little mole began to think of having a home of his own, where there would be nobody else to crowd him, or quarrel with him, or snatch the best of everything to eat. So presently, one by one, they wandered away to find pleasanter places. One prowled into a garden, and tunnelled ridges all over the green lawn. One stumbled into a pond, but he did not drown, for he could swim with his webbed feet. He swam across to a small island and dug his house under a bank where he could catch plenty of frogs.

The three others strolled into a field that had been freshly ploughed. The soil was not wet nor hard nor stony, but just what they liked best. Each one chose a corner, and ran his main tunnel from end to end of the space to be used for his hunting ground.

The five new homes were much like the old one. Each had a domed underground room with a nest of leaves and grasses in it, and several outlets to allow escape in case of danger. Each had one or more main tunnels, with smooth-pressed sides and many zigzag side tracks leading in all directions. Each one had tiny wells of water, and little storerooms for the winter supply of earthworms.

When winter came, and the ground was frozen hard above, each little mole, alone by himself, dived down into his safe deep nest and stayed there till early spring softened the soil. Then, livelier than ever, he shovelled his way out to the surface to find a mate. Soon in every

pleasant little home under the ground there was a new family of soft, round babies, with their specks of eyes deep hidden in their satiny gray fur.

The Bat
"The One with Wings"

Very early in the spring the little brown bat was born far back in the cool darkness of an old cave. All about him hundreds of mother bats were hanging, heads downward, from the black roof. They clung by their hooked claws to the rocks and to one another as they hung there, still drowsy from their long winter's sleep.

He was a tiny baby,—no bigger than a bean. His bits of eyes were tight shut, and his little skinny wings were folded close around his naked body. The mother bat looked like a furry mouse, though her tail was shorter, her ears were much larger, and her teeth were pointed instead of edged like chisels.

She had awakened enough to turn about and hang by her hooked thumbs instead of her feet. She held the baby in one of her wings while she nursed him. They were wonderful wings, made of thin skin stretched over her long fingers, like cloth over the ribs of an umbrella. Her fingers were longer than all the rest of her body. The wings reached from her hands to her hind-legs and short tail. Sometimes the baby lay in the little cradle of skin that spread from her legs to her tail. Sometimes he swung in a fold of her wing.

There were many other babies in the cave. Each one was clinging to its mother with its strong little claws. The old bats had been hanging there asleep all winter long



without eating or drinking. Their hearts beat very slowly, and their breath came faintly as they slept and slept, waiting for the spring to rouse them.

Day by day the frosty air outside grew warmer and came stealing gently into the shadowy place. The bats began to breathe more deeply. Here and there one stirred uneasily, raising drowsy eyelids, and fanning herself with one wing. Some squeaked softly as they twitched their long ears and sniffed with their crumpled noses. Presently they started to crawl up and down the walls. They shoved awkwardly against one another as they dragged themselves along by hooking the claws of their feet into the rough rock.

More and more restless and wide awake the bats became as the weather changed to mild spring sunshine. They knew that now they could find insects to eat outside. So one after another let go her hold and dropped into the air. Then turning a summersault to get her head up she went flapping away to the mouth of the cave.

The baby's mother flapped out after the others, while the little one clung head downward to her fur. His eyes were open by this time and the silky fur was growing on his tiny body. His needle-like teeth were pushing through his gums, and his wings were getting stronger every day.

It was just at dusk when the young bat felt himself sailing out of the cave. If it had been bright daylight he could not have seen anything at all, for his eyes were made

to use in the dark. To be sure, even now he could not see much, because his mother was flying so fast that it made him dizzy.

Her broad wings went flap, flap, flap above him while he clenched his claws more tightly into her fur. His tiny head swung to and fro below as the old bat darted this way and that. Every minute or so the baby heard her lips suck something into her mouth and her jaws snap shut. Then came the crackling of a brittle shell as her pointed teeth crunched and crunched. He could feel her swallow once or twice and go darting away after another insect.

Long before daylight the bats flew back to the cave and hung themselves up, heads downward, to sleep through the day. After sunset they flitted out again to hunt for their supper,—or breakfast, it might be called. Of course all the young ones went with their mothers everywhere.

One evening, while the baby's mother was flying along as high as the tree-tops, she stopped so suddenly that the little fellow lost his hold. When he felt himself falling down through the air he flung out his wings. Almost before he knew it he had flapped his head up and was flying all by himself.

His knees were hinged behind and bent forward at the same time with his elbows. His tail could be used like a rudder. When he gave it a whisk toward one side it sent him darting away toward the other. He learned how to climb up, up, up so lightly, and then sink downward with

wings held motionless. It was such fun that the baby could not keep silent. Opening his wide mouth he uttered tiny squeaks and screams of joy as he flitted hither and thither.

Soon after this first lesson in flying he learned to catch and eat all sorts of insects. Every evening, at sunset, when the light began to grow dim at the mouth of the cave, the young bat followed his mother out into the cool, sweet dusk. He flew close behind her while she led the way to the pond. There they skimmed along, just above the water. Sometimes they dipped down for a sip as they went darting to and fro after the dancing gnats and mosquitoes.

At first very likely the little fellow did not catch all he needed, for he was not yet able to turn quickly enough when they slipped out of his path. Often and often, at sight of a swarm rising and falling in a glistening cloud just before him, he made a dive with his mouth wide open, only to find that they had scattered like magic. There he was left hungry, with not even one of their glittering wings to tickle his tongue.

Moths were easier game, as they fluttered over the night-blooming flowers. He could see their bright wings from a long way off. Many a chase they led him, darting through the trees and wheeling about the bushes. Once in a while he found a sleepy butterfly among the dewy leaves, or a cricket chirping in the warm dusk of the summer fields.

It was hard to hunt insects on the ground, because the young bat could walk only by dragging himself along with his hooked thumbs, while his folded wings stuck up like the hind-legs of a grasshopper. When he did happen to catch something crawling on the grass he spread his wings over it to keep it from getting away; then he thrust his head down beneath and snapped it up. He drew food into his mouth by a succession of eager bites and sucks. Sometimes it took him several minutes to eat one large fly.

For a time the baby was afraid of beetles, because the first one that he caught gave him a nip with its sharp pincers. It was a big green beetle with a hard shell. The little bat was trying to shear its wings as he had seen his mother clip off the wings of moths and flies. When he felt the stinging nip he dropped the beetle and flew squeaking to his mother.

He was not so much afraid of the red June-bugs in the early summer. Many a one he caught kicking on its back in the grass. Dozens of them he chased as they plunged humming through the soft darkness when the fire-flies were sparkling here and there. One night he flew so far in his hunting that he lost sight of his mother. Then he knew that he was lost. He flitted to and fro in the woods calling for her.

A big gray owl heard him and came whirring softly through the shadows. But the little bat felt it coming and slipped away among the trees. In and out between the

leaves and branches he threaded his way, without bumping against the slenderest twig or scraping his wings over the smallest bud. Even with his eyes shut he could fly without knocking into anything. All the sensitive skin on his body and wings seemed to feel, without touching, if so much as a spider's web swung across his path.

Daylight dawned while he was still flitting noiselessly through the strange woods. The first sunbeams dazzled his eyes, and the warm air made him feel feverish and uncomfortable. Finally he crept beneath the shadiest bush he could find and hung himself up by his hooked feet under a broad leaf. There he stayed quietly all day, only stirring uneasily and hitching farther into the shade when a sunbeam slanted through the leaves around him.

At last the sun went down and the cool dusk gathered in the woods. The lost baby bat opened his little eyes in the darkness that he loved so well. Almost all animals that sleep through the day have large eyes by which they see at night. Bats, however, have such sensitive skin to feel their way about that they do not need very keen sight.

Somehow, after flying for a long time, the young bat found his way home to the old cave. The other babies had not even missed him. They were squeaking and fluttering together. Some were playing on the ground, pretending to bite at one another as they dragged themselves to and fro in their queer hopping run. Some were washing their faces and combing their hair after their suppers. The bat who

had been lost was almost too happy to eat. He flew to his corner and fell fast asleep, wrapped in his own skinny wings beside his mother.

So the summer passed away. As the days grew colder in the autumn there were fewer insects to catch. Though the nights were longer the bats did not hunt so many hours as before. They were sleek and fat from the good eating all through the warm weather. Now they hardly felt hungry at any time. They seemed to grow sleepier and sleepier.

When winter had really come, and the frost had nipped the last insect from the air, the bats flitted into the cave to stay. They hung themselves up close together, clinging to the rocky roof or to one another. They wrapped their skinny wings around their plump, furry bodies and went fast asleep. Their little hearts began to beat more and more faintly. The blood ran more slowly in their veins, and their skin grew cooler in the cold air far within that dark place. There they rested, sleeping peacefully, till spring came to wake them with its warm breezes and hum of many insects in the sunshine outside. When the twilight gathered still and dusky, out flew the furry bats and darted hither and thither with a soft flap-flap-flap of their wonderful wings.

Selections from

Animal Secrets Told:

A Book of Whys

by

Harry Brearley

Preface

This is not a work of science save in a broad interpretation of that term. It is believed that it will not be found to contain inaccuracies of statement, but any one who looks to the following pages for comprehensive treatment or even scientific arrangement will look in vain. Furthermore he will entirely misapprehend their purpose which is as far as possible from the text-book idea.

"Animal Secrets Told" is intended much less as a means for conveying information, than for suggesting, and if possible stimulating the use by the reader of those original powers of observation and deduction by which he may gain knowledge at first hand.

These powers are natural and active in the mind of the child. He is surrounded by a world of crowded wonders which must at first produce the sense of confusion, but the innate orderliness of his mental action soon manifests itself in his commencing to ask "Why?" In other words he perceives that this is a world of Reason—that there is Law behind these phenomena—and it becomes at once a keen, intellectual pleasure to find these reasons, and then by applying straight-forward childish logic to uncover the law.

No parent need be told how active is this phase of childhood, nor how the rapid fire of "Whys" from little lips is accompanied by the rapid expansion of the little mind.

But the grown person is apt to become mentally lazy and to wish to receive his knowledge in predigested form, whereby it happens that the fascinating glamour of those early "golden days" passes swiftly away.

One's arm will shrivel if he never use it, one's teeth will decay if he neglect to chew. One's eye was intended for *seeing* not for *looking*, but steadily neglected for years in its higher function it becomes at last a mere dull looker upon a leaden-colored world, where the truer-visioned child finds light, color and enchantment.

As a matter of fact the world is as fascinating a place as ever. It has not changed its capacity during the few years since childhood. The dreary, unimportant phenomena which seem to fall into a heavy-footed procession of endless repetition, are in reality dancing forth alive with interest and almost bursting with significance as the *seeing* eye would at once perceive.

The many admirers of Conan Doyle's great detective will remember how Sherlock Holmes was one day found, by Dr. Watson, inspecting "a very seedy and disreputable hard felt hat, much the worse for wear and cracked in several places." Invited to examine it for himself the narrator continues: "I took the battered object in my hands and turned it over rather ruefully. It was a very ordinary black felt hat of the usual round shape, hard, and much the worse for wear. The lining had been of red silk, but was a good deal discolored. There was no maker's

name; but, as Holmes had remarked, the initials 'H.B.' were scrawled upon one side. It was pierced in the brim for a hat-securer but the elastic was missing. For the rest, it was cracked, exceedingly dusty and spotted in several places, although there seemed to have been some attempt to hide the discolored patches by smearing them with ink.

"'I can see nothing,' said I, handing it back to my friend.

"'On the contrary, Watson, you can see everything. You fail, however, to reason from what you see. You are timid in drawing your inferences.'

"'Then pray tell me what it is that you can infer from this hat?'

"He picked it up and gazed at it in the peculiar introspective fashion which was characteristic of him. 'It is perhaps less suggestive than it might have been,' he remarked, 'and yet there are a few inferences which are very distinct, and a few others which represent at least a strong balance of probability. That the man was highly intellectual is of course obvious upon the face of it, and also that he was fairly well to do within the last three years, although he has now fallen upon evil days. He had foresight, but has less now than formerly, pointing to a moral retrogression, which, when taken with the decline of his fortunes seems to indicate some evil influence, probably drink, at work upon him. This may account also for the obvious fact, that his wife has ceased to love

him...He has, however, retained some degree of self-respect...He is a man who leads a sedentary life, goes out little, is out of training entirely, is middle-aged, has grizzled hair which he has had cut within the last few days and which he anoints with lime-cream. These are the more patent facts which are to be deduced from the hat, also by the way, that it is extremely improbable that he has gas laid on in his house.'"

The mystified Dr. Watson, as will be remembered, asked how it was possible for his friend to come to any such conclusions. To quote the narrator a little farther:

"'...I must confess that I am unable to follow you. For example how did you deduce that this man was intellectual!'

"For answer Holmes clapped the hat upon his head. It came right over the forehead and settled upon the bridge of his nose. 'It is a question of cubic capacity,' said he: 'A man with so large a brain must have something in it.'

"'The decline in his fortunes then?'

"'This hat is three years old. Those flat brims curled at the edge came in then. It is a hat of the very best quality. Look at the band of ribbed silk and the excellent lining. If this man could afford to buy so expensive a hat three years ago, and has had no hat since, then he has assuredly gone down in the world.'

"'Well that is clear enough, certainly. But how about the foresight, and the moral retrogression?'

"Sherlock Holmes laughed. 'Here is the foresight,' said he, putting his finger upon the little disc and loop of the hat-securer. 'They are never sold upon hats. If this man ordered one it is a sign of a certain amount of foresight, since he went out of his way to take this precaution against the wind. But since we see that he has broken the elastic and has not troubled to replace it, it is obvious that he has less foresight now than formerly, which is a distinct proof of a weakening nature. On the other hand, he has endeavored to conceal some of these stains upon the felt by daubing them with ink, which is a sign that he has not entirely lost his self-respect.'"

The other points of the summary were the result of deduction quite as plausible and Watson was forced to realize the truth of his friend's charge: *"You can see everything. You fail, however, to reason from what you see."*

All may not become like Sherlock Holmes in degree, but the same powers of observation and deduction are universally present in some degree, and also far too widely neglected.

There has been happily of late years a strong tendency toward a closer understanding of Nature's phenomena, particularly of Plant and Animal Life, which has generally taken the form of reading books upon these subjects and attempting to find illustrative instances in Nature. This is so excellent that nothing in these pages must be understood as implying the slightest criticism of such

methods. The output of popular Nature books has included many of remarkably high order, and their reading is broadening and uplifting. "Animal Secrets Told" merely purposes to suggest that each observer make his own some measure of the *principles* which have led to the accumulation of the knowledge in the books. It has all been derived from Nature in the first instance through the medium of human eye and brain, and similar eyes and brains are possessed by multitudes who feel a strange timidity about using them in their natural functions—in other words in seeing and asking "Why?"

The writer has on various occasions taken children to the Zoological Park or Museum of Natural History with this thought in mind, and the delighted avidity with which they have seized upon the idea of working out their own reasons by analysis and deduction gave it the elements of a game. Grown people as well have come easily under the spell of doing what so many adults have hardly grasped as possible to them, viz.: learning things for themselves instead of waiting to be told.

The great Animal World offers exceptional opportunities of this sort as the following pages may suggest. In presenting them the writer wishes to add several earnest qualifications. It must not be thought that there is the slightest disposition to ignore the painstaking thoroughness of method by which scientists have delved so deeply into the secrets of Nature. On the contrary every exercise of mind however humble along similar lines

should but deepen the respect of the amateur for the specialist by establishing the bond of sympathy.

It must not be thought for a moment that difficulties are to be minimized and a premium placed upon "cock-sureness." Indeed the observer will come upon many questions which will not respond to the first application of his "Why?" nor to the second, nor the third. In this respect he is also like the trained Naturalist far, far beyond him on the road but also winning slowly Nature's reasons and also still confronted by the great mass of the thus-far unexplained. He will realize, however, as does the other, that there are reasons, and in this search will come ever into closer harmony with that vast orderliness of Nature which transforms and hallows it to the student.

No apology will be made for the unscientific irregularity of the following presentation. A study of systematic zoology is heartily recommended to every reader, but a classification which requires expert knowledge of comparative anatomy, with a technical study of bones, teeth and organs is apart from the purpose of this little work. It has been sought instead to start from the standpoint of the absolutely untrained reader, who forms and who will continue to form the great bulk of the total public, and then without the use of microscope or scalpel to suggest such simple and obvious reasoning as will come within his powers.

Animal Secrets Told

Eyes

One may wander through a Zoological garden with this subject of Eyes in mind and perhaps the very first thing to strike his attention will be the fact that many of the animals return his gaze from two eyes placed squarely in front like his own, while others can see him best with but one eye at a time, theirs being upon the sides of their heads. Practically all of the animals appear to be in one or the other of these two classes. He wonders Why. Then he notices that the Front-eyes are found in the various members of the Dog family, such as the fox and the wolf, in the lions, tigers, leopards and all other cats, bears and a variety of other animals; while the Side-eyes comprise a great list, running all the way from the towering giraffe to the tiny mouse, and including the Deer family, the Cow family, the Squirrel and Rabbit families and a multitude beside. It all looks accidental, for what has a giraffe in common with a mouse? And then perhaps he remembers some day having seen a cat intently watching a mouse-hole or a dog coursing a rabbit and realizes in a flash that an animal whose instinct it is to hunt for its food must have eyes placed directly ahead, and at the same moment there comes the rest of the answer—the "Side-eyes" are the *hunted* creatures endowed with eyes which look in opposite directions to warn them of approaching danger.

To the giraffe indeed, whose great size renders him particularly conspicuous, Nature has been especially kind in giving him large projecting eyes and grooving his skull behind them in such a way that he can actually catch a glimpse backward.

What could be more simple—Front-eyes and Side-eyes—the Hunters and the Hunted, through all variations of form and size? There are, it is true, exceptions, some of which will be noted under Birds, but among Mammals this rule seems to be nearly a general one.

The Cat's Eye

Everyone knows the cat's eye, with its strange elliptical pupil, changing from a narrow vertical line in bright sunlight to a wide ellipse in the twilight.

Probably most children have also asked the reason and been told that the pupil is in reality an opening which lets light into the back part of the eye, so that in the night time, when cats like best to seek their food, it must open widest to admit all of the faint light possible. Most children know something of this and yet probably few, even of their elders, appreciate the advantage of such an arrangement as fully as did the man who furnishes the following experience:

"I was being treated," he said, "for a trouble in one of my eyes and had for several days to apply atropin to it. This atropin had the effect of greatly enlarging the pupil

so that ordinary daylight became extremely painful to me and I was forced to keep my eye well bandaged. However, when I stepped into an unlighted room after nightfall the effect was interesting. Laying aside the bandage I found my doctored eye to be much more serviceable than the other one. Closing first one eye and then the other I would notice how the gloom, to my well eye, in which objects were barely discernible, became suddenly illuminated as soon as I tried its fellow pupil, and the furnishings of the room fairly started out of the darkness on all sides. I could realize as never before how a cat with its great pupils might go swiftly and surely where a man would only stumble and feel his way. My oculist also assured me that it was not uncommon for astronomers to treat their eyes with atropin during a total eclipse of the sun in order to observe more clearly."

Of course most animals have pupils which contract and expand to some extent, but the cat's advantage lies in the peculiar shape which makes this possible to an extraordinary degree, not unlike the looping back of curtains from the side until nearly the entire iris may be opened to gather in light rays. At the same time this wide opening would cause the animal blindness in sunlight did not nature provide for its automatic closing to a mere slit in the daytime.

The fox, also, that cunning night-raider of the dog family, unlike the rest of the canines, has this same

contractile pupil, and so have some of the night reptiles, such as the alligator.

The Owl's Eye

Here, indeed, is an example of a night-seeing eye which is frequently nearly blind in the daytime. Compared with that of the hawk or the eagle the owl's eye is enormous and is fitted to gather in many more light rays, so that daylight with most varieties is too dazzling for comfort. Therefore the owl retires into some dark retreat at sunrise and waits for the shadows of the next night to bring it both vision and food, since it feeds upon mice and other small animals which venture out in the darkness.

The owl is the only front-eyed bird. Remembering what has already been said this would indicate that it is a hunter. Still the owl is only one of many hunting birds, of which hawks and others have their eyes upon the sides of their heads. This seems a bit perplexing until we remember that the owl is the only *night* hunter among birds—the insect flight of nightjars and their kind being hardly to be classed as hunting.

The daytime birds of prey sight their quarry from a height and need to command a wide range with their vision, while the owl wings noiselessly through forest darkness, peering into every place of concealment much as might a prowling fox and must have eyes so placed as to accomplish this use.

The Eagle's Eye

Sometimes a man is spoken of as "eagle-eyed." Such a man generally has a bright eye and an overhanging brow and whether he may have sharp sight or not he at least appears to have. This over-ridging of the eye is so noticeable in eagles themselves that it may well halt us to ask "Why"? The reason is not far to seek. One can see at a glance that because of it the eye is so set that it cannot look upward readily, but has a much better view beneath than the eye of the ordinary bird, and the rest of the answer comes on some summer day when one is out in the country and sees an eagle swinging in wide lazy curves so far above him that he seems a mere speck in the sky. It looks like the purest recreation and one cannot help envying him this mastery of the air. But to the eagle it is a matter of business—he is looking for his dinner. From the tremendous height he can scan miles of the earth's surface and with his telescopic eye sees objects which no man could distinguish without a powerful glass, so that the luckless squirrel, or rabbit, which is to satisfy his appetite is by no means overlooked. Hence it is that the eagle's interest lies all beneath him and the eye is so set as best to serve his needs. Moreover in scanning the distance the eye needs shade, and this, too, is accomplished by this same ridge, much as a person might hold his hand above his eye in looking afar.

In the eagle, as in other birds and some four-footed creatures, is found that curious, translucent third lid

known as the "nictitating membrane," which passes over the eyeball with a shutter movement and cleans its surface from dust or other particles, without shutting out vision.

The Frog's Eye

The frog is about as unlike the eagle as one thing can be unlike another and the contrast is especially great in their eyes. Instead of overridged eyes with a keen glance downward the big pop-eyes of the frog start from the very top of his head like the turrets in an old-fashioned monitor. This contrast is not surprising for they have a very different purpose to serve. In addition to looking for his own dinner the frog is forced to beware lest he himself serve as a meal for some one of the many creatures which esteem him. The danger to such a low-squatting animal is likely to come from above and needs to be watched for.

There is another and important respect in which these elevated eyes are of great service—a purpose suggested by his life in the water. Squatting in some shallow place or hanging suspended in a quiet pond with little appearing above the surface save two very observant eyes, which bear a close resemblance to water bubbles, he is remarkably well concealed from the casual observer and not easily to be surprised.

The alertness of these eyes is well indicated in the words of Edwards, the Scotch naturalist, who describing the great noise made by frogs on a moonlight night, says:

"Presently, when the whole of the vocalists had reached their highest notes, they became hushed in an instant. I was amazed at this and began to wonder at the sudden termination of the concert. But, looking about, I observed a brown owl drop down, with the silence of death, onto the top of a low dyke close by the orchestra."

The unwieldy hippopotamus and the savage members of the crocodile and alligator tribe share this same peculiarity of elevated eyes, and like the frog enjoy submerging their bodies in the water while still able to keep a sharp lookout about them. Indeed one of the most interesting things about the comparative study of single features is to note how frequently animals which differ in almost every other respect may still have some feature characteristic in common, indicating one point of resemblance in their mode of life.

The Fish's Eye

The solemn fishes which peer at us through the glass fronts of their aquarium tanks, however dissimilar in size, form or color are pretty much alike in the expressionless stare of their large unwinking eyes. It need not occasion surprise that these eyes have such great pupils when one realizes how dim the light becomes on even the brightest day in penetrating the waters they live in. And as to expression, we are accustomed to speak of the eye as an "expressive feature," while any artist can tell us that the eye

considered by itself has very little expression. It is the combination of lids and brow that gives the human eye its expression and how should the fish with practically neither lid nor brow have an expressive eye? In truth the fish has little need of either. Our eyes being subject to injury from blows, scratches and even from dust must be carefully protected, but no dust can fly in the fish's world and the great cushion of water which surrounds it largely protects its eyes from accidents of other kinds. To give lids where lids are not needed would be contrary to the "Economy of Nature" and the fish must continue to wear its vacant stare, no matter what rudimentary impressions may be passing through its stolid brain.

One familiar group of fishes wear both of their eyes upon one side, but this fact is relieved of some of its strangeness when we learn that they are bottom-loving fish which habitually rest upon one side until the other becomes the top. Flounders, soles, halibut and other flat fish, though starting in life with the upright position of ordinary fish, begin to lie on one side as they grow older, until in time they lose their power of swimming back-uppermost and come to live entirely upon that side on the water's bottom. And herein is a fact which indicates how wonderfully flexible is Nature in meeting changed conditions. The eyes which were at first placed opposite, as in the ordinary fish, undergo a change—or rather one of them does. The eye which would otherwise be kept against the bottom escapes that difficulty by traveling

slowly around the head until it rests beside its fellow on the top.

In the waters of Brazil is found the "Double-Eye" a small fish with the strangest of all fish-eyes. Lengthwise across the center of this eye is a line which divides it into two sections, and these two sections have lenses of entirely different character, as in "bifocal" spectacles where the upper part is made for seeing at a distance and the lower for reading. In the eye of this fish the upper lens is lenticular (*i.e.* like two joined watch crystals) and the other of the spherical type. The mystery appears to deepen when we learn that the lenticular lens is similar to that of land animals while the spherical type is that of fishes which must see through the dense medium of water; and yet herein lies the explanation, for these curious creatures frequently swim with just half an eye projecting above the surface,, and this upper half eye looking through air must needs differ from that which stays in the water.

Down in the black waters of Mammoth Cave, Kentucky, on the other hand, dwells a fish with no eyes whatever. In a place where not the faintest ray of light is ever seen, save from human visitors' torches, eyes would be entirely useless and Nature has accordingly dispensed with them.

The Snake's Eye

Here is another lidless eye, and one for which mankind feels an almost universal abhorrence. These beautiful creatures—for in spite of prejudice they are almost universally beautiful, with much richness of marking and an unapproachable grace—have nevertheless a glittering, stony stare which brings an instant repulsion. A snake with eyes softened by eyelids would be no longer the snake of our childhood's terrors. Still, the snake is in no wise responsible for its lack of lids, and would indeed find them an embarrassment when it came to shedding its skin, for we must not attribute this lack to the same cause as marks it in the fishes. A snake does not have its eyes protected by water, on the contrary it has special reason to need protection going as it does "upon its belly all the days of its life," but in this ease it carries before its eye a clear, horny plate attached to the skin, which is like a window to look through.

If one think of a diver's suit and helmet with wearer he will get some idea of this skin-shedding process, to be more fully discussed in another chapter, for the eye-plate goes with the rest of the covering. One will frequently hear mountain dwellers speak of the especial danger from rattlesnakes in the shedding season when they are practically blind and will strike on suspicion at everything near them. This is due to the fact that shortly before losing the skin a gummy, milky secretion begins to form just under the eye-plate, in time hardening and clearing into a

new plate like the one which is being lost. It renders the snake virtually blind for a short time, during which its instinct of self-defense renders it particularly savage and suspicious.

The Fly's Eye

The baffling skill with which a fly evades a sudden blow becomes less mysterious when one examines the relatively huge "eyes" which cover so much of its head. If one will use a powerful magnifying glass he will see that the surface of these eyes is composed of a mosaic-like pattern of honeycomb effect, and, as it is generally known, each of the tiny sections is the lens of a separate eye. In other words these two large patches are really eye-clusters.

In the light of what modern science has shown us of flies as conveyers of disease, it is undoubtedly a righteous act to crush one of these little nuisances, if one can catch it, but think, after all, of this sudden destruction of a creature bearing 8,000 separate eyes pointed in 8,000 separate directions! It is perhaps small wonder that it so frequently escapes.

These compound eyes are true lenses as is shown by an interesting experiment with the microscope, when a portion of the cornea of a fly is mounted in such a way as to cover a photographically minute picture or bit of printing. Looked at through the microscope this object may be seen refracted by each individual lens.

Such compound eyes are very common in the insect world and some of them are much more elaborate than those of the house-fly, the dragon fly possessing some 13,000 in its clusters. Their owners cannot roll their eyes, nor readily turn their heads, but then how little need with such a battery to rely upon!

The Snail's Eye

So slow that it has passed into a proverb, and a most persistent "house-holder" even when forced to move, the snail is curious in several respects, not the least of which is the interesting way in which it wears its eyes. These eyes are too simple and primitive to deserve much notice here, were they not thrust up into our attention by being mounted on a pair of stalk-like processes which it is able to push upward from its head.

This arrangement has its advantages to the snail as anyone who has ever climbed a tree to get a better view will realize. Most animals have legs or wings to raise them from the ground, or have at least the power to raise their heads like caterpillars, but the humble snail can only elevate its eyes to get its view, and this may at times be most important because of the bulky shell which must be carried through many tangled obstructions. It would be hard to imagine another device so effective.

The Human Eye

Passing over a number of animal eye-forms there is one which is undoubtedly more wonderful than any other in nature and that is the eye which reads these words. Have you ever examined your eye with a mirror and a question combined? If not you will find it interesting. Notice how long it is in comparison with the rounded eye of the dog or the cat. Why? Roll your eyes and see. Man is front-eyed, for he is not only the most successful hunter in the animal kingdom but he has many higher uses for a focused gaze. On the other hand man's body is naturally defenseless compared with most creatures, neither swift to escape danger nor strong to repel it, and with no natural weapons worth speaking of. Consequently he may also be classed among the hunted animals, which, as already seen, are generally side-eyed.

These long, narrow front-eyes of ours also command a very considerable side view, and a slight movement well around to one side will catch "the tail of the eye" in an instant. It is impossible to say how often lives must have been saved by this side-eyed action.

Compared with man there is very little eye-motion among most of the animals which are forced instead to move their heads in looking. This eye-motion is so necessary in focusing, that is, in bringing both eyes to bear upon the same point whether it be near or far, and focusing is so useful in giving us our ideas of relief and

perspective, that this difference alone shows the higher capacity of man's perception and the higher requirements it serves.

For example, shut one eye and then reach out to touch some neighboring object. You will find yourself curiously unable to determine its distance, since all vision looks flat when seen with a single eye.

Another illustration is that of the difference between an ordinary flat photograph, and the wonderful sense of distances obtained from stereoscopic views, where two slightly different images are blended together by the glasses. Man's ideas of the relations of surrounding objects must therefore be much clearer than those of other creatures.

There is a point which may be mentioned in passing, although one cannot learn this from the mirror but must take instead the word of the oculist, viz., that there is a small circular spot upon the retina, or back wall of the human eye, which is the only spot capable of receiving absolutely true impressions. This is found in no mammals save the order of Primates which includes man, the apes and the monkeys, and it follows that the sight of lower animals, however well adapted to their own purposes must be somewhat defective judged by human standards.

Returning to our mirror inspection, supplemented by experience, the protection of the human eye is hardly less wonderful than its powers. What of those arches that we

call eyebrows, what is their office? Not merely beauty, we may be sure, beautiful as they often are. It is easy to solve the problem, on any warm day when the perspiration forms upon the forehead, rolls down the vertical, smooth surface—so different from the hairy, sloping animal face—and then is deflected by those admirable arrangements of smooth lying hairs to a point beyond the angle of the eye. If an occasional smarting drop should enter through carelessness of position, it but emphasizes our indebtedness to the brows for the many they lead safely by.

And then the lids, not only do they exclude the light when we wish to sleep, or modify it when it is too strong, but they must be constantly on guard against dust and other flying particles, closing automatically, "quick as a wink," and fringed with other hairs curved outward for the same beneficent purpose. Let an occasional bit of dust slip by the defense, however, and see how quickly the *lachrymal glands* flood the eye with tears to wash the intrusive particle into the nose passage or over the rim of the lower lid.

Finally the eye must be protected from blows, must have a shelter in proportion to its great value, while still left in the exposed position from which alone it could be of any service. This is accomplished most beautifully by placing it in a socket formed by the bridge of the nose and the bones of the brow, cheek and temple, which so guard it that one can press a lead pencil across the average eye,

either from top to bottom or from right to left, without particular discomfort, while the eye-ball is additionally so cushioned as to suffer ordinary blows and survive.

All of which, without going at all into the technical side of optics, forms such abundant scope for our observation that we may well close a brief survey of Eyes in Animals with some of the plainer characteristics found in those of the head of the kingdom.

Noses

Ask any three people what noses are for and two of the three will probably answer "to breathe with," and let it go at that. The third, after a moment's thought, may add "and to smell with." Ask again, "What other uses has the nose beside breathing and smelling?" and now all three have no answer; it is your turn. You continue, "The nose is also a probe, a plow, a club, a hand, an arm, a pump, a hose, a blow-pipe and a feeler!"

By this time the first two have decided that you must be crazy—always the easiest judgment upon the unusual—but the third begins to look interested, for he thinks he detects a bit of method in your madness. He wants to know "Why." For answer we shall examine a variety of Noses, in all their strange unlikeness, to see whether we can discover some of Nature's reasons for making them to differ so greatly.

"Front Nostrils" and "Side Nostrils"

At the very outset, as in "Eyes," we meet with an interesting fact which might hardly be noticed were we considering the animals entire, instead of just their Noses. It is this: nearly all of the mammals divide into two great classes, viz., those having flat-tipped noses with both nostrils squarely in front and close together, and those

having slanting nostrils running well around to the sides of the muzzle. A little examination reveals that this division is strongly marked, and when we come upon anything strongly marked in the realm of Nature, it is an invitation to ask "Why."

We look again. Which are the animals having Front-nostrils? The Dog family of course, including the wolves and foxes, and all of the Cat tribe, little and big, from old "Tortoise-shell" in the kitchen to the tiger in the jungle, as well as bears, hyenas, minks, weasels, etc., etc. Curiously enough these seem to be practically the same animals as the "Front-eyed" Hunters of the last chapter. But even so, why should they have Front-nostrils?

As we stand for a moment perplexed a dog brings us our answer. He comes trotting along, his nose close to the ground, and, without hesitation, bends his course to the right or left as though tracing over some invisible chart by means of his power of scent. It is natural for him to do this. He has a nose especially fitted for it: that flat tip and those two openings squarely in front, where they can be brought to bear upon the same spot of ground in concentrated attention in order to pick up the delicate trace which human nostrils could not perceive.

The dog is a natural meat eater, therefore must be a Hunter when not supported by man, and that wonderful nose is perhaps the most important part of his entire outfit. It helps him to find his prey. And the wolf, fox, tiger,

lion, mink, weasel and other "Front-nostrils" are Hunters, too, and hence are also specialists in ground scent, as is shown by their noses.

But as there are Hunters there must also be the Hunted, and these are found in that other great division, the "Side-nostrils," eaters of vegetation, not flesh. These are keen-scented creatures too; but their interest is less in knowing what animals have passed before than in detecting those which may possibly be approaching, and this information comes to them on the wind from the most remarkable distances, as every hunter knows. Hence their nostrils run around to the sides where they can read the message of each passing breeze and receive warning of the coming danger.

"Jake," a guide in the deer country of Canada, was talking indignantly of the foolish ways of would-be hunters from the city. "Only yesterday," he said, "I was watching a fine buck, across a lake fully three-quarters of a mile wide. He was playing about on the other shore when all of a sudden I noticed him lift his head, and sniff with his nose out in my direction. The next moment he was off as hard as he could jump. I was sure he could not see either of us from where he stood, but when I looked around to the other chap I understood why the buck had jumped. The crazy-head had lighted a cigar so quietly that I never heard him, though he was close to me. The deer smelt it, though nearly a mile away."

Jake also objected to the scented toilet soap which his companion used, to the perfumed vaseline with which he anointed his gun, and especially to the top-boots which he wore, soaked with tallow as a protection from moisture. These last, he insisted, must be exchanged for his own spare pair of deerskin moccasins. "You see," he explained, "they are Indian-tanned by smoke, and the scent of wood smoke doesn't tell a deer that man is coming his way. Yes," he continued, "it's a wonderful thing, is a deer's nose. Now just look at this foot. See, just above the hoof on the leg there is a little cleft between the parts of the leg bone, just about as big as you could put the tip of the blade of a dinner knife into. That is where the deer carries its musk, the old hunters say. It is not a very powerful perfume, is it? Yet a deer will know its mate, or the sex of another deer, by the scent, far away, long before he can see its form. I've proved that many a time.

"I believe that you will never get very near to deer of any kind if you have their blood upon your clothes. The Indian women have for generations done all the skinning and bleeding of the game. And the reason is not, as some missionaries think, because they are an uncivilized lot, but it's a case of self-preservation. The women know that it is necessary in order to get food, that the hunter should not be tainted so that he would not be able to catch up to the deer."

The Bloodhound's Nose

We should expect to find that the bloodhound with his long, full muzzle, and broad, flat nostrils, had well developed powers of scent, and indeed he is the most famous of all the trailers. The greyhound, on the other hand, has also a long muzzle but its tip is narrow and pointed, and his scent correspondingly so much weaker that he hunts by sight and is sometimes known as the "gaze-hound."

It is hard for the man born blind to form any conception of Sight; and it is hard for the degenerate human nostril to gain a true idea of the vastness and meaning of the World of Scent. True one may be gifted with power to discover when onions are being cooked, or to receive certain impressions in passing an arbor of blossoming honeysuckle, but so also may some practically blind people dimly perceive a lighted lamp. This is not smelling as understood by our four-footed friends. What is to us chiefly a world of Sight, then of Sound, then of Touch, Smell and Taste, is to many of them chiefly a world of Smell, with Sight and Hearing as subordinate senses.

Perhaps our own earliest ancestors far back before the dawn of history may have once possessed this power in greater degree. Certain it is that memory has a curious trick of seizing fast on odors and weaving with them all kinds of unconscious associations. A veteran of the Civil War tells how vividly the battle of Antietam is flashed

before his mind if he catch but a whiff of peppermint, since his regiment had been in a field of this pungent herb during the fighting. Other examples are within the experience of almost everyone; while in dog-world scent-memory is surely most prominent. A friend supplies the following instance. A small dog belonging to the household had formed a strong attachment for a young man of the family, who finally went away to college and was gone for a number of months. His return was somewhat unexpected, and coming in one day unknown to the rest of the family, he hung his coat on a hook in the hallway and went out upon the rear veranda. Shortly afterward the dog came bounding down the stairway as was his wont and started to run to the front door, but in passing the coat, stopped with such suddenness that he almost went off his feet and then putting his nose to the floor rushed out to where his master was sitting. He had remembered his master's scent as plainly as a person would recall his face or voice.

But to return to the bloodhound, whose extraordinary keenness has long been used by man in trailing criminals, many instances are given which would be unbelievable were they less well established. One case is as follows: A dwelling in a Western city had been broken into by a burglar who made his escape without leaving a perceptible clue, perceptible that is, to man, for bloodhounds brought to the scene at once picked up the trail. Straining at their leashes they led the officers a roundabout course through

many busy streets, plunged into a railroad station where *possibly five thousand* people had passed in the few hours which had elapsed, then out again across the railroad yard, and finally ran the thief down in a small hut in the outskirts of town.

In another instance bloodhounds trailed a stolen horse and buggy into St. Joseph, Mo., from a distance of 135 miles, after being permitted to smell of the curry comb; and the thieves were arrested.

In this case even the iron of the horse's shoe was transparent to the odor of the horse, laid down upon the ground at every stride. What can it be, this strange, elusive and yet most potent thing of scent?

The Nostrils of the Horse and Cow

To see a handsome, clean-limbed horse dash past at high speed, with mane and tail flying and great nostrils widely distended, who would need to be told that the reason for this power of spreading is the same as that which causes one's own nostrils to dilate when running? The horse with his great speed and endurance needs a large intake of air and must have the nostrils to supply it.

With our common cattle the needs and the nostrils are different. Narrow and comparatively rigid they can furnish no such deep draughts of oxygen; but then their owners have been free from danger for so many

generations that they have rarely the need for violent exertion.

That this form is due to manner of life rather than to race is seen upon comparing the cow's nostrils with the much larger ones of her wild cousin, the buffalo.

The Camel's Nose

With the camel we come to a very different kind of nostril, and this warns us of a different mode of life. It is almost like telling a detective story backward to try to reason out the latter from the former in an animal so well known as the camel, but even so it is not without interest.

Here, then, is a nostril even narrower than the cow's, but set in soft skin instead of the rigid, gristly substance of the other. This soft skin permits expansion when the camel is swinging in long easy strides across the desert courses, and also makes it possible to close the nostrils tightly in time of sand-storm. When the great wind, gaining power in its fierce sweep over desert wastes, fills the air and darkens the sun with flying particles of sand, the camel riding it out like a true ship of the desert will survive where the wide-nostriled horse would quickly choke.

The many wild camels found in some parts of Turkestan are believed to be descended from certain domestic ones, which were thus enabled to live through a

terrible sand-storm of some two hundred years ago, from which no human being escaped.

The Alligator's Nose

The long snout of the alligator, or of his cousin the crocodile, usually ends in a slightly raised hump bearing a couple of slit-like nostrils.

Like those of the camel these have the power of closing tightly to seal the air passages, but not against sand-storms, for the alligator is hardly designed for a "ship of the desert." In fact both the nostril and the hump point to the same fact, viz.: the water-life of an air-breathing animal. Floating or swimming noiselessly nearly submerged in the water with his cruel eyes projecting above the surface, this elevated nose tip enables him to breathe in that position so that the unsuspecting animal coming to drink does not notice the stealthy approach. Then it is seized by a sudden snap of the tremendous jaws, and as the great reptile sinks with his victim beneath the surface the nostrils closing prevent the inflow of water.

At this point another interesting arrangement comes into play, although one outside the range of our easy observation. The air passages do not open into the mouth cavity as do ours, but run so far back as to be completely shut off from it, and no water comes into the lungs even when the mouth is opened below the surface, while there are special valves in the mouth itself—but that we must

save for our Chapter on "Mouths" lest we stray too far from "Noses."

It is enough to say that the alligator can hold his prey under water until it is drowned; while if he thrust but the tip of his own snout above the surface he is supplied with sufficient air.

Many other air-breathing, water-loving animals, among them creatures so unlike as the hippopotamus and the seal, are also provided with these closing nostrils.

The Pig's Snout

And now we come to a new division of the subject. Up to this point we have been considering noses which, were merely "breathers" and "smellers"; but the pig's snout has still another important use for its owner has farther needs, and Nature has not hesitated to throw their burden upon his snout. These needs refer to the satisfying of an appetite which has made him famous.

Once in a while we meet with an exception which warns us against cock-sureness in making definitions. The pig is such an exception. He has front nostrils apparently well adapted to following a trail; he has partially front eyes, also somewhat like the hunters; and while he does not refuse to eat flesh, yet he may not be ranked as a beast of prey, save upon rare occasions.

The principal thing to notice about the pig's snout is the cutting edge of its gristly tip, and anyone who has seen the havoc of this animated plow in a garden will not need to be told its purpose. Backed by a long, strong head, and powerfully muscled neck and shoulders it is used with great success in laying bare the secrets of the soil. But why? Well, there is the constant urging of that great appetite which must be satisfied. The pig is neither a beast of prey nor a successful grazer. Apples and other fruits are most acceptable, but the pig cannot climb for them and they do not fall save during a limited time, nor last long upon the ground. Acorns, beechnuts and the like are more enduring, but are apt sooner or later to disappear in the ground-tangle or beneath the surface, where they must be sought with just such an eagerly snuffing, swiftly cutting instrument as this snout. And then there are always those roots—those fleshy, tuberous, satisfying roots, which most of the other animals cannot enjoy because they lack the power to "root."

Our lazy hogs, gorging themselves at the well-filled trough, and squealing unhappily because they cannot hold another mouthful, may not have great use for a digging implement, but one must not judge animals as they have been influenced in habits by man. The farmer with his potato-parings and his bucket of sour milk has not always been known in pig-world. Curiously enough, however, the pig loses his "civilization" very quickly once the opportunity arises. It is said to take but three

generations of running wild to turn the ponderous Berkshire, round as a barrel, short-snouted and with insignificant feet, into a lean, wiry, bristly "razor-back," swift as the wind, a savage fighter, and an active rooter.

It must also be remembered that with eyes placed so far from the food he seeks, the end nostrils help him to locate it.

The Mole's Nose

If the pig roots at the surface, the mole goes through a somewhat similar process below, and his little pointed muzzle pushes its way through the loose soil, with the impulse of his powerful feet, wherever the delicate senses of scent and feeling may indicate a worm or an insect.

The star-nosed mole has an odd little branching protuberance at the end of his snout, which from its position is most probably an extremely sensitive organ of touch, responsive to the slightest motion in the earth about.

The old question as to whether the mole is a pest or a blessing depends upon one's point of view. It is doubtless annoying to have a tunnel driven through a garden sometimes injuring the roots which lie in its course, but it must also be remembered that the small intruder is in search of beetles, cut-worms, grubs, etc., eating something like his own weight every day. One farmer is recorded as having destroyed every mole on his property only to lose

his crop next season to the cut-worms. Thereafter he purchased moles from his neighbors and preserved them as friends.

The Ant-Eater's Nose

These snouts, however, do not compare with the very long tubular muzzle of the Giant Ant-Eater, a nose so extraordinary that were it not for the clue supplied by his name we might hardly guess its use.

Even so it is not clear at once. We are most familiar with the common ants which swarm in decaying wood or dig in our garden paths, and why should this peculiar creature need such a probe-like nose to feed on them? Neither would he, were these the ants he had to deal with, but in those lands where he makes his home the busy insects throw up huge colony-mounds often taller than a man. Thus his problem is a peculiar one, calling for special tools.

With his powerful claws the ant-eater tears his way into these great earth heaps; then his long probing nose and slender, flexible tongue play havoc in the rudely uncovered galleries.

The Moose's Nose

Returning to our own northern forests, we may, if we are skillful and fortunate, some day catch a glimpse of a

big, long-legged, spreading-antlered beast with what seems like an awkwardly bulbous, projecting muzzle-end. Although he belongs to the deer family we can easily see that such an obstacle would not permit him to graze with comfort, even were his neck of greater length; but our confidence in the wisdom of Nature leads us to look farther for the answer. And then, possibly, we observe him reach up to a branch above and skillfully gather in twigs and leaves with that same overhanging muzzle, now seen to be prehensile, and realize that for his particular purpose it is a help instead of a hindrance. Browsing, not grazing is the meaning of such a form.

The Tapir's Snout

The tapir suggests an understudy to the elephant—not fitted to play the star's part—having legs thick but less massive, a body bulky but not so huge, and a long, overhanging proboscis too short to be called a trunk.

It is of exactly the right length, however, to browse upon leaves and shoots, while for poking about in the long grass for such dainties as fallen fruits it is most efficient.

The Elephant's Trunk

But it is in the trunk of the elephant that the *ne plus ultra* of all noses is reached. It would be hard to find an adult, and harder to find a child, who did not feel a special

interest in this mightiest of land animals, and of course such interest largely centers in the amazing appendage hanging down before his mouth. Any youngster who visits a "Zoo" and pauses before one of these vast creatures, so strongly suggestive of a bygone age, must have a hard heart indeed if he can refuse to share his supply of peanuts with that leathery, double-barreled tube which offers itself so persistently. And if his hand happens to touch this peanut-collector he gets an impression of iron-like muscles combined with a living flexibility which is difficult to forget. Well may he touch it with respect. Cuviér once dissected a trunk and tried to count its muscles but tired after reaching 20,000! He estimated that there were double that number. Probably most people do not realize how marvelously versatile is this member—how helpless its owner would be without it.

Consider then that the elephant, whose life someone has described as "one continuous meal," must supply his enormous body with several hundred pounds of food per day and that every mouthful of this must be carried by the trunk. Without it he would stand helpless, perhaps able to browse a little from vegetation which happened to be of the exact height of his mouth but with so little neck movement that even this would be difficult, while with it he is the most independent of animals, free to choose food from the ground, from the tree-tops or from several feet to the right or left, the probability being that he will end by choosing everything within reach. The trunk is thus neck,

hand and arm, in addition to its use for breathing and smelling.

The food-collecting is not, however, limited merely to plucking that which offers itself easily, but it often includes most prodigious feats of strength, such as tearing off large limbs or even uprooting moderate sized trees. One traveler speaking of the forests lying between the Victoria and Albert Lakes says: "The damage done by elephants to these forests is incredible. I have more than once come upon spots where these huge beasts would appear to have held a kind of elephant carnival. A large area covering many acres would be completely stripped of trees, nothing but jagged stumps sticking up a few feet from the ground remaining of what had once been thick forest."

Frederic Selous, the famous hunter and explorer, gives an appalling example of this strength, in which a bull elephant seized a big, powerful Zulu of his acquaintance, and holding him down wrapped his trunk about the man's body and actually tore him into three pieces.

When caught and trained, however, this same strength is turned into account for man's service and the Asiatic elephant is commonly employed with trunk and tusks for handling large timbers which would tax the strength of a number of men. It is fortunate indeed for the rest of the animal world that the elephant does not also possess such ferocity as for example that of the weasel, but is naturally quiet and good natured.

Added to these qualities he has that of extreme caution. Save at the mating season or when wounded the elephant rarely does anything reckless, and this is no doubt largely due to his great weight. With little to fear from any other animal save man, he has much to fear from the results of a misstep for once fallen into some awkward place his size and his lack of springing muscles would tell heavily against him. Consequently the wise beast, well knowing his limitations, finds this same hanging feeler of the utmost importance as he moves ponderously along, and should it detect anything suspicious there is time for him to stop short of peril. Probably the elephant's hundred or more years of life are largely due to this guardian of his steps.

When swimming or fording rivers the elephant's trunk is used like the diver's air tube, for by thrusting the end above the surface he will have a supply of air even though his entire body be under water. A pathetic instance of this air-tube use occurring many years ago is thus given by an eye witness:

..."In 1833 an elephant at Sonepoor, opposite Patna, had waded into the Gunduck River near the junction of the stream with the Ganges till it stepped into a quicksand. Its efforts to emerge merely worked it deeper and deeper into the dreadful trap ... slowly, slowly, but surely it settled in its living tomb. It was some hours before they lost sight of the poor eyes staring piteously at the spectators on the shore. It was long before the head itself had sunk under the

turbid stream and when toward sunset I had arrived at the spot on my way from Hajipoor to Patna, nothing but the end of the trunk was visible sucking in the last gulps of air the poor creature was able to inhale."

The elephant's trunk is oftentimes a good example of a pump and hose attachment. No need to stoop from his majestic height for a drink; the trunk lowered to the stream sucks up a deep draught of water and then bending, discharges it into the thirsty throat, or again if the day be hot and thirst be slaked the water may be sprayed in grateful coolness upon his back and sides. Everyone has also heard stories of exhibition elephants avenging some old-time insult with a sudden douche of water.

When not a hose, the trunk may be a blow-pipe instead, and a good-sized sigh will whirl the dust of the enclosure or blow away the straw he is fond of flinging upon his back.

So much for the trunk considered as a whole, although much more might be said; but it must not be forgotten that with all of an elephant's strength and intelligence the most truly remarkable point is his extraordinary dexterity and niceness, because of the little pointed finger upon the end of his trunk. In the New York Zoological Park is one big fellow named "Gunda" who went in for "high finance" and operated a bank, with the assistance of his keeper. High above his head, fastened to the bars of his cage, was a box marked "Elephant's Bank," and, hanging by it, a bell.

Visitors were always ready to toss a small coin into the cage and this falling upon the smooth cement floor would be hard for a man to pick up unless he used his finger nails. Down came the trunk with a lazy sweep, located the coin, which the skillful end-finger deftly secured, and then swung it up to the box, raising the lid and ringing the bell in doing so.

That this finger is as powerful as it is precise was shown by an incident at the New York Central Park Zoo in 1903. Jewel, one of the inmates, was noticed to be suffering from lameness and the elephant man decided that she must have a corn upon the sole of her foot, as is often the case with captive elephants. Examination showed a rather unusual callous spot and upon cutting into it the keepers were surprised to come upon the head of a three-inch wire nail. By pulling with a pair of pincers this was drawn out about an inch and there stuck, being bent in the middle. The poor beast trumpeted in pain and then swinging her trunk around twined its finger about the head of the nail and had it out before her keepers realized what had happened.

From every standpoint let us respect this noble creature, more worthy than the lion to be known as the "King of Beasts" and let us remember that no mechanism man has ever made, can compare with that marvelous instrument the elephant's trunk.

The Human Nose

Did you ever think how carefully guarded one's eating is: how every particle of food must run the gauntlet of four of the five senses? First it is seen, and the eye judges it by its appearance. Next one picks it up, when something peculiar may be noticed in feeling or weight. Then in entering the mouth it must pass under the downturned nostrils, and even the human sense of smell is of no little protection since the morsel which has satisfied sight and touch may fail at this test. The mouth, too, has delicate nerves of feeling in both lips and tongue; and finally the taste may reject even the bitten mouthful unswallowed. It would seem strange that man should ever have to digest anything unwholesome; but what can be expected of a creature who will eat not accidentally but intentionally, food which his own experience has shown him to be unfit? None of his brethren of fur, feather or fin would so transgress, and Nature has assuredly done her part.

Starting (externally) from between the eyes, the nose forms a ridge which helps to guard those very important features from injury. Then after dividing the face and accenting the expression it ends in two narrow but flexible nostrils. These nostrils are separated from the mouth and turned downward directly over it because man, unlike most mammals, eats without thrusting his nose into his food. Man's nose has not additional uses like the elephant's trunk, but is merely a breather and smeller—very much a breather, very little a smeller.

There is one thing, however, which, while it concerns us most closely, is generally overlooked, viz.: the way in which the nose protects the lungs. The air is full of floating particles. Let a beam of sunlight strike through even apparently clear air and it will light up a surprising number of dancing motes. At other times one is forced to breathe in atmosphere so thick with dust that he is almost blinded. Think of it, so many breaths a minute, night and day, year after year, with particles of foreign matter in practically every breath! How many pounds, actual pounds of dust must thus first and last be drawn in through the nostrils! What becomes of it all? This dust is mainly mineral and cannot be assimilated, the lungs are not digestive organs and they have no other outlet. We might imagine that they would soon become solidified into two great dust-cakes were it not for the wonderful guardianship of the nose. In the air-passages is a mucous lining, moist and sticky—sometimes in case of a cold unpleasantly so. It is very much the story of the fly and the sticky fly-paper. The nasal passages are narrow and twisting. The air does not enter in a solid column but must turn corners and "spread out thin" and all along the route the sticky coating takes toll in the shape of the dust particles until the air is relieved of its burden. This mucous discharge is continually making its way downward to the nose opening under the influence of gravity and especially through the wonderful action of the *ciliated epithelial cells*. Here indeed we stray a trifle beyond our subject, since these cells are much too

small to be seen without a microscope, but they are too interesting to be omitted, and whether seen or unseen are actually there in vast numbers in daily service of our needs. It is enough to say that the mucous lining is filled with myriads of these tiny cells bearing hair-like threads called "cilia" which have a curious waving or kicking motion, always in the direction of the opening—a motion which greatly helps in working out undesirable particles. Such epithelial cells are not peculiar to the human body and a doctor supplies an account of a college laboratory experiment with a piece of mucous lining taken from the mouth of a frog. The lining was laid upon the corner of a table and a tiny tissue-paper boat placed upon its inside edge. During the class lecture the boat traveled slowly across under the action of this kicking motion (for the cells retain their life long after being removed from the animal) and fell upon the floor before the lecture ended.

Sometimes a particularly large and disagreeable particle enters the passage in spite of the nostril hairs, which generally prevent it, and then the sensitive nose-nerves telegraph, hastily to the diaphragm for a spasmodic blast which sends it flying. We call this a sneeze. These nerves are necessarily very sensitive, and occasionally, becoming hysterical, they actually call for help which is not needed, as in a fit of sneezing; but on the whole it is better so than to have them sluggish.

And here, perhaps, it may be well to draw an unexhausted subject to a close; for as with "Eyes" and all

the other subjects our purpose is merely to suggest with a few instances, the methods which may be more broadly applied.

Ears

Keen as is the sense of Hearing, in many animals it ranks probably third in the kingdom as a whole, compared with Sight and Scent. Man would place it second, but man with all his self-esteem is only one small fraction of the great animal kingdom, and by no means a model of sense perception. Therefore in giving Ears the third place we must average the needs of our two- and four-footed brethren and our brethren of no feet at all. Even so, the whole subject of Sound and Hearing is a wonderful one, and we never cease to marvel at its possibilities as revealed to us by the phonograph, telephone, and other achievements of modern science.

This great vibrating air envelope about us is so alive that possibly not one minute of absolute silence comes to anyone, not actually deaf, from birth to death. The "silence of a summer night" is a veritable symphony of the soft sounds of Nature; at any hour in a city room there is almost always some faint suggestion of outside life, and the sound of breathing or even of the pulsing of our blood is perceptible at times. It is really more a matter of attention than of anything else; but we are ordinarily so occupied with our own thoughts and plans as to deny ourselves many sense perceptions to which the free-minded animal instantly responds. The curtain is drawn from the inside—not the outside.

"Front Ears" and "Side Ears"

The above heading is inexact, for those animals designated as "Front-eared" have some side-ear movement, and "Side-eared" animals can hear forward. The distinction is not so clear as with Eyes or Nostrils and it has more exceptions; yet there is a distinction which cannot be overlooked and which marks much of the same line between the Hunters and the Hunted.

Taking the cat as the typical hunter we find ears that naturally point nearly forward and are large, as they should be in a night-hunting animal when sounds are important. These ears are very broad across the base, well adapted to gathering even faint sound waves, and anyone who has seen a cat hunting will have noticed how they are set, as part of the whole attitude of attention.

Let a sound occur at the side and the ear will "flick" toward it readily enough, but if the sound passes around to the back where the ear of a horse or a rabbit would easily follow it, the cat has difficulty. Her ear is too broad at the base to turn very far and begins to close instead. Pussy will lay back her ears when she is angry, it is true, but not for the purpose of hearing behind her. Rather it is from a natural instinct to protect organs so large and easily torn, in going into battle, just as a battleship is cleared for action. Carrying nautical figures still farther, anyone who has seen a tugboat bend back its hinged smokestack in

passing under a low bridge will also appreciate the convenience of having ears which will lie down when crawling through contracted places as the cat is fond of doing.

These same ear characteristics, in varying degree, are met with among a large part of the Hunting Animals, although one very remarkable exception will be noted in the ears of hounds.

The Hunted Animals, especially such as live upon the ground, must be ever on their guard, so ears as well as eyes and nostrils are posted for sentinels. Their ears are usually narrower at their base so as to turn more readily. We do not think of the horse as a hunted animal, but his forefathers were, so he will furnish an illustration. Notice him standing relaxed when nothing ahead attracts his attention and you will see that his ears naturally open sideways instead of nearly forward like the cat's. At the slightest sound in front he will prick them forward in a flash, or if you speak to him in driving, the opening is instantly directed backward and you realize how much head turning is saved by the ready action. He does not have to neigh "I beg your pardon" and wheel about with results disastrous to the carriage. He plods quietly ahead and simply presents his ear instead.

The Rabbit's Ear

"Br'er Rabbit's" ears have made him famous from the earliest times and are an important part of his outfit. It is needless to say that such large ears must be especially sensitive to sound, or that the shrewd, mischievous but well-nigh defenseless little fellow has great need of keen senses. The length of his ears is most valuable when he squats in the long grass where sight is hindered and the scent-bringing breeze cannot blow freely. At such time by rising on his haunches with ears aloft he can read the faint sound warnings that come across the grass-tops and take to his fleet little heels if danger threatens. It seems also probable that even if seen these ears might often be mistaken for the long narrow leaves of some weed.

Without such ears and such heels, without, too, their extraordinary reproductive powers, rabbits would have been exterminated long ago. They form a favorite prey for many beasts and some birds, while man with his gun and snare is ever to be reckoned with. It is said that more than 1,000,000 are eaten yearly by Maine Frenchmen alone.

The Bloodhound's Ear

One who is carrying his "Why" among the ears of the animal kingdom, and trying as with "Eyes" and "Noses" to find some reason for their differences in form, is apt to receive a mental jolt when he turns to consider the dogs. If sound is borne in air vibration, if the outer ear is

designed to gather and focus these sound waves for the ear drum, then why should so many varieties of dogs have ears which almost seem designed to defeat this purpose? What is the reason for the flap which hangs down before the ear-opening and is such an exceptional form in the animal kingdom? Is it to protect the ear from the entrance of insects? Undoubtedly it may have this effect, but many other animals manage this protection by means of the long hairs which fill the opening without checking sound. Why may not the dog?

If we put our hands over our ears it interferes with our hearing, much more, it is true, than does the thin skin of a dog's ear-flap, but still we cannot doubt that this flap is actually an interference with sound. This is further borne out when we speak to a hound and notice him "cock his ears" to hear more clearly. What then are we to understand from this strangely contradictory phenomenon in the realm of well-ordered Nature?

It seems to the writer that the simplest explanation is also the most reasonable hypothesis. The flap must interfere to some extent with the dog's hearing; may it not indeed be that such interference serves a valuable purpose? We have taken the bloodhound's ears as an extreme example of this overhanging obstruction. Is it only a coincidence that the bloodhound is also an extreme example of the high development of another sense—the power of scent? Is it merely another coincidence that the greyhound with so little scent-keenness that he cannot

well follow a trail, has nearly upright ears well adapted for hearing?

The writer remembers a friend who was asked to notice whether he could detect a peculiar faint odor, and who impatiently said "Hush!" as his companion began speaking. The other laughed and asked him whether he smelled with his ears, but his instinct was correct: he needed to concentrate his attention upon a single sense, and sound was a distraction. With this illustration in mind, consider the marvelous delicacy of the bloodhound's task in following the almost infinitely faint trail left by a man wearing shoes and walking rapidly along a street—in doing this moreover hours afterward, and in keeping the individual trail distinct from that of the many other foot passengers. One's imagination is staggered at the difficulty of such an undertaking and it is easy to see that the four-footed specialist would have need for the greatest concentration upon his marvelous power of nostril.

Instances are given of bloodhounds so indifferent to everything save the trail they were following that they have been killed by the unheeded approach of a train. Under these circumstances does it seem a far-fetched explanation that the bloodhound and other keen-scented dogs should actually find value in the curtaining of sound afforded by their ear-flaps, when focusing all their powers upon the difficult task of their nostrils?

The extent to which a hound will ignore all other senses when following a trail is shown by this incident given by Dan Beard in his jolly "Animal Book": "...Another time when the writer was seated on the doorstep of a Pennsylvania farmhouse,...he saw a fox, chased by a hound, come trotting along the trail amid the stones and big rocks of the mountainside....Presently it hopped upon a stone about the height of a man's waist, from there it jumped to the slanting trunk of a chestnut tree which gave it just sufficient foothold for another spring to the top of a rock about eight feet high; landing on the flat surface of this large stone it coolly walked over to the edge and squatted in a position to command a view of the trail. It waited there for the hound to go by....Apparently the fox enjoyed the hunt as much as did the hound, for after the hound had passed the rock the fox would jump down from its perch, and go through the same tactics again and again to the utter bewilderment of the dog. *It never seemed to occur to the dog to look up or about, or to use its eyes in the search but it depended entirely upon its nose to find the object of its pursuit."*

The Elephant's Ear

Our massive friend the elephant who makes such an impressive showing as proprietor of the most marvelous of noses comes to the fore again with the largest pair of ears to be found in the animal kingdom. These,

particularly in the African species, are of such enormous size that Sir Samuel Baker tells of using one as a mat to lie on in the shade of a tree. They are also capable of being either extended at right angles to the head or laid back smoothly upon the animal's shoulders. In charging, the African elephant extends his ears like two great sails and as each is often some 3½ feet broad their total width including the forehead may be as much as 10 feet. One can imagine the terrifying nature of such an apparition accompanied by its tons of weight and its giant strength.

At first there might seem to be points of resemblance between the hanging ear-flap of the elephant and that of the hound, but on looking more closely we see that the elephant's ear-opening is left uncovered by the flap so that the sound waves are not diminished by having to pass through skin. The elephant is normally side-eared and with his ears at rest his hearing cannot be especially keen, but as soon as he extends these sail-like organs the whole situation is changed. He becomes at once front-eared in that his hearing is directed forward, and the reinforcement of these great vans—as with the man who holds his hand behind his ear—must wonderfully quicken his hearing.

Why, then, an arrangement so unusual?

It must be remembered, as stated in the preceding chapter, that the elephant has little to fear from four-footed animals but much to fear lest an incautious step should get his great bulk into some dangerous pitfall.

Hence he moves with caution and the long, hanging trunk helps to determine his footing. His eyes, too, are set in such a position that they can watch his path. But the elephant, like many tropical animals, is semi-nocturnal and loves to wander about in the darkness when his rather poor eyes can be of little service and the sense of hearing must largely replace them. With ears so placed as to listen forward, a suspicious sound might give some warning of danger before the trunk had come within reaching distance.

On the other hand think of the great inconvenience of such ears if fixed immovably in this position. How soon would they be torn to ribbons by the branches of his native forests did not Nature provide a way to lay them back smoothly out of trouble when they met with an obstacle.

The Hippopotamus's Ear

Nearly as bulky as his giant neighbor, the shorter, clumsier hippopotamus has ears that are almost grotesquely small in proportion to his size. He, however, does not spend his hours roaming forest shades, but has a genius for being comfortable in almost any lake or river of somewhat swampy conditions where he can be left undisturbed. Let others run the affairs of forest and jungle, what is their activity compared with the placid content of munching and dozing in the mud and water?

And then if one wish to sink luxuriously and lie nearly submerged, what arrangement could be better than to have one's ears placed with the eyes and nostrils on the very top of the head, where they may still be useful after the rest of the great form has disappeared from view?

The Owl's Ear

Someone is sure to ask, ere this, "But how about the ears of birds?" Our answer must be that birds have ears concealed among the feathers of the head, which cannot, of course, be as keen as though reinforced by external sound-wave gatherers, and are evidence in themselves that birds depend less upon hearing than on sight.

We are dealing only, however, with such ears as may readily be observed and so naturally turn to the one bird which at least appears to be eared—the owl. These two horn-like appearances are really tufts of feathers, so different from the ears of skin and cartilage that we may perhaps question their right to the name, and yet they are found in a bird whose concealed ear-openings are of great size and it is probable from their shape and position that they are of some little assistance in deflecting sound waves into them. If so they are veritable ears, whatever their structure.

It must always be remembered that the owl is the night hunter among birds, and, noiseless himself because of his

strange plumage, is keenly listening for every indication of prey.

The Human Ear

Those crumpled bits of skin-covered cartilage stuck upon the side of the human countenance—are they not curious when one stops to think? Suppose that it were proposed to decorate the smooth beauty of a bird's head with such appendages, would it not seem grotesque? Yet there they are, confronting us in the mirror or borne by our companions, and even our artistic taste would hardly consent to their removal, for there is a certain beauty which goes with their crumpled curves, and sonnets have been written in praise of "shell-like ears."

Considered practically, however, the human external ear is a most ingenious arrangement which differs greatly from all other types save that of our ape and monkey "kindred." Here again, as in eyes, man appears classed both with the Hunters and the Hunted—he may be called both Front-eared and Side-eared. Front-eared in that his ears stand out somewhat from the sides of his head and that the rim and the bowl-like hollow at the center are so shaped as to intercept sound waves coming from in front, while he is obviously Side-eared in that the greatest surface is presented sideways.

Man, too, is comparatively alone in lacking ability to move his ears, and, it may be added, in any need for

moving them. The reason is not far to seek. Man stands upright upon two feet, instead of extended on four, and can wheel about more quickly than even the most agile animal. Furthermore, his head is poised on top of his neck instead of being hung far in front, like a horse's, for instance, and can turn instantly.

These facts give him an advantage much greater than the movable ears of his four-footed friends.

Ear-protection has been provided too—protection differing in kind from that of eye and nose but none the less effective. No large foreign body can enter the ear-tube because of a little corner which narrows the opening and just above this a small projecting tip protects the same opening from both front and side and helps to deflect the sound waves into the tube after they have been condensed by the bowl-like hollow. This tip is most important in shielding the ear from the winds and the particles which they bear, and little danger remains to the ordinary man save from an occasional inquisitive insect small enough to explore the inviting cavern. But here indefatigable Nature has provided most effectively a sticky wax, bitter and offensive to the insect taste which usually discourages farther investigation. This wax is continually secreted anew, since the peculiar shape of the surrounding bones and their action on the ear-tube when the jaws are moved tends slowly to force the wax downward and outward to the ear opening, bearing with it whatever may be imbedded therein.

Of course all this concerns only the ear outside of the drum, since that alone is within the range of the ordinary observer, while the complicated and wonderful structure of the inner ear and the ingenious way in which the drums are protected by equalizing the air pressure upon both sides comes beyond the scope of our amateur "Why." There are books which will supply such information to those who care to pursue the subject farther, and the wonders of Nature's provision will ever repay the student who wishes to employ his "Why" in more serious investigation.

Mouths

Now come we to the most important of all the features. An animal can exist without sight or hearing and even a thing so indispensable as breath may occasionally be taken through the mouth if nostrils are disabled, but there is no other provision of Nature for the reception of food save in some of the lowest forms of life. Mouths are, therefore, universal within the range of our observation, but in such unlimited variety that but a few of the most interesting types can even be hinted at within a single chapter. For the mouth is the index of the food, and Nature has provided strange foods for some of her hungry children. Few places will be found so barren that they do not support some form of eaters, big or little, and few foods are so repellent to our ideas as not to tempt some eager appetites. It is merely a matter of taste and adaptability. After all we can hardly judge for others. "How can you eat such stuff?" we might inquire of the vulture at his carrion meal, and we can imagine him replying indignantly: "*I* find it nourishing, wholesome and *good!*" Really such an argument is unanswerable. One of the humorous papers supplies the picture of a bird bargaining with a squirrel, which has just collected a store of nuts—"Say, Mister, what'll you take for the worms you find in those nuts?"—which expresses the idea of contrasting tastes very well. The writer remembers

standing once upon a muddy corner and watching an unkempt little dog-waif which had caught sudden sight of a bone lying in the gutter not far away. Some shreds of meat were still clinging to it but it looked like ancient refuse, and what with its coating of mud a more unappetizing morsel could hardly be imagined. Nevertheless the little starveling crept toward it with timid eagerness and an anxious glance toward his human companion that said as plainly as words could have done: "Such a lovely bone must be a great temptation to you, but please don't take it for I'm so hungry."

And so with the horse munching his oats, the snake bolting whole an unchewed frog or the ant-eater raiding a colony of his chosen prey; everywhere there is variety in taste, and with it just the variation in the mouth and its furnishings best suited to supply that taste. In fact the subject is so fruitful that we shall consider the mouths of birds in a separate Chapter on "Bills," and make chapters also of "Teeth" and of "Tongues."

In general the animals are divided by their foods into the Carnivorous, or flesh eaters; the Herbivorous, or eaters of vegetation; with an additional subordinate class known as Omnivorous, or eaters of both flesh and vegetation. Necessarily the first group are largely Hunters, although including some carrion eaters which do not usually kill for themselves, and the Herbivorous include most of the Hunted creatures; but it is not easy to classify these merely by their mouths, if we exclude the teeth. It

may merely be stated in passing that the latter class have in general much better development of lips than the former. This will be more fully considered in the following paragraphs.

The Cat's Mouth

It seems natural to start again with the cat as in several preceding chapters. Pussy is so typical and so easily studied that our thoughts seek her freely for illustration, and we always remember that her near relatives include many of the mightiest hunters of the forest and jungle. She looks the picture of innocent harmlessness as she lies curled up on the rug: then drowsiness overcomes her and she yawns. What a yawn! Where is the harmlessness of a moment ago? Suppose one were a mouse and saw that sudden, frightful cavern with its tremendous spread and its cruel fangs! Would not that yawn be one of the most terrifying spectacles in nature?

Compared with the widest spread of a horse's jaws the opening possible to the cat tribe is extraordinary. The whole head seems little more than an enclosure of the mouth; and the bunches of muscles on either side indicate the crushing power with which the jaws may be closed. Naturally all of this speaks to us of food and habits. The cats must catch, kill and tear. Their jaws are not intended for the grinding side-swing of the horse or cow in chewing, but have great closing or biting power; so it is not

surprising that they can so often kill even large prey with a single bite. This strength of jaw also enables them to pick up and carry away heavy carcasses, it being their instinct to eat their kill in secluded places. One writer tells us that "one of these terrible animals (lions) has been known to pick up a heifer in its mouth and to leap over a wide ditch still carrying its burden."

However, the cat family has no monopoly of jaw power. The gorilla has the strength to crack nuts with its teeth and the hyena will perform still greater feats. Speaking of the latter, Sir Samuel Baker, the African explorer, wrote: "I can safely assert that the bone-cracking power of this animal is extraordinary. I cannot say that it exceeds the lion or tiger in the strength of its jaws, but they will leave bones unbroken which a hyena will crack in halves. Its powers of digestion are unlimited. It will swallow and digest a knuckle bone without giving it a crunch, and will crack the thigh-bone of a buffalo to obtain the marrow, and swallow either end immediately thereafter."

The Horse's Mouth

As already hinted, the horse's mouth forms a considerable contrast to the hunting jaws of the cat. This is seen most conspicuously in the teeth, which must be left to another chapter, but there are other points worth noting. The horse's mouth, like that of most grazing

animals, is placed at one end of a long head, at the other end of which are the eyes and ears; so that these sentry organs need not be buried in the grass in feeding. His mouth is also much smaller in proportion than those of the hunting animals and does not have so wide an opening, nor such powerful muscles. This in itself is evidence that it does not need to enclose such large objects, nor to bite so hard, and in fact we find that the horse feeds upon finely divided substances like oats, blades of grass and the like. In their methods of eating the two are very unlike. The cat bolts her food in a succession of gulps, while the horse munches slowly and steadily, grinding his food with a side-swinging motion which the cat's jaws do not provide for.

The lips, too, are significant. Everyone knows how slightly these are developed in the cat and how thick and firm are those of the horse. This points to the difference between the chewing and the tearing animal. The horse gathers the grass or the oats into his mouth with the assistance of his strong lips, retaining the mouthful while it is thoroughly ground and mixed with saliva before swallowing. Without these tightly closing lips it would be difficult to keep a mouthful of this character from running out again during so slow a process.

The Manatee's Mouth

Sometimes in an aquarium will be found a big, logy, shapeless creature like an elongated leather bolster on a large scale, in a tank labelled "Manatee, or Sea Cow." It is generally so sluggish, keeping down in the shadow of its tank so persistently that we get little chance to examine its strange mouth, but could we see it feeding in its native southern waters we would observe a curious lip action far excelling that of the horse. While the horse grasps its forage with two lips the manatee manages the same feat with one. This sounds hardly credible, but examination proves that the upper lip is provided with a pair of fleshy pads which have the power to spread sidewise and draw together again, thereby gathering and holding mouthfuls of the water vegetation upon which the creature feeds.

The Alligator's Mouth

In the same waters with the manatee will sometimes be found one of the most formidable mouths in nature, used with terrible effect by the alligator or its near cousin, the crocodile.

Tourists returning from Florida are frequently beguiled into bringing back with them specimens of the baby alligator. These unlovely little beasts, consisting largely of mouth and tail generally survive but a short time in their new homes, but in that time are apt to give exhibitions of the savage temper which has made the race

famous. To see the tiny bit of black leather, not much longer than a lead pencil open its surprising proportion of mouth and snap viciously at a stick is rather amusing, but multiplied into the size of a full-grown 'gator the amusement vanishes. Or if one allows the little pin-point teeth to fasten upon his finger he gets an idea of the race's instinctive, bull-dog grip for the little fellow will allow himself to be lifted and will hang suspended until the mouth is—not too easily—forced open. This also ceases to be humorous when pictured in terms of an adult animal.

In truth the mouth is a really formidable affair on a large specimen, with tremendously-muscled jaws opening to a point well back of the eyes, and with a waved outline which gives added security to the grip of the tusk-like teeth. Imagine the steel-trap snap of these terrible jaws and it can be seen how small is the victim's chance of escape, for the alligator's custom is to drag its victim at once beneath the surface where drowning soon and mercifully completes the killing. So powerful are large specimens that crocodiles will occasionally attack even the lion or tiger coming to drink, while the comparatively puny human being is frequently devoured.

A missionary to the Congo relates seeing one such tragedy within her first half hour after reaching the mission station. Some native boys, although warned by teachers, disobediently went into the water for a swim, and hearing an outcry she rushed to the door just in time

to see one of them dragged below the surface. His mangled body was later recovered through the united efforts of the men. In general, however, these mighty saurians do not relinquish their prey but devour it at their leisure, as it must first be torn into fragments to fit the small size of their gullets. As stated in the Chapter on Noses the alligator has a special arrangement of its air passages, and can open its mouth beneath the surface without taking water into its breathing apparatus. It has also special valves to prevent the water running down its throat at such times.

Herodotus tells us of a bird which does not hesitate to enter the opened mouth of the crocodile in order to pick off the troublesome parasites, and is never molested by the grateful monster. This was long supposed to be fabulous, but modern observers have discovered a species of snipe which runs over the creature's broad back in search of insects and leeches, and even picks from his teeth and gums such parasites or shreds of food as it can find.

The Hippopotamus's Mouth

Another cavernous mouth yawns up at us from those African lakes and rivers where the ponderous hippopotamus feeds. It is one of the sights of the Zoo when a captive "hippo" expresses his weariness with tiresome civilization by splitting his mighty head asunder in a yawn of such proportions that one gazes fascinated.

Such a mouth upon a living creature! But perhaps we should turn this into a query—*why* such a mouth?

Well, it requires a fairly roomy mouth to house the great cutting tusks—more like agricultural implements than teeth—and to operate them in severing the reeds and other river growth upon which their owner feeds. It requires also a large mouth to hold a mouthful which is big enough to he "worth while" to such a frame; for the hippo has no mere 150 lbs. to nourish, but occasionally 4 tons or more. He must be provided for liberally and if he possess an appetite proportionate to his bulk, his mouth should most naturally correspond to his appetite.

The big fellow is not entirely popular with the natives, being rather too much interested in their fields of corn and sugar-cane where his clumsy feet tread down as much as he devours. He is also a dangerous antagonist in the water unless one is armed with modem fire-arms, and an old bull frequently possesses a savage temper to match his formidable jaws.

The Whale's Mouth

But there is one mouth which far eclipses all others known to man. Like those of the alligator and hippopotamus it belongs to an air-breathing, water-loving animal, but unlike them its owner never willingly comes ashore. For although zoologists tell us that the whale may have been in past ages a land animal, which through

pursuing its prey into the sea, came to live more and more in the waters, it has long ceased to have the slightest connection with land and is as totally marine as are the fishes. Right whales while no longer the subjects of the great industry which once supported whole towns, are still hunted to some degree, although rarely seen in the ordinary lanes of travel. Were one to see this gigantic sea mammal, however, he would be probably chiefly impressed with a mouth so huge and so strange in its appearance that no other mouth in nature could be compared with it.

Fancy a mouth fifteen or sixteen feet in length and of great width with side lips on the lower jaw and the most curious fringe-like substance hanging from the upper jaw; the whole vast chasm ending in a gullet of but 1½ inches in diameter. What food can it be designed for?

We might, not unreasonably, suppose that this monster fed upon larger sea creatures and needed a mouth sufficiently large to enclose them, but that he has no teeth with which to tear or grind, and as to swallowing them whole, there is that absurdly small gullet to consider. Then again we cannot overlook the fringe-like substance already spoken of, and familiar to us as the whale-bone of commerce. This whale-bone, or baleen, hangs in hundreds of horny plates, sometimes seven or eight feet broad where joined to the jaws, ten feet or more in length and set closely side by side, so that only the edge of each plate is seen from the outside, while the inner edge fringes

into hair-like fibers that interlace until the whole forms a wonderful natural sieve. A *sieve*—that word is the key to the food problem of the right whale, for this vastest of creatures feeds upon almost the tiniest of visible life—a strange paradox of nature surely. In the arctic waters he frequents, are to be found inconceivable millions of minute shell-fish, sometimes seen floating in broad bands miles in length, upon the ocean's surface. Through these multitudes plunges the whale, his mouth engulfing water and crustaceans like a mighty scoop, and then the raising of a tongue of a ton or two in weight slowly forces the water through the fringed strainer until only its living freight remains to slide down the narrow throat into the waiting stomach. One cannot calculate the numbers necessary to provide even one square meal for twenty or thirty yards of whale but lavish nature has provided enough and to spare.

There is, however, another whale mouth which contrasts sharply with that of the right whale ("right" by-the-way is the whaler's designation of the species most profitable to hunt—all others being naturally "wrong") and this is the mouth of his equally huge cousin the sperm whale. Here are no high, enfolding lips and no whale-bone. Here, on the other hand, are strong teeth in the lower jaw and a very large gullet capable of swallowing as much as a six-foot cube—or even a Jonah if necessary. The lower jaw is thin enough to be capable of great movement and can be dropped at almost a right angle to

the head, thus giving considerable biting power. All of this points to a difference in diet and we are not surprised to hear that the sperm whale takes heavy toll of the world of fishes; but it is from the strange, uncanny tribe of cuttle-fish and squids that he gets his choicest meals, and these boneless creatures, some of them of great size, are eagerly gulped down whole or bitten and swallowed as their size requires.

The Shark's Mouth

Having once embarked among the creatures of the populous sea there are endless strange mouths to claim our attention, while the limits of time and space compel us to yield it to but few. Among these the shark is one which appeals strongly to the popular imagination, and has come to be a synonym for all that is greedy, fierce and ruthless. Superstitious sailors at sea shudder when one of these monsters is seen to be following the ship, as they not infrequently do, thinking it to mean that one of their number will die or fall overboard to feed him.

It has been claimed by some naturalists who have cultivated his acquaintance, that the shark has been slandered, and is really less savage than many other fishes. However, the shark family includes many varieties, some of which are comparatively harmless. While others are not averse to human flesh, it must be remembered that man in

the water is out of his element and an easy prey for any flesh-eater of sufficient size.

The shark seems rather handicapped than otherwise by a crescent-shaped mouth, set beneath a projecting snout, and requiring him to turn upon back or side in seizing food; an obvious disadvantage if the prey be agile. For this reason the shark is more especially a sea scavenger, greedily bolting vast quantities of refuse and offal, under the special guidance of his strange little companion, the pilot-fish, whose mission in life it seems to be to lead the big fellow to food supplies. The persistent following of a ship is undoubtedly due to the refuse thrown overboard from the ship's galley rather than to any expectation of disaster among the crew.

The shark's mouth gains an added look of menace from its many rows of teeth, which must be left for a later Chapter.

The Ray's Mouth

Nearly allied to the sharks are the ray group, which hardly seem fish, so extraordinary is their form. Of great thinness and a broad-extending flatness their life is naturally upon the water bottom. Their mouths are also upon the under side as with the shark's but unlike the latter they are not active, and may be seen slowly flapping their way along the bottom of an aquarium tank in a manner that speaks for their habits at home. Such

conditions indicate that Nature must provide their food also upon the bottom, and we are, therefore, not surprised to learn that many of them subsist chiefly on flat-fish, shell-fish and crabs.

The Angler-Fish's Mouth

Living also upon the bottom but with his mouth above instead of below is the squat and savage angler-fish, than which anything more utterly hideous can hardly be imagined. His is a mouth in which the upper jaw rises at right angles to the extended lower one and its resemblance to a steel trap is suggestive of its action.

From the top of the head rise strange filaments, the longest of which is provided with a small flap of skin at the upper end, and these are inconspicuous among the waving seaweed where he lies concealed. But let a passing fish carelessly touch this most sensitive "feeler," and the huge jaws act instantly and effectively. The angler-fish is indeed an animated self-setting steel trap. It is even assumed that the waving flap referred to is a lure to the hungry victim, since it may easily have an edible look upon first sight. If so the trap is not only set but actually baited.

The John Dory's Mouth

Hardly less remarkable is the artifice by which the john dory makes his captures. Instead of lying in wait, he

approaches by stealth somewhat after the manner of the cat-tribe when stalking their prey, and Nature has granted him, for this purpose, two curious provisions. The first is an exceptional thinness—a thinness so great that seen from the front he is merely a vertical line in the water and too inconspicuous to alarm the prey, especially as his movements are made by a slow fin vibration which disturbs the water but slightly. In this way he may often approach closely enough to use the amazing second provision referred to—nothing less than the power to shoot forward an extensible mouth, like the sudden opening of a telescope, and enclose his victim.

This same fish, by-the-way, is highly valued by epicures and was called "Zeus" by the ancient Greeks as king of edible fish. Tradition connects him with the New Testament story of finding the tribute money in the mouth of a fish, and Mediterranean peasants believe to this day that the dark spots upon his sides are marks of the fingers of St. Peter.

The Gar-Pike's Mouth

An extraordinary fish mouth suggesting the bill of birds is found in the fresh water gar-pike, or bony pike. Such a mouth is well adapted for seizing, and when its large and savage owner rushes from concealment among the river reeds, the hapless prey has slight chance to escape the snap of those long-toothed jaws.

In this method of lying in ambush the gar-pike resembles the common pike, of which the mouth is also specialized for seizing, though not in such unusual form.

The Snake's Mouth

But with many curious mouths still untouched in the wide waters, we must return again to the land, and glance at but one or two of the multitude there awaiting us. Some reader may have chanced upon a snake with an apparently abnormal swelling in the center of its slender body, and of course needed not to be told that this represented a newly swallowed meal—a frog it might be—neither chewed nor torn, but bolted whole after the manner of snakes. Remembering the elastic nature of skin, muscles and floating ribs, it occasions no great surprise that the snake's body should have stretched itself over an object so much greater than its natural diameter, but like the cucumber in the bottle the question is, how did it get in? We know that our own jaws are composed of rigid bone and when they have opened to the extent of their hinge can go no farther without injury. Clearly this rule with even the snake's wide mouth would limit it to much smaller objects than it frequently swallows, but the mystery clears itself away when we examine the skeleton. There must of necessity be a point where the bones of the skull will give way, and we find that point in the front of the lower jaw which consists of two bones unjoined, save for the elastic tissues in which

they are imbedded, unlike the solid bone of ours. These bones are, therefore, capable of spreading widely, and when the snake has seized its prey the jaw is forced forward one side at a time, then the teeth are hooked into the flesh and the jaws drawn backward. This process repeated, slowly forces the victim down the elastic throat, although the snake's head loses all appearance of being a head, while so engaged.

The Squirrel's Mouth

There is a class of pocket-mouths which must not be overlooked in even this restricted survey, and the squirrel is probably its most familiar example. That furry little bunch of impudence has a wise habit of storing away nuts for winter use and these nuts must be carried to the hidden storehouse. Since he requires all four feet for the perilous journey over tree limbs, and there is no room for a pocket in his elegantly-fitting suit, Nature has provided him with highly elastic cheeks which serve that purpose. An observing city boy in the country might think the squirrels subject to fearful attacks of mumps during nutting season, but the country lad could tell him that the swellings merely represented nuts in transit.

Some of the monkeys and various burrowing rodents are also possessors of cheek pouches. The common little pocket gophers found in many parts of the West have cheek pouches which open on the outside and are

sometimes crammed with spare food. When wishing to call upon this food supply it is only necessary to press the feet against the cheeks from behind until the food is forced out upon the ground in front.

The Human Mouth

There are mouths without number still unconsidered, but the subject must be left at some point, and the human mouth will do for a final exhibit. Man focuses in his mouth so far as appearance goes. Ask an artist which is the most expressive feature and he will tell you it is not the eye but the mouth.

A portrait may take no little liberty with the eye, but let one vary the length, thickness or angle of either lip ever so slightly and the likeness vanishes in a flash. For this reason, it is easier to get a likeness of a man who wears a heavy mustache than of one smooth-faced or of a woman, and this possibility of endless slight variation may answer the frequent question as to how so many millions of faces are possible without actual duplicates.

It is not surprising that the mouth should be full of character marks considering its constant use. Even when one is not talking the emotions passing through his mind are apt to be reflected upon this most flexible feature. The nose, and even the eye, have comparatively little range; but mirth, sarcasm, decision, doubt, discouragement, brutality and much beside, show easily upon the lips. It is

often pathetic to note how speedily the "cupid's bow" of the little child's mouth is exchanged for the hard lines of maturer years: this is undoubtedly due to the great flexibility which serves to make it the reflex of the most familiar mental states. No other animal has such expressive flexibility just as no other animal has such variety of mental action.

Viewed in its most important physical capacity, that of food-port, the first point to strike our notice is that man's mouth is strongly lipped and has no great opening power as compared with that of the cat, for example. This indicates that man chews instead of tearing his food, thus classing him in general with the Hunted Animal group; for man at least neither hunts nor seizes with his mouth.

This matter of thorough mastication, more properly to be considered under "Teeth," is one which is highly vital to the health, as is coming to be generally recognized, and Nature encourages it in a most interesting way by placing all of the sense of taste within the mouth. To enjoy a pleasant flavor to the full one must retain it in the mouth as long as possible, for once swallowed it passes beyond the range of the taste. This same delay of swallowing is also an important guard against receiving poisonous or unwholesome food. As explained in a previous Chapter (Noses) our food supply must usually run the gauntlet of four of the five senses—so discreet is Nature—and it does not enter the stomach until sight, touch, smell and taste have passed upon its availability. Even at the last moment

the tiny, hanging soft-palate may challenge it in the very act of swallowing, and call for a swift, convulsive action which saves the stomach from its presence. One is lost in admiration for the wonderful provisions for our well-being which the slightest study reveals.

But man, though an animal, is much more than animal, and indispensable as is his mouth from a physical standpoint, it is perhaps even more important as the servant of that higher mental and spiritual self, which should dominate his physical being. This phase of his nature requires a means of expression, and this is furnished chiefly through the agency of the mouth. Animals have some variation in their calls, but when compared to the range and modifications of the human voice, these are but crude at best. This is not the place to go into any technical discussion of the way in which the vibrations of the vocal chords are given various shades and keys by the control of the air chamber of the mouth cavity, nor of how the tongue, teeth and lips are employed to form these sounds into articulate speech, but communication with our kind is chiefly due to this same wonderful contrivance whose complexity compared with the rest of the animal world is another proof of man's right to be placed at the head of the kingdom.

Tongues

And in the mouth is a tongue. Shall we pass it with such simple statement seeing that this is a small member, generally concealed, or shall we halt and probe it with our "Why"?

History has not overlooked the importance of the tongue. Small as it is, it has given its name to the languages of the earth, small as it is, the greatest consequences have often hung upon a moment's use of it, and in the Bible we read: "But the tongue can no man tame; it is an unruly evil, full of deadly poison."

Unquestionably we realize that all of this is in a figurative sense, but curiosity is aroused nevertheless to the point of trying whether a little simple deduction may not throw interesting light, as already in the case of Eyes, Noses, Ears and Mouths.

The Cat's Tongue

We have already noticed that the cat has but slight lip development and this affects the tongue in two ways. First as to drinking. A horse will plunge his nose into the water where his firm lips make it possible to set up a considerable suction. But the cat cannot so drink. She would die of thirst were it not for the swift darts of that little flexible tongue which curls over at the tip as it enters

the fluid and draws it back into her mouth. So little can be secured at each lap that one might think this a slow, hard method, but for the speed with which she empties a saucer of milk.

When you let her lick your finger you feel a dry roughness as of a tiny file. This, too, is a reflection of the construction of her mouth and the consequent manner of feeding. A cat is not fitted for chewing. She does not retain the food in her mouth and reduce it to a pulp before swallowing, but deals often with bones too large to swallow from which she must tear the flesh with her teeth. This is apt to leave sundry shreds too precious to be wasted and these may be rasped off by the action of the roughened tongue until the well-polished bone is bare of nourishment. In lions and tigers this tongue rasp is so powerful as to break the human skin, and stories are told of tamed lions which have had their first taste of man's blood and grown suddenly savage through licking their master's hands.

The cat, as is well known, is daintily clean. Long, elaborate toilets are frequently made and the tongue is the washrag employed, for she appears not at all squeamish about taking into her mouth dirt which she will not tolerate upon her coat. The tongue's roughness has its obvious value for cleaning.

The Horse's Tongue

With the horse the tongue becomes a very different kind of member, decidedly thicker and less flexible. The mouth is also much moister and the reason for these differences is apparent from the contrast in the manner of eating and drinking. As already stated the horse has no need of a lapping tongue nor of one which will aid in polishing a bone. He will look with entire indifference upon a bone at which a cat's eyes would gleam, while she would sniff contemptuously at the bag of oats for which his mouth would water. It is well, indeed, that his mouth should water so freely since a bag of oats would seem but dry fare to us. We must have our oatmeal long boiled to make it palatable, while the horse, his nose buried deep, will munch away contentedly, grinding and salivating his mouthful, and needing the tongue merely for the fundamental tongue use of moving the food about in his mouth until it is thoroughly chewed and then aiding in the swallowing.

The Whale's Tongue

In our Chapter on Mouths we examined the manner in which the right whale gains his food, so we shall only pause at his tongue long enough to note its vast size—a ton or two in weight—its substance so soft that it may be easily indented, and the fact that it is attached for its entire length so that it cannot be extended. It seems to be used

merely as the mighty plunger which forces out the watery part of each mouthful in order that the tiny morsels may be entangled in the strainer of baleen, or whalebone.

This tongue is itself a morsel much appreciated by the orcas, or killers, those savage thugs of the sea which sometimes attack the monster in organized hunting gangs and endeavor especially to tear out his tongue.

The Giraffe's Tongue

It is rather hard to realize that the whale and giraffe are to be classed in the same group of Mammals. One is absolutely without neck which the other has to the extent of several yards; the limbs of one have been modified into flippers, while the other looks as though walking on stilts; and in the matter of tongues the soft, clumsy mass of the whale contrasts with a most remarkable member which can be far extended or withdrawn, thickened up or narrowed down to an end no thicker than a lead pencil, and curled so as to grasp with its tip.

Nor is the reason far to seek. Ladies wandering too near to the giraffes in the managerie have sometimes lost leaves from their hats by the action of that dexterous tongue and the giraffe in his native Africa so obtains the more nourishing leaves of the tree-tops. Poking his head among the branches or reaching over the wide top of a spreading "camel thorn," he can pluck them as deftly with his tongue as could one of us by hand.

The Ant-Eater's Tongue

The ant-eater whose extraordinary nose claimed our attention in the Chapter on Noses is another creature to gain his living with his tongue. When he has torn open an ant-hill there is the problem of obtaining a sufficient number of the excited, rushing particles to constitute a meal. He cannot do this with his clumsy feet nor yet with his tiny mouth and he really might have his trouble for nothing were it not for 8 or 9 inches of slender, flexible tongue which looks like a big earthworm. This twists its way into the passage tunnels of the little builders or wipes them up on the ground by regiments and brigades. It seems to be a somewhat disputed point among scientists as to whether this tongue in common with that of the manis and some other ant-feeders is or is not covered with a sticky secretion. The fact remains, at all events, that it is entirely effective for its purpose, and the poor little ants could they have any image of the "Grim Reaper" might well make him in the form of a brush-tailed, claw-footed, long-mouthed ant-eater, with a worm-like tongue in place of a scythe. The armored pangolin or manis has also a taste for ants, but extends its glutinous tongue across an ant-path until it is covered with the insects and then draws in the load.

The Woodpecker's Tongue

Another creature—a bird this time—which meets a somewhat similar problem with its tongue is our little tree protector, the woodpecker. In these days when the preservation of the forests is being recognized as a vital necessity, one department of the movement might well be directed to the suppression of those gun-fools who think it smart to take a shot at this invaluable ally, for although his motive is the selfish one of food, he is busy every day fighting the battle of the trees. How he cuts his way into the trunk in search of the borer will be discussed in the "Bills" Chapter, but that is only half of the story for the borer packed in a tight-fitting hole needs a special instrument for its extraction; namely, the extremely long, slender, pointed and barbed woodpecker's tongue. This tongue is hard and sharp enough at its tip to transfix the prey which its barbs hold securely in withdrawing. Saliva from two large glands lubricates its movements and makes it sufficiently sticky to capture ants and other insects too small to be speared.



DIAGRAM (AFTER WOOD) SHOWING BARBED TONGUE OF WOODPECKER AND HYOID ATTACHMENT TO THROAT

There is an interesting arrangement in connection

with this tongue, lying rather outside of the range of our observation. This is its attachment to the hyoid bones of the throat; very slender, movable bones which curve backward and around the bird's skull and are attached at the forehead. Through this wonderful mechanical contrivance the tongue, though not in itself extensible like that of the giraffe, may be darted out to a great distance by the mere forward motion of these bones.

The Humming-Bird's Tongue

Another bird-tongue with a very similar extension arrangement, belongs to the tiniest, daintiest member of all the feathered brotherhood. The humming-bird has one of the most curious of tongues, curled into two rather stiff tubes, something like two tiny hollow straws laid side by side and attached for about half their length. Imagine the straws sharpened at the end like the point of a quill pen, and the outer edges at the point finely fringed into a

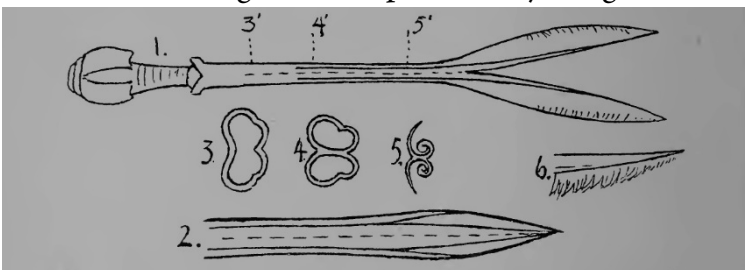


DIAGRAM OF HUMMING-BIRD'S TONGUE (AFTER ROBERT RIDGWAY IN NATIONAL MUSEUM REPORT)

1. Tongue with free portion separated and membrane spread out. 2. End of tongue with membranous fringe curled up as in life. 3, 4, 5. Sections through tongue at points 3′, 4′, 5′. 6. Tip of one of free portions. (All greatly enlarged.)

minute feather or brush and you gain some idea of this tiny but important instrument. For the hummer, as all know, patronizes deep-throated blossoms for the drop of nectar and the small insects which it attracts. Here, out of sight of the beady eyes, the delicate tongue locates these several dainties and either draws them up, as one would sip lemonade through a straw or wipes them up with the feathered filaments, according to size.

The honey-eaters of the Old World have a tongue developed at its end into a veritable brush with which to gather nectar from cup-shaped blossoms. So too have the "brush-tongued" parrots. With most parrots, on the other hand, the tongue is club-like. It is hard to realize that a bill so thick and a tongue so clumsy can belong to a bird with such powers of mimicry until we watch Polly closely enough to see that her speech comes from her throat. It never occurs to her that tongue tips were made to talk with, but in still further observation you will see how well that strong, chunky member serves in pressing a sunflower seed from its husk, or in reducing any other morsel before swallowing. Parrots masticate instead of bolting their food like chickens, and the action of the tongue against the inside of the upper mandible, as well as the scraping use of the lower mandible are in the nature of chewing.

The tongue is also used cleverly in prehension for handling objects between itself and the upper mandible, being muscular and having a nail-like formation on the under side. Furthermore it is a delicate organ of touch.

The Toad's Tongue

The toad appears so utterly phlegmatic that one might almost fancy eating a matter of indifference to him. Possessing no teeth and no neck to speak of, with stumpy little front legs, clawless toes, and a squat, clumsy body he seems poorly fitted for the capture of insects—particularly the many flying kinds which find their way inside his warty skin. But wait, he has a tongue! That explains it. Sometimes if you are as patient as a Nature student should be, you may chance to be watching the inert little fellow when some careless insect ventures too near, and suddenly—there is no insect. The toad has not changed his position and were it not for certain slight movements of satisfaction in his throat might seem to have been unaware of the occurrence. What has happened is that the insect has been captured by a remarkably extensible, sticky tongue which struck it with unerring aim and the speed of thought. This tongue, unlike all of those heretofore considered, is not attached in the throat but at the front of the upper jaw and lies with its free end pointing backward. Thus it is not darted out like the woodpecker's but snapped forward like those stinging rubber bands of our school days.



THE CHAMELEON'S POP-GUN TONGUE

Its effectiveness is shown by the fact that insect collectors sometimes catch toads in the very early morning and kill them to examine the contents of the stomach. These, turned out upon the surface of water, float apart and in the mass of yet undigested insect bodies may often be found night species which are rare and difficult of capture.

The quaint and diminutive chameleon—he of the changeable coat and absurdly slow movements—has another form of missile-tongue, "like a pop-gun cork at the end of a string," and he can shoot it out with lightning precision for as much as six inches in capturing insects.

The Snake's Tongue

It is fascinating to stand before the glass front of a cage of snakes and watch the slow, sinuous grace of the gliding movements. Frequently, as we watch, there is the flickering dart and play of a forked, threadlike tongue, shot out and withdrawn through a small hole in front without opening the jaws. This has such an uncanny look in connection with the baleful glitter of the lidless eyes that it is not surprising to find ignorant people fearing it as

poisonous when, as a matter of fact, it is less dangerous than the tongue which slanders it.

Here is no capturing, chewing, sucking, rasping nor lapping tongue. It is far too delicate to serve such mechanical use, but its activity and the mouth provision for its constant use, show its importance to the snake. The spreading fork is also significant. It proves to be, in fact, a sensitive organ of touch by which the reptile, moving often in the dark, may explore its way, somewhat as the fixed whiskers of the cat help to keep their owner out of awkward places. Furthermore it assists in examining an object of food before the snake commits itself to the act of swallowing, and here the double touch of the fork gives a much better idea of bulk and shape than would be possible to the feeling of a single point.

It seems probable that the snake may occasionally use its darting motion to threaten enemies—in truth it is a bit terrifying—just as the toad will puff or the frilled lizard extend its frills when showing resentment. Some scientists have the further idea that the tongue is sensitive to the testing of air vibration.

The Human Tongue

But what of that tongue which most concerns you—that tongue which gets you into trouble and out of it—which the doctor asks to see when he places an inquiring finger upon your wrist; which assists you in the pleasures

of eating and helps to unite you through the medium of speech to your fellow beings? The human tongue is at least as interesting as any thus far considered. And let it be said in passing that we have considered these others only for their most obvious peculiarities of use, chiefly of a mechanical nature. It must not be thought that they are without the power of taste simply because that point has been reserved for this division.

Stand before a mirror in a strong light, open your mouth and examine the strange, red, muscular member which lies back of your teeth. Stretch out its broad flat length and see what an admirable floor for the food it makes. Curl the tip downward or upward, retract it, thicken it to a narrow chunk, roll it over to right and left, dart it in and out, explore with it the interior of the lips and cheeks and the surfaces of all the teeth. Had you ever fully realized how marvelously active and flexible it could be? Place your finger upon its surface and try to hold it down when you will to raise it and learn its muscular power. All of this indicates that the human tongue has its mechanical uses, too, and we know from every day experience how it moves the food about until it has been thoroughly ground and mixed with saliva and then gathers it from all parts of the mouth and presses it backward for swallowing. With some of the softer foods even the teeth are not called into use and the entire process is carried on by the tongue against the roof of the mouth.

And now stretch out your tongue again and examine it very closely. Its surface is seen to be roughened with fine rows of those tiny projections known as "conical papillæ," and supposed to be for the purpose of touch, while sprinkled about are distinct little white lumps called "fungiform papillæ" believed to be intimately connected with the sense of taste. The few large "circumvallate papillæ" lie too far back to be within view. This whole sense of taste, as already noted under "Mouths," has great value in protecting us from unwholesome foods, in stimulating the flow of saliva needed for digestion, and in tempting us to retain the food in our mouths until thoroughly ground and mixed before swallowing. The tongue as the chief taste organ is thus of great importance aside from its mechanical uses.

And finally there is that great function of speech which so distinguishes the human family from the lower orders. Without the tongue it would be still possible to make inarticulate noises and these by their force or inflection might convey certain rudimentary emotions such as one may suppose the animals to feel, but all of the wonderful structure of spoken language, all of the delicate shades of communication by which our most subtle thoughts are conveyed in speech to fellow beings, all of the beauty of pronunciation and much of the loveliness of the singing voice are directly dependent upon this same versatile member; instrument not only of man's physical nature but of his highest mental and spiritual powers.

Teeth

The subject of Teeth, scientifically considered, is so technical and bristles with such a bewildering array of many-syllabled names that the amateur may well hesitate to venture upon it, for it is rather staggering to come upon such terms as "Rodentia Duplicidentata," or "Homolodontotherium." Teeth are of especial value to the Zoologist in classifying for two reasons: first, animal habits are principally influenced by the foods they seek, so that a glance at the teeth tells a plain story to the experienced eye; and secondly, teeth are so hard that they frequently endure long after flesh and even bones have decayed. Thus when we turn our thoughts back to the dim distance of that almost incalculable past before what is known as the "Tertiary Period," our sole knowledge of the mammal life of the day comes from examining a few lower jaws and a considerable number of teeth found imbedded in certain rock formations. Slight material it would seem—yet it has revealed much.

Our methods, however, are not to be technical and therefore will deal but slightly with Latin names and dental formulæ while we see whether the "amateur detective" process may not again throw some degree of light upon inquiries.

We all know that teeth come in contact with food at the very beginning of that process which leads at last to

digestion and nourishment, and this means, of course, that most foods are not fitted for immediate swallowing. What needs to be done to them and why this jaw-tooth-machine assumes so many different forms, will be glanced at in considering some of the tooth-bearing animals.

The Cat's Teeth

Whether seen in the ivory flash of a cat's yawn, or the snarling gleam of the mounted tiger, there is something peculiarly business-like in the appearance of feline teeth. Four long, strong, sharply pointed, slightly curved canines are the most conspicuous. These, set at the front corners of the jaws, two above and two below, are so plainly designed for piercing that we need not stop to question, especially when we notice also that the jaws are so short that none of the power from the tremendous jaw-muscles need be wasted and that the front teeth (incisors) are too low to check the great penetration of the canines. The whole mouth arrangement seems to be especially planned for these four large fangs, an interesting word, by-the-way, since it comes from the German *fangen* (to catch) and that is a large part of the explanation. The cat tribe must catch since they kill and eat other animals. In some cases these animals are of considerable size and strength, so that the grip of the teeth must have deadly power and penetration.

Once killed, the flesh needs to be torn from the bones—no easy task with uncooked meat—so that here

again strength and sharpness are necessary. The front teeth (incisors) are too small to play an important part in this process, but farther back in the jaws are certain jagged ivories with strong cutting edges which help reduce such fragments as are too large to swallow, and also to crush the bones for their rich marrow.

Our common cats usually hunt small prey like mice and birds and so have no extreme tooth development, but the big tropical cats make an impressive display.

The Horse's Teeth

When we lift the lip of the horse to examine his strong front teeth we see incisors raised from their minor rank with the cats and given an important part to play. Here are two straight, even rows closing together firmly with a biting edge fitted to seize and break a number of grass blades at each mouthful. One realizes that if these teeth were at all irregular such small ribbons as blades of grass would pull from between them whenever he raised his head.

The canines having no catching nor tearing work to do are not prominent, the upper ones being late in development and often not appearing at all in the mare. Between these and the grinders comes a considerable space—*a space which possibly has made the horse a domestic animal*—since therein lies the bit when he is harnessed. This space also speaks of the extremely long jaw as

compared with the cat tribe, and such length can neither have nor need their tremendous biting force.

Lastly come the molars, not with jagged, cutting edges, but in shape to really justify their name, for "molar" is derived from the Latin *mola*—"a mill." These are true grinding mills of an interesting design called *selenodont* or "crescent-toothed" because of the curved folds of enamel upon their surface. Tooth enamel is a wonderfully hard substance—the hardest substance which the body produces—and is placed at points of greatest wear; just as an ax head is made of ordinary steel save at the bit, or cutting edge, which is of highly tempered, crucible steel. The jaws of animals are really machines and the teeth are machine tools charged with the important work of preparing food for the soft organs and chemical processes

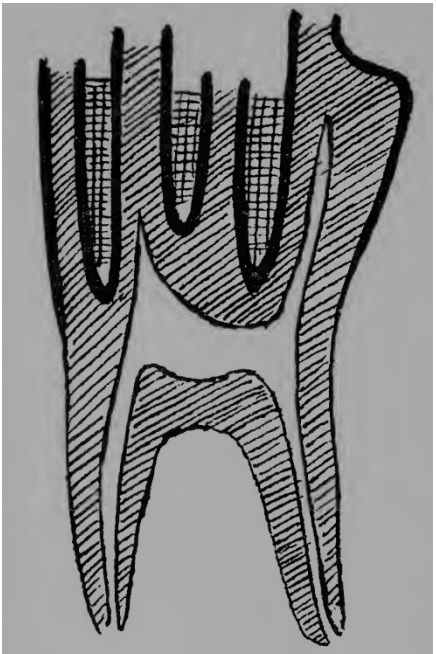
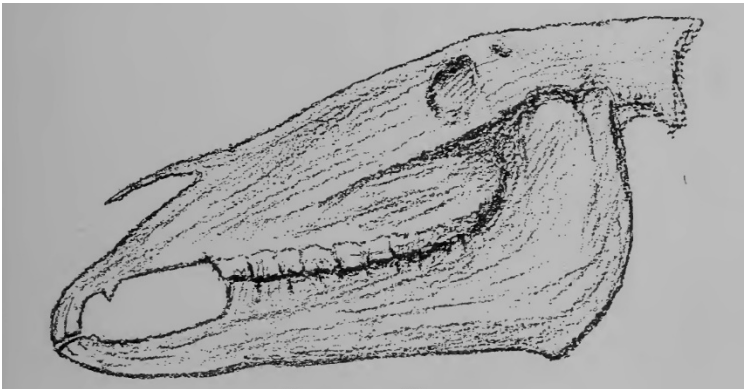


DIAGRAM (AFTER ENCYCL. BRITANNICA) OF MOLAR OF OX—THE SELENODONT TYPE

Enamel folds shown by heavy lines, Dentine by diagonal shading, Cementum by cross-shading.

which digest it. It is not strange, therefore, that even the hard dentine, or ivory, should be faced with still harder enamel.



SKULL OF HORSE
Showing Strong Incisors, Rudimentary Canine, bit opening and great array of Grinders.

However, in the teeth of the horse and other grazing animals, this enamel is even further strengthened by folding—as corrugated iron is stronger than sheet iron—and the space between the ridges of the folds is filled in with a substance called cement to make it solid. Cement is less hard than enamel and wears down slightly in use, leaving the curved edges of enamel projecting in an irregular pattern which makes a wonderfully effective grinding surface, not unlike the sharp ridges of a coffee mill. These grinding teeth placed far back in the long jaws can exert great pressure, and having the power to swing in a side-wise movement, in place of the simple up-and-down hinge motion of meat-eating animals, the mouthful

of oats, hay or grass comes in for a thorough grinding and insalivation.

One of the first things a horse fancier will do in examining an animal is to look at its teeth to judge of its age. This is roughly possible because of the single fold of enamel in the front teeth, pushed back like the in-turned end of a glove finger, leaving a cavity which is also filled with cement. The cement becomes somewhat discolored in use and shows in contrast to the white ring of enamel around it. As the horse grows older the tooth wears down and the central cavity becomes smaller until at about the 8th or 9th year it has disappeared, showing that the tooth has worn below the fold, after which there is no certain indication.

The order in which the teeth are cut is also of value. The first permanent molar appears a little after the end of the first year; the second molar before the end of the second year; at two-and-one-half years the first pre-molar pushes out its predecessor of the "milk" series; between that date and the third birthday comes the first permanent incisor; at three years come the second and third pre-molars; in the first half of the fourth year the second incisor is cut; in the first half of the fifth year the canine appears and, lastly, at about five the third incisor completes the permanent dentition. The "colt" is now said to be a "horse," and the "filly" a "mare."

The Elephant's Teeth and Tusks

More complicated still are the great elephant molars with their remarkably deep enamel folds. Could we cut one of these across lengthwise the folds would look not unlike the teeth of a coarse comb, so long, narrow and closely set are they; thus when the cement filling has worn down a trifle their edges make a succession of sharp, grinding ridges. With such teeth the elephant must have a great deal of grinding to do, which is indeed the fact for the African species in particular, chews up vast amounts of woody fiber, such as the roots and branches of certain trees, in addition to fruits, bark shoots and other softer foods.

Ridges so hard and long would be years in wearing down, even with constant use, but when at last they do go, the tooth remnants are cast out in front and the wear comes upon the next teeth in the series. For the elephant develops successively some six great molars on each side in each jaw, although those are so large that only one, or a portion of two are in use at one time. The whole series gradually presses forward to present a new tooth when the used one has ceased to be of service, and it takes the many years of an elephant's life to destroy them all.

But the elephant has another kind of tooth much more familiar to the average observer. Talk about prominent teeth—what can compare with the two huge, curving, upper incisors which push their way from near the base of

the trunk to a length of four, five, six, sometimes eight, sometimes even ten feet! There was indeed one aged bull elephant killed near Mount Kilimanjaro with a pair of tusks which probably exceed all others known to history. One of these weighed 228 pounds and sold for $5,000. The other nearly equaled it, so that their original owner had to carry a weight of almost one-quarter of a ton of ivory.

Such tusks are of course entirely abnormal and must have been a serious burden to the animal, but the average one is of great value in gaining food, though not in chewing it. The tender, juicy inner bark of certain trees must be reached by scoring and splitting the outer bark, the sought-for roots must be plowed out of the soil, or if there be the leafy top of a mimosa upon the bill-of-fare it may prove most convenient to uproot the tree and bring it down. For all of these purposes nothing could be more valuable than such a long, strong, sharp and elastic tusk with just the right degree of curve to give it purchase. This elasticity has even been something of a misfortune since it has led to the use of ivory for billiard balls which has been one of the great causes for slaughter. Ivory is said to be the most elastic of all substances, and if two balls, one of rubber and the other of ivory, are dropped from the same height the ivory will rebound the higher.

If you were to examine a separated tusk you would find a conical hollow at its base in the place of an ordinary tooth-root, indicating that the tusk is a much simpler form

of structure than the great, enamel-ridged molar. The tusk is usually without enamel, since the small amount at the tip soon wears away, and free from this hard coating, can grow without restraint. Thus while the grinders wear out in slow succession, the tusks may grow larger in spite of hard usage, the hollow referred to being filled with the "permanent pulp" from which new ivory is constantly formed.

Tusks are, of course, most savage weapons at times, although probably less used for this purpose than most people imagine, and are of value with the trained elephants of India in raising and transporting large timbers.

Possibly the strangest use ever made of these great teeth was that of a savage old rogue known in captivity as Jumbo II. Having already killed several keepers the dangerous brute was avoided by all save one favored trainer who was on friendly terms, and this trainer conceived the idea of making the elephant his banker. Screwed to the end of each of the sawed-off tusks was a hollow brass ball and in one of these the man used to deposit his spare bills, sometimes to the amount of several hundred dollars. No safer place could have been imagined for the big cashier would have killed any other person who dared to approach.

The Walrus's Tusks

Somewhat resembling the elephant's tusks are those of that unwieldly sea-monster, the walrus, but there are important points of difference in which lie much of the story of the difference in their lives and habits. In the first place they point downward and slightly backward from the upper jaw. So long and sharp are they, so huge is their owner, and so high does he carry his bristling head that at first sight one might think him a savage warrior, the terror of other animals in his region. But a little thought should show us that such tusks to be used most dangerously must strike swiftly downward, and that would require a slender, flexible neck which this clumsy brute does not possess. In truth the walrus is not a particularly savage animal unless attacked, when he can make some little use of his tusks if the enemy be near enough, and what with his great size and extraordinarily thick skin he has little to fear from even the polar bear.

There is another tusk use, which reflection may suggest. The walrus like the seal lives out of water for a part of the time. It is no easy matter to drag such a ponderous shapeless mass to a place upon wet rocks or a slippery ice floe. If we were in his place we should require some means of hooking fast to the surface and would appreciate the fact that Nature has supplied in these tusks two effective hooks for that very purpose. Much as the boatman by striking a boat-hook into the timbers of a wharf can pull

his boat up to it, the walrus by the use of his tusks is able to scramble ashore.

They are also of value in the search for food. In the mud where the water is not deep are found many forms of small, sluggish marine life which may be grubbed up with the tusks and these together with sea-weed constitute his daily bill-of-fare. Of course he has other teeth than these prolonged upper canines, but it is not our purpose to go into anything of a detailed description. From this point on we shall satisfy ourselves with the forms and reasons of occasional peculiarities in the wide subject of Teeth.

The Narwhal's Tusk

In the same Arctic seas with the walrus will be found that curious member of the whale family which sports a single tusk straight as a walking stick, strong, sharp, and five to eight feet in length, pointing directly forward from the front of its head. Not only is this a tooth (usually the left canine, although sometimes the right) it is also the only tooth developed, for its fellow canine is rudimentary and does not pierce the bone of the jaw. Thus it is an exception to that general rule that the teeth on both sides must be alike.

A tusk so long and slender would be subject to accident were it not strengthened by being spirally twisted for its entire length upon somewhat the principle of "helical tubing," and thus it makes a formidable weapon

which is believed by some to be used for the purpose of transfixing sluggish bottom fish. Yet as the food problem must be equally important to the female which has no tusk, it seems more probable that it is merely one of those of fighting weapons which are found in the males of many animals. Its food, too, which consists mainly of marine mollusks, squids, with only an occasional fish, accords with its otherwise toothless mouth.

The Dolphin's Teeth

But its cousin, the dolphin, has a mouth furnished in great contrast. Here the long, pointed jaws are set with numerous simple teeth which are all alike and thus come under the class "homodont," in distinction to the "heterodont"—differing teeth of most animals. These dolphin teeth, slender, pointed and slightly curved, present another good occasion for the use of our "why." Clearly they cannot be for grinding like the molars of the horse; clearly also they have no biting edge like his incisors. They are too small, and set in jaws too long for the tearing or crushing use of the cat-tribe, but their curved and pointed shape suggests something of the catching, holding use of the cat's fangs. This, too, is emphasized by their number and we come logically to the conclusion that the dolphin's prey, while weak, is active and hard to hold. Just such prey is found in the great schools of mackerel and other small fish upon which it

feeds. It is also an evident advantage to have no grinding teeth and be forced to swallow the food entire for such fish have many needle-like bones which the force of chewing would press into the flesh of the mouth. In the stomach they may be harmlessly dissolved by powerful digestive juices.



THE POWERFUL TUSKS OF THE WART-HOG

The Boar's Tusks

Were this a scientific study of teeth, we should go into a thorough discussion of the hog's forty-four teeth—more than those of any other animal in the barnyard—and of the difference in shape between his upper and lower incisors, or in size between his front and back molars.

These points prove the hog to be an extreme type of "heterodont" and they have to do with his taste for many kinds of food; but since our purpose is by no means thorough we shall simply glance at some of the interesting tooth variations such as those which have armed the old boar with his tusks.

The pig tribe are short-legged and low-bodied. The snout is carried especially low since it is used in digging. Hence it is not surprising that the tusks should grow upward instead of downward like those of elephant or walrus, or forward like the narwhal's lance. Pig flesh is appreciated by many of the four-footed hunters, but a well grown boar is able to defend himself with surprising ability. Possessed of great courage, strength and quickness, his razor-like tusks are wielded with such force and fury that cases are on record in which he has even killed a tiger. In one instance an American wild hog did battle with a bear for an hour and the grass and bushes of an acre of ground were trampled down in the fury of the fight. Finally both retired blood-streaked and exhausted but the boar was the first to return to the fray, and in the morning the mangled body of the bear showed his antagonist's terrible prowess. His sides were ripped open for their entire length and one leg nearly amputated.

Of an African variety an experienced hunter says: "There is no pluckier beast in Africa than a bush-pig, and even a leopard will hesitate before attacking a full-grown boar. Face to face in the middle of a 'fast' bush, and only a

Swazi 'stabbing-assegai' with which to kill him, I have seen an old boar after receiving nine thrusts from the terrible weapon, two of which were still fast in him make a charge that scattered us like chaff, and in three consecutive lunges lame one of our number for life, and disembowel two of the finest pig-dogs I ever hunted with."

In the great East Indian island of Celebes is found a strange type of hog, named by the Dutch "babirousa," or "pig-deer." These, in addition to remarkably long and sharp lower tusks, have two still longer tusks which grow from the upper jaw, but which in place of coming out of the mouth at the sides push through the skin on top of the muzzle and grow backward with a strong curve. In some cases these have grown until they touched the forehead, rendering them useless for weapons. One on record measured 14½ inches over the curve in addition to the end buried in the socket.

And then there are those hideous creatures of South Africa, known as wart-hogs, with great, repulsive heads bearing wart-like protuberances and armed with amazingly large, strong tusks which are said to be of use for tearing and prying surface roots from the ground as well as for fighting. These sometimes project as much as 8¾ inches from the jaw.

The Hippopotamus's Tusks

Although tusks are more properly teeth which project from the mouth, the canines and incisors of the "hippo" are of such size that they are generally so called. When he opens his vast cavern of a mouth there gleams from its red recesses a bristling armory of such savage-looking ivories that one is thankful for the stout cage bars between. And yet if man would let the big "riverhorse" alone he would have little to fear from the tusks which do occasionally play havoc with the hunter or crush the timbers of his boat. The monster is not usually aggressive save when wounded; and his teeth are for vegetable fiber instead of flesh. For that purpose they are remarkably adapted. Coarse grass and reeds abound on the edges of African lakes and rivers and these in great quantities must be harvested in behalf of a stomach which holds five or six bushels at a time. The tusks so set that they are self-sharpening by constantly grinding against each other are keen harvesting tools and reap grass and thick-stemmed reeds almost as neatly as a scythe. Unfortunately they are also quite as effective in gathering sugar cane and other standing crops, and the effect on the mind of a native cultivator when he finds that his fields have been visited during the night by a clumsy, ravenous beast, like a combination reaper and steam roller, may be imagined. Perhaps it is not strange that he turns hunter and tries to get back some of his crops in the shape of edible hippopotamus meat.

But the true prize of the hunt is the tusks which have been known to reach a weight of 7 lbs. and a length of 30 inches. These grow in the form of a half circle of which the greater part remains imbedded in the jaw, and are of such fine grade of ivory as to have been formerly used for the manufacture of artificial teeth, and for delicate, scientific instruments. Their natural curve made them also useful for the verniers of ships' sextants.

In addition to the curved tusks are two strange incisors projecting forward from the lower jaw which are said to act as crowbars in tearing aquatic plants from the mud.

The Beaver's Teeth

Our own watersides contain some few examples of the

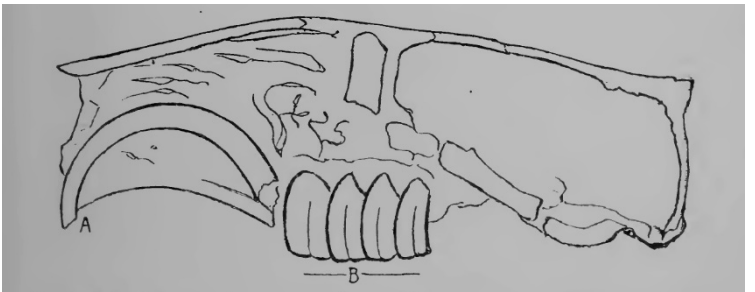


DIAGRAM (AFTER LYDEKKER) OF SECTION OF BEAVER'S SKULL
Showing Semicircular Incisor, always growing from base as cutting end wears, and always kept in vertical position at its free end.
A. Incisor. B. Molars.

fast-vanishing race of beavers, which have still greater prowess since even good-sized forest trees must fall before

their teeth. These are the star performers of the great group of rodents, or gnawing animals, and sometimes in the night when we hear the steady irritating rasp of a rat or mouse working its way through a floor board we should be thankful that its carpenter tools are not so large as those of its big cousin the beaver.

As is well known the beaver's habits call for a certain depth of water in order that he may enter his home by diving beneath the surface where most enemies cannot follow. This accounts for the wonderful dam by which this instinctive engineer backs up the water in his chosen stream, and which needs the strength of tree-trunks for its foundation. Hence he requires genuine woodman's tools and these are found in the two broad chisel-like incisors of each jaw which meet in front. Conspicuous as these are, but a small part of the tooth is visible, and if one could see a cross-section of his upper jaw it would be noticed that the incisor is in reality semi-circular, pushing upward and forward from a point back near the molars. Thus it grows constantly from its base as hard work wears off its free end and the semi-circular shape of its growth keeps this end in a vertical position (see diagram) ready for service. The grain of the tooth and the method of its use preserve its sharpness as well, for a grind-stone is not required by Nature's woodsmen, and the vertical position gives a biting force which could not be possessed by slanting teeth.

When, therefore, the beaver selects his tree the chips must fly, as he first gnaws girdling grooves above and below and then tears out the wood between until sufficient depth is reached to bring it crashing down, after which the same keen cutting instruments swiftly trim it of incumbering branches.

The Snake's Teeth

The foregoing are but a few of the more striking features of tooth development among the Mammals, treated in an incomplete way, the Bird group we can pass entire, since toothed birds are found only in fossil remains, while among Reptiles we shall but glance briefly at the teeth of the snake.

It will be remembered that in our Chapter on "Mouths" we noticed how the bones of the snake's lower jaw are put together so loosely that they have the power to distend widely when swallowing prey entire, as is its custom. For this reason we should not expect to find molars for grinding, incisors for cutting, nor even the tearing teeth of many meat-eating animals. All that such a feeder would need would be barbs to aid in catching and holding prey and these we find in the sharp and slender teeth, curving backward and set in rows—usually two rows in the upper jaw and one row in the lower. In swallowing, their smooth backward curve would present no obstacle but any struggle to escape on the part of the

victim would but hook it more firmly upon many needle-like points, and the snake itself could not release its prey once fastened. Gorging active prey would be practically impossible to a creature like the snake, being without claws to hold or feet to assist, were it not for these simple but most effective barbs.

But in considering snake's teeth our first thought is apt to turn to the poison fangs which have gained such an evil reputation. It is not enough to answer that many snakes are non-poisonous and absolutely harmless save to the small creatures upon which they feed, frequently being a real help to the farmer by destroying the enemies of his crops. Nor are we disposed to remember that even the poisonous species are generally anxious to avoid an encounter, for the fact remains that these latter bear with them those subtile and powerful fluids which cause death in a peculiarly abhorrent form. There is an association of cowardice and treachery in the thought of poison, which makes us place it far below the use of violent means.

With venomous snakes this poison is conveyed by long curved fangs, slender as needles, which lie backward along the upper jaw but are erected in *striking* (the snake does not bite). These are grooved so deeply from base to tip that the walls of the grooves often join and make a tiny tube down which slips the deadly drop, when the poison gland is squeezed by its special muscles. Thus the merest puncture of the skin may be sufficient to cause suffering or death, and the delicate fangs of the serpent become as

dangerous as the mighty ones of the tiger. Accidents have sometimes occurred to those who have captured snakes and deprived them of their fangs, thinking to render them harmless, but forgetting that Nature immediately begins the development of other fangs to replace those lost so that the creature is soon as dangerous as before.

In the most poisonous snakes there is but a single row of hook-teeth in the upper jaw. There is also a difference in the position of the fangs—some being known as "front-fanged" and others as "back-fanged."

The Rachiodon's Teeth

The rachiodon is a curious little tree snake of South Africa which is clever enough to take its prey in the unresisting form of eggs, thereby saving itself the trouble of capture. What has made it famous is the fact that some of its vertebræ have projections into the throat, tipped with enamel and constituting a kind of "throat teeth." This is really a beautiful device. An egg in its shell is not particularly nourishing, a smashed raw egg is an awkward thing to deal with, the rachiodon has no facilities for hard-boiling nor even so much as a spoon to eat with. All are unnecessary to the possessor of throat teeth, for these split open the shell of the partly swallowed egg, allowing the contents to run down the throat and the empty shell to be ejected.

The Shark's Teeth

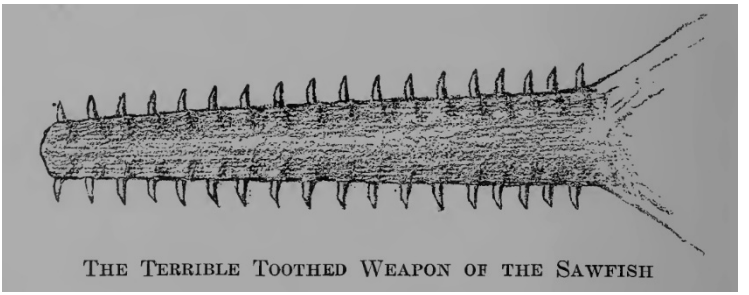
In the great world of the waters a most common type of tooth is the "pisciverous," or fish-eating, already considered under dolphins; viz.: numerous, small, curved, pointed and similar, not intended for chewing or crushing, but admirable for the capture of the quick, slippery body of a fish. Since fish prey so largely upon each other these are widely useful and in most cases are attached firmly to the bones of the jaws instead of being set in sockets. However, there are so many exceptions and variations that one hardly realizes how many changes may be rung upon the familiar tooth plan until he studies them among fishes—teeth varying from none in the sturgeon to almost countless numbers in the pike, ossified to the jaws, set movably, or again attached to the other head bones, the throat, lips or even the tongue, sharp like needles or flattened together like a pavement, all of these speak to us fascinatingly of many differences of food and condition in this vast realm, although we purpose glancing at but two or three.

In the more familiar sharks there are many rows of sharp, conical teeth, filling the broad mouth cavity and pointing backward so that prey is firmly held. These also from their numbers give an exceptional hold upon flesh to be torn, since the shark is a sea scavenger and eagerly attacks the dead carcasses of whales, for example.

The backmost rows, while little more than rudimentary, are continually developing and pushing forward to replace the outer rows as these may wear or break.

The Sawfish's Teeth

There is one energetic member of the shark family which carries additional teeth in an unusual place. The sawfish wears, projecting from the front of its head in much the manner of the narwhal, a broad blade of cartilage, which may reach a length of 6 feet, and is set on either side with strong, very sharp, slightly curved teeth.



THE TERRIBLE TOOTHED WEAPON OF THE SAWFISH

This formidable-looking weapon cannot be used for piercing since its end is blunt and rather soft, but that it is necessary for food gathering is evident if we glance at the small mouth with its enormous number of small, weak teeth, sometimes as many as fifty rows but all unfit for rough work. Indeed its method of hunting is peculiar to itself, for plunging into the midst of a school of smaller fish it lays about it with its blade like a savage swordsman, the sharp teeth ripping the bodies of its hapless prey so that

the monster may feed upon their soft entrails, to which its mouth and mouth-teeth are best fitted. So formidable is this weapon that there are instances of men having been cut completely in two while bathing.

The Ray's Teeth

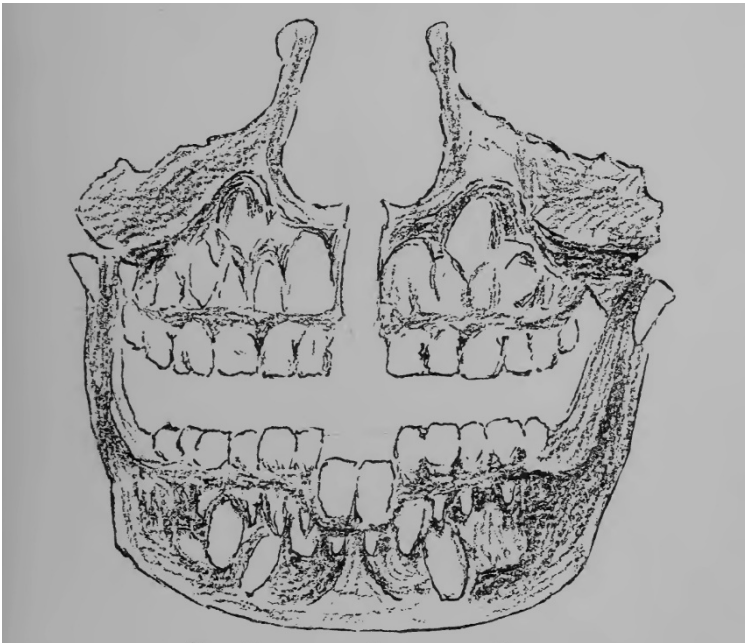
But that there are crushing teeth among the fishes is shown by various types among which are those oddly flattened relatives of the shark family known as rays. The parrot fish have strong front teeth able even to bite off pieces of coral. The carp have grinders in their throat which have led to the suggestion that they may regurgitate and chew their food, like the cow with her cud, but it remains for the rays and a few others to show us teeth of the "pavement" type. In other words theirs are so flattened and united that they form a powerful crushing surface in either jaw, being joined like the blocks of a pavement. One need only remember that with their flat bodies they are fitted for life on the sea-bottom, where crabs and hard-shelled mollusks abound, to perceive the value of such a crushing instrument. Thus again are food habits indicated by teeth.

The Human Teeth

We have not so much as noticed some forms of teeth and have "touched only the high places" with the others, but one who has followed thus far must have realized the

purely mechanical character of the tooth design, intended in some cases for weapons like the tusks, or for artisan use like the beaver's incisors, but in most cases simply a means for preparing food for digestion by reducing its size or breaking up its tissues.

So soon as we reach man, however, we come upon a new set of conditions—the artificial. Man has an active, scheming brain, with which he is ever seeking to alter Nature's original methods. Thus he has added to his eyes other eyes with which to explore the stars or examine the invisibly small; he has given himself ears to hear for



THE JAWS OF A 6-YEAR-OLD CHILD
Showing milk teeth with permanent set forming behind them. In this instance the permanent middle incisors of lower jaw have forced out the corresponding milk teeth.

hundreds of miles; has invented weapons which change his weak body into the destroyer of the greatest beasts; has learned to outswim the fishes; outrun the deer and is even vying with the eagle in the air. Still more: in the matter of food he has added to his teeth so many other devices that we can hardly wonder at the tendency of Nature's instruments to decay from neglect. Man's knife and fork are kinds of external teeth which save him from tearing or biting down his food to small sizes. So, too, are the various cooking processes which break up and soften the tissues and fiber—work which would otherwise have to be done by long continued grinding with the molars. Even worse is the careless habit which has resulted from these aids; that of swallowing food with such slight chewing that it reaches the stomach almost unmasticated. There is small wonder that with all this use of the brain, the forehead has filled out and straightened, while the neglected jaw has gradually reduced until civilized man has a facial angle much more nearly vertical than that of savage races. But brain use is not always *sensible*, and this is particularly the case in the neglect of teeth. Nature has tried to provide for sufficient chewing. She has placed the nerves of taste within the mouth as an inducement to prolong the pleasure, she has capped the teeth with a substance, enamel, containing 96% of mineral matter and hard enough for unlimited use, she has provided incisors for cutting, canines for tearing if need be, bicuspids for reducing and broad rough molars for grinding and she has

combined in the jaws the biting hinge of the cats with the side-swing of cows and horses. All has been done that could be done to fit us for properly preparing the greatest variety of food for healthy digestion. If man neglects these many provisions he should not complain at the pangs of dyspepsia or tooth-ache. How well Nature rewards their proper use is shown by the experience of one dentist who was surprised to find perfectly sound teeth in the mouth of one of the London poor—a man of fifty. As this was an unusual condition with this class he made investigation and learned that for some reason this man was unable to swallow his food without very thorough mastication. He gave about 120 separate bites to even a piece of bread in a steady, deliberate way like the cud-chewing of a cow, and through this habit the teeth retained their good condition. Fletcher and others assure us that the average eater in our hurried modern life misses most of the pleasure of food and also so much of its nutrition through insufficient chewing that he tries to make up in increased quantity for his lack of care, thus injuring the digestive system through overwork.

This is not the place to go into an examination of the tooth structure nor of the differences between our rooted teeth and the unrooted ever-growing type found in the tusks of the elephant or the incisors of the beaver. It may simply be noted that man together with most mammals has two sets of teeth—the so-called "milk teeth," and the second or "permanent" set—which *should* be permanent

even when they are not. While nursing, the baby has no need of teeth, but when the little snowy edges begin to force their way painfully through pink gums, it is foreshadowed to the proud mother that Baby is intended to play a man's part in the world. Soon these are sufficient in number to call for more solid food and from the first year until the seventh this first set are used or abused as the case may be. But the child is growing rapidly and finally outgrows his teeth. The bones, limbs, features all increase with the size of the body but an enamel-covered tooth is much too hard for such growth and never increases when once fully cut. Therefore Nature has another device and develops above and below in the spaces of the jaw other larger teeth which gradually force their way into place pushing out their predecessors, until the larger mouth has cutters and grinders to correspond. From this time, until death at whatever age, authorities tell us, we need never lose a tooth save through accident or neglect. It is merely a question of chewing properly, cleaning carefully and occasionally visiting a dentist to correct the result of any oversight.

This is the ideal but the use of fillings and false teeth from the days of ancient Egypt to the immense industry of the present day when $2,000,000 worth of gold is said to be used annually in American dentistry alone, shows how far we fall short of our physical privileges.

Bills

Come into the Bird-House at the Zoo. We will collect a few bills. Not bills of the unpleasant first-of-the-month kind, nor yet the green-backed sort that many bill collectors desire. The bills of our purpose are the most important of all since without them a great division of the animal kingdom could not live. You perhaps hardly realized what curious things bills could be while you were thinking of the whole birds. Some are as sharp as awls, some broad as spoons, others thick, thin, curved, bent, pouched, even crossed; varied in all sorts of fantastic ways.

What does the whole collection most remind you of? Is it not like a show-case full of tools in a hardware shop? And after all is not this the clue to our research? There they are, cage after cage of feathered artisans each one ready and anxious to go out into the world to make his own living, if someone would only open the door, and each one equipped with his own particular and special tool.

At first it might seem as though the bird had been unfairly treated as compared with other creatures when it came to securing food. He has no front feet to seize or hold with like the cat, the monkey or the squirrel, he has no strong, grasping lips like the horse, no prehensile tongue like the giraffe, no trunk like the elephant, no tearing, cutting or grinding teeth like the multitude. Yet he

is as well fed as any for to balance all of these lacks he has a bill, and if ever there were a master-key for the unlocking of every sort of food problem it is that self-same bill.

But now we must look more sharply into some of the cages and begin to use our "Why" on special cases.

The Common Bill

Let us examine it as though we had never seen a bill before—two little hard pieces coming to a point in front and having sharp edges lengthwise. It looks like a toy combination of tongs and scissors, which really is not far out of the way. Why? Well, if you were to try to pick up tiny seeds or insects from the soft soil or among the grasses you would find it a difficult thing to do with your soft, blunt finger-ends, but if your nails were extra long you could manage it easily. Now if you cared to trim your nails to a sharp point so that you could pick each thing separately you might become really expert, and then you would see why our common birds have hard and pointed bills. Still your nails would not begin to be as good as a bill. If, for example, you wished to carry a choice morsel to the nestlings you would quickly learn the advantage of a hollow bill with its better grip, while if there were some berry to be plucked or an extra-sized insect to dismember, the bill's scissor edge would be valuable. Often, too, the bird chews with his bill. "Dixie," a tame mocking bird, considered a meal-worm the greatest of delicacies. If one

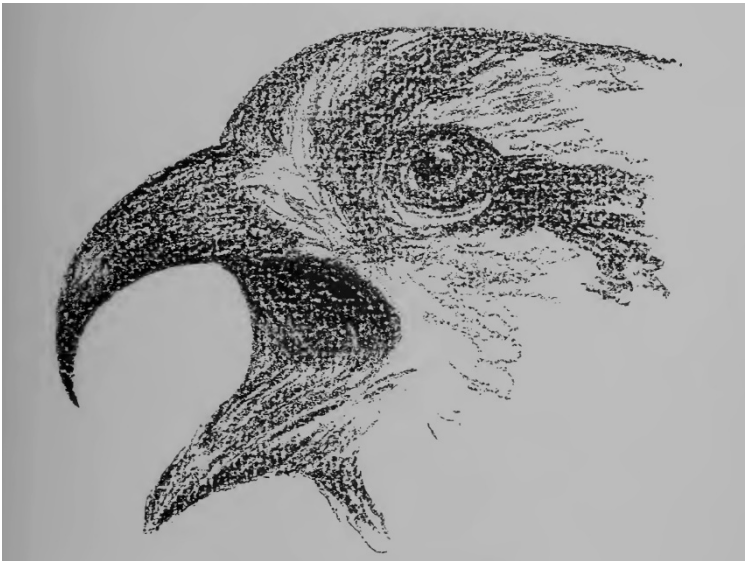
were held before the bars of his cage he would dance up daintily with wings upraised, snatch it away, and run it back and forth through his bill with swift little bites before turning it lengthwise and swallowing it. It helped prepare the worm for digestion and gave a longer taste of the probably delicate flavor.

Before leaving the "common birds" there is one other bill use which every spring shows us in the trees and bushes. The little nest-homes of woven grasses and plastered mud, some of which are really remarkable pieces of work indicate how much a good workman can accomplish with but a single tool, for every wisp of straw, every pellet of mud has had to be carried and worked into place with the bill. Examine the hanging nest of an oriole, or look at a picture of the wonderful *sewed* nest of the Indian tailor bird if you would realize what a deft construction tool this may sometimes be.

All of the common bills are not alike of course, as anyone can see. Some are best fitted for eating worms and fruit, some are "hard bills," like that of the canary, made thicker and stronger for cracking the shells of certain seeds and there are many other small differences for other needs, but we must pass on to some of the more striking and remarkable tools in farther cages—bills that we see less frequently.

The Eagle's Beak

Here, then, is a corridor of big, stern, silent birds, which hardly deign to notice us, and there is something dangerous-looking about the strong beak that hooks so sharply at the end. From its size and strength it might be used to capture prey—but no, that will hardly do for the long, overhanging hook would surely be in the way. The eagle cannot open his jaws widely like the cat, and prey is



THE BEAK OF THE OSPREY
Showing tearing hook and manner in which it narrows mouth opening.

quick and wary. Imagine a hungry eagle trying to snatch a swift-flying duck or a nimble rabbit by darting at it with his mouth opened to its limited extent and still further narrowed by that down-turned hook. You can see that it

would be almost as useless as for a hunter to arm himself with a bag of salt to put on the tails of birds.

But if we relax our rule long enough to steal a glance down at his spreading talons it becomes plain enough how the duck or the rabbit is caught and held. And now with his victim safely landed in some lofty dining-pavilion how well the beak comes into play at last. Watch him in fancy as he eagerly strikes its savage hook into the firm flesh and tears from it shred after shred small enough to pass down a rather narrow gullet. What could he have done with a pigeon's bill for instance, and how abominably and hopelessly in the way would have been the long clapping jaws of the pelican! Each one to its own use.

Wood gives an instance which shows that some time is required for this style of feeding. An eagle was seen to carry a duck he had captured to a large block of floating ice and sit there while he tore and devoured it. Then he spread his wings for flight but found too late that while engaged in the feast his feet had frozen fast to the ice cake. Sympathetic onlookers were unable to reach him and saw him finally carried out to sea in the darkness.

The Heron's Bill

But this is a tool of a different kind. Here is a long-legged fellow standing so motionless that we might almost think him stuffed, and wearing a peculiar, intent look as though he were doing a problem in mental arithmetic.

And his bill which is long like his neck and legs comes to a sharp straight point like a pair of shears. This is no tearing beak, as we can see with half an eye for it has no hook. It would be as inconvenient for rending as would those long, thin toes for catching and yet there is an appetite beneath that feathered breast and plenty of food must come by way of the pointed bill.

What kind of food? Not rabbits, not fowls, not anything too large to be swallowed whole for the reason already given. How about bugs, worms, seeds or berries, like many birds? Yes, possibly, at a pinch but imagine the awkwardness of the big bird dabbing with his long bill at little grubs and creepers. It would be like a man on stilts picking up marbles with a pair of tongs, and a short-billed rooster, his nose close to the ground, would catch ten to his one. Here is a point to be remembered—Nature doesn't handicap her children in the struggle for food. If there appears to be a handicap it only means that we haven't looked closely enough—haven't searched out the answer. If we could watch him at some quiet marshy pool or riverside we might see him standing in the shallow water, again motionless, again staring fixedly as though that perplexing mental arithmetic were still troubling him. Then comes a swift motion of his head—ah, he has solved it! What, the arithmetic? No, the food problem for there is a small-wiggling fish in the long bill. A gulp, and it has disappeared. After a little there is another and there will be still others to follow. And the thing is done with the

greatest deftness and grace, for awkward and ungainly only when out of his element, as a scientific fisherman he could give points to Izaak Walton.

For example: one of them captured not long ago disgorged two recently swallowed trout, weighing respectively thirty-two and twenty-four ounces, while another was found to have dined rather well on seven small trout, one mouse, and one thrush.

Standing in the shallow water his thin legs must look like dead sticks to careless little fish that cannot see upward readily, and so they come within range of the swift dart of his flexible neck and javelin bill. Now we see the advantage of its straightness and sharpness. A fish is agile and can whisk away in a flash, hence that one stroke must be unerring in its aim and this could not be if the bill were broad, crooked or otherwise clumsy.

The heron's bill makes him a dangerous antagonist even for a man. A hunter tells of trying to capture a bird which had been wounded and narrowly escaping a lightning-like thrust at his eyes which would have blinded him had he been less wary. The eye indeed seems to be the usual place of attack and an instance is given of a captive heron which, shut up in the same cage with five owls, during the night completely blinded four of them and destroyed one eye of the fifth. Certain savages, who are said to make spears by fastening heron's bills to long sticks, appreciate their value as weapons.

Another fishing bill much like the heron's is found on the earnest little kingfisher, which we have all seen sitting upon branches overhanging the water. If the heron is to be likened to a spearman the kingfisher is himself both archer and arrow, as he hurls himself into the water with the sure aim of an expert marksman.

It takes many fish to feed either one of these feathered fishers, and yet they are less enemies to water life than some of our human sportsmen, for once their appetites are satisfied they do not continue killing for the mere love of the game. Even the foemen of untamed nature seem to have something of a "live and let live" understanding.

The Pelican's Bill

There are no hook-and-line anglers among the birds, but there is a *scoop-net* fisher that is too interesting to overlook. Waddling in and out among the long-legged waders in the bird-house is a squat, heavy-bodied fellow with a most preposterous bill and a grave, almost worried look. To judge from his expression, life is full of heavy responsibility and yet there must be some fun in his make-up for he seems ready for an occasional frolic or scuffle with his fellow inmates. Perhaps you will see him clap his huge bill at some inoffensive duck that does not move quickly enough from his path. But the duck does not act alarmed and appears to know that it is all in sport.

The action, though, has called our attention to quite the most interesting thing about the pelican. The bottom of his bill is not solid as with most birds, but closed by a pouch of loose skin like a long, shrunken pocket, the use of which does not fully appear in the bird-house. Still we can realize that the pelican's bill is much too clumsy for the swift stroke of the heron while the short hook on the end would also interfere. In spite of this the pelican is as much a professional as the heron or kingfisher and gets both his living and considerable sport out of his style of fishing. To see him at it we would have to go to the coast waters of some of the Southern States. Here schools of fish swim often to the surface and here we would see the pelican flying with powerful strokes at a height of twenty to thirty feet and then suddenly hurling himself open-mouthed into the water with a tremendous splash. Just as he dives—and this is the interesting point—the sides of his lower mandible spread out to about the width of your hand so that the pouch becomes at once a fair-sized scoop-net. Thus the dashing white pelican fishes, his brown-colored cousins preferring to swim in flocks beating the water with their wings and driving the fish into shallow water in order to scoop them more readily.

Of course either may miss but the chances are that there is something good in the leathery bag after a scoop. Then the bill must be held up to drain out the pouch-full of water, next it is given a quick jerk to throw the fish forward into a position for swallowing and now possibly

there is a disaster, for certain inconsiderate gulls are apt to take a selfish interest in the pelican's fishing and if so much as the tip of the fish's tail is seen sticking out of his bill the bold pick-pocket makes a snatch for it. Often and often the poor pelican must begin all over again, but he does so philosophically. After all such is life from Pelicanville to Wall Street.

But perhaps there are babies at home. If so, the scrawny youngsters with their ever-ravenous appetites plunge their heads greedily into the mighty jaws of the fond parent and even drag forth partially digested fish from the latter's gullet. In the remarkably fine pelican group in a case at the New York Museum of Natural History is shown one curious method by which, the half-grown young sometimes deal with fish which are too large for their own gullets to enclose. Squatting in the foreground is such a one with much of the tail of a sizable fish sticking from his open mouth patiently and contentedly *waiting for the head to digest,* so that he can swallow it the rest of the way. Poor little chap, the naturalist didn't let him finish his meal and future generations will also doubtless see him still working doggedly on that same indigestible fish.

The Woodcock's Bill

But too many other interesting bills await, for us to spend more of our limited space with these fishers, and

down in the soft mud near the water's edge or in boggy woodland may be found one of them in the possession of the quaint little woodcock.

The woodcock's eyes alone would prove to us that he is no fisher. Compared with those of the heron, kingfisher or pelican it will be seen that his are set much too far back for aiming a stroke or a scoop, since one must have a quick eye to catch swift-moving fish. Nor is his bill a fishing bill, being rounded, very slender and moved by a neck too short for striking. Why then is he so often at the water-side? Because of the soft mud which we would tread upon unthinking but he knows to be stored full of the most delicious worms if one know how to get at them. And indeed he knows, for that is a scientific mud-probe which he carries and he can push it down to a depth at which most worms might feel secure. Even so one might wonder how a bird's hard bill could detect anything so soft as a worm in the similar softness of the mud, but the woodcock's bill is a wonderfully sensitive organ of touch, and he can tell in an instant. It is not blind chance either, for whether by the power of scent or hearing, or both, the woodcock knows exactly where to try for his food. A tame one was observed probing a sod and pulling out a worm for almost every thrust.

Then he has still another advantage. One can realize that it would not be easy to open even a slender bill when pushed deeply into sticky mud, but the woodcock's upper mandible is flexible and slightly movable at the very tip, so

that he can grasp with it while the rest of his bill remains closed.

The Avocet's Bill

His cousin the avocet—for both belong to the plover tribe—has also a long slender bill, but in his case it curves upward like a pair of manicure scissors. There is also something scissor-like in the way it is used, for the avocet walks along on the mud or in the shallow water, his curved bill held down before him and fairly "scissors" the ground by moving his head back and forth, and rapidly opening and shutting his jaws. This is because of the many tiny crustaceans and other forms of life he finds, each one so small that one must be active to make out a square meal. It is easy to see that only such an upward curved bill could run over soft mud without sticking. Cousin woodcock's straight probe would merely plow into the mud if he tried to push it before him.

The Flamingo's Bill

And now we come to a thick, downward-bent mouthpiece very different from any of these. Tall and stately is the flamingo and his beautiful flaming color has given him his name, but his bill looks as though it had been broken. Is this an instrument, too? Indeed it is—a most excellent one for its purpose. Let us see—the flamingo's long legs tell us that he must wade out into the water to feed. His

wonderfully long neck, long enough to reach to the ground, makes us sure that he feeds from the water's bottom. He certainly could not make a living striking at fish with that crooked, clumsy bill, and it would even be awkward in picking up objects, hence we realize that Nature must have some other food plan for him. However to make it clear, there are multitudes of tiny spiral shell-fish at the bottom of the waters where he lives and these must be grubbed for in the soft mud—hadn't you noticed how much, like a grubbing-hoe is the bend in that bill? It is by means of that bend that he lives. Frank M. Chapman who made the famous visit to the flamingo city says that it is a curious sight to see the big birds feeding, standing out in the water which may reach to their bodies, their heads thrust down out of sight while they tread up and down in a "ridiculous kind of jig," which is really to loosen the mud in which the food lies. Meanwhile the bill scoops its mouthful of mud and shell-fish and then the upper mandible squeezes rapidly (although with most birds it is the lower mandible which moves) and the mud is forced out through, little side-strainers until the food is washed clean and ready to swallow. It is an excellent squeezer, too, that bent bill. It gives a powerful pressure almost exactly like the action of one of those patent lever potato-mashers, which you may have seen, where a plunger presses the potato through a screen. May we not then call the flamingo's bill a combination grubbing hoe and potato

press applied to securing little shell-fish? Who but Dame Nature would have thought of such a device?

But the baby flamingo's bill has no bend. For the first three weeks or so it is as straight as that of any other bird. Nature does that on purpose, too. The chick is too small and weak to wade out after shell-fish like the bigger birds but takes drops of juice from the mouth of its parents—"regurgitated clam broth," Mr. Chapman calls it—or else picks and swallows bits of its own shell, needing a straight bill for both these uses. And then some day with longer legs and greater strength, the straight bill begins to droop into the familiar bend and Nature whispers to the little chap that it is time for him to try the shallow pools and begin to stand on his head, too, in regular flamingo fashion.

The Skimmer's Bill

But it will not do to spend too much of our time at the water's edge. We are not trying to cover the whole subject but merely to take some of the interesting types and show how Nature may be questioned in other cases. Therefore we must pass over the grasping tugging bill of the duck, the down-curved picking bill of the curlew and ibis, the thin-edged diving bill of the puffin and loon and many, many others, to hasten back to the land birds. And yet in doing so let us pause just long enough to glance at one of

the most remarkable tools in the kingdom—that of the skimmer.

It is not quite fair to tell the name at the start because that explains the use, but can you imagine a pair of large shears such as tailors use held slightly open, and pushed swiftly over the surface of the water with only the lower blade dipping? Imagine also that the upper blade is much shorter than the lower one and you have a pretty fair idea of the skimmer's bill and its use. Most birds' bills are hollow or grooved, but the skimmer's bills are blades nearly up to his head and cut the water like a knife. Little fishes which swim at the surface find themselves seized before they know that there is any danger.

Darwin thus describes a flock which he saw feeding: "They kept their bills wide open, and the lower mandible half buried in the water. Thus skimming the surface they plowed it in their course—and it formed a most curious spectacle to behold a flock, each bird leaving its narrow wake on the mirror-like surface. In their flight they dexterously managed with their projecting lower mandible to plow up small fish which are secured by the upper and shorter half of their scissor-like bills."

The Night-Hawk's Bill

If this skimmer runs to bill, there is another skimmer—an air skimmer—that seems at first to have practically none at all—merely two little points that look

almost too small to speak of as a bill, but when he opens his mouth you see from its breadth that it is meant for catching something. It seems perhaps a little strange to think of this solemn, frog-mouthed bird as the graceful night-hawk that we see high overhead in summer afternoons. We know him by his weird rasping cry of "zee-e-oop" and by the way he takes a few swift wing strokes and then soars in a free irregular course. Occasionally as we watch him we see him make a swift swoop and then could we be near enough we would find that he was rushing with his broad mouth wide open upon some high-flying insect which hardly has time to be surprised. His cousin the night-flying whippoorwill has also a fringe of bristles about his bill which help to strain the insect from the air, almost as a butterfly-net might do it.

The Humming-Bird's Bill

Another summer visitor is the daintiest member of all the brotherhood of birds. How exquisite he is as he hovers a moment before a bed of salvias, for example, and probes one after another of the red-throated blossoms with his needle-like bill. His taste for honey and the tiny insects it attracts is quite in keeping with his smallness and beauty, and he needs just such a long slender bill to reach to the bottom of the flower tubes.

Strangely enough humming-birds are not known outside of America and while this little "ruby-throat" is

our most familiar example there are many more brilliant kinds in the tropical regions. One of these has a bill that curves downward sharply, but not too sharply for the kind of blossoms which he seeks. Another is the marvelous sword-bill, that looks as though he must have got the bill of some older and larger bird by mistake. He makes you think of the six-year-old son of the Kentucky mountaineer who has taken "Dad's rifle" to play at being a man.

It is hard to think of a bird with a bill longer than all the rest of him and yet how else could he reach far up into the nectary of the huge, bell-shaped blossoms of some of the tropical vines? Nature could not leave so rich a store unpatronized, even if she did have to have a gentle joke at the sword-bill's expense, while the little fellow really has no idea of how ridiculous he looks.

The Woodpecker's Bill

While the humming-bird is still investigating our salvia bed there comes a sudden, sharp, rattling beat from the big tree across the way and there is a woodpecker hammering away for dear life until it makes our own heads fairly ache to think of jerking them so swiftly. He is signaling "the long roll." A little later we may see him cutting his way into the trunk with skillful strokes for this little workman's bill is a drill, wedge-shaped, sharp and very strong, and everyone knows that there are grubs and insects in the wood that he finds worth working for. Again

it is of value when it comes to cutting a tunnel for a nest as is the custom.

But there is also another use and a rather curious one. Californians know that it is no uncommon sight to find the bark of trees perforated with holes somewhat larger than a bullet hole and spaced so accurately that one might almost think them laid out mathematically. In some sections they will be found in nearly all of the softer timber. At first thought one might fancy this the work of boring insects, but no insect would plug so many of them with neatly fitted acorns. It is really a clever sort of outdoor cupboard constructed by the shrewd woodpecker in order to store away food where it cannot be covered by the winter's snows. After the acorns fall the provident birds may often be seen, fluttering and clawing around the tree trunk with acorns in their bills until they find a hole of exactly the right diameter when they insert the acorns skillfully and tap them tightly in. Not until those on the ground are buried under the snow do they draw upon this supply.

The Crossbill's Bill

But let us be moderate. There is a temptation to stop and examine the huge jaws of the macaw, the huger ones of the toucan and that greatest monstrosity of all, the rhinoceros hornbill. The whale-head and boat-bill looking as though their faces had been stung by bees, challenge

our curiosity. The spoonbill looks interesting and so does the wry-billed plover and any number of others but something must be left for other days, and we will pass with but a parting glance at our own crossbill. This sparrow-like little fellow, with his reddish throat and breast and his strangely crossed, twisted bill-tips has been the subject of a quaint old German legend which tells how he flew to the Cross where the Savior hung and did his best to release him by tugging at the piercing nails until his bill was twisted and his feathers dyed with the blood. However he may have come by that unusual twist he has learned that it is the best kind of an instrument for getting the seeds out of the pine cones, and small as he is, his bill is one of the most ingenious devices in all the great collection. And now will you say that a bill is "just a bill"? Hardly so, or you would never have had the patience to read thus far. What then is a bill? It is as we said at the beginning—a tool, an instrument, an implement marvelously designed to fit the exact needs of its owner and delivered over to a workman who uses it so skillfully that he never feels the need of any other.

Feet

There are many fresh marks in the dusty country road this morning. Bare-footed Oscar went by about an hour ago—I heard his whistle—and here is the record in his foot-prints. Here also are the double, spreading marks of the cow he drove, somewhat marred by the later solid hoof-prints of neighbor Wesley's horse. Hens have been wandering about leaving odd little diagrams of branching lines, smaller diagrams, in pairs, show where the sparrows have hopped. A good-sized coon must have trotted across just below the old white oak sometime during the night, while this looks as though a cotton-tail rabbit had ventured out into the open, stopped to listen, and then scurried back again to the shelter of the bushes. And so it goes, every living creature which has stepped upon the road has left behind it the plainest evidence that its feet are different in size, or shape, or both from those of all its fellows in the great Animal Kingdom.

There is a world of character in Feet. If those highly-trained scientists we read of can reconstruct an entire animal by examining a single bone, we at least, in a humbler way, can gain not a little knowledge of the needs and habits of the Animal Kingdom, by noticing the differences in its multitude of feet.

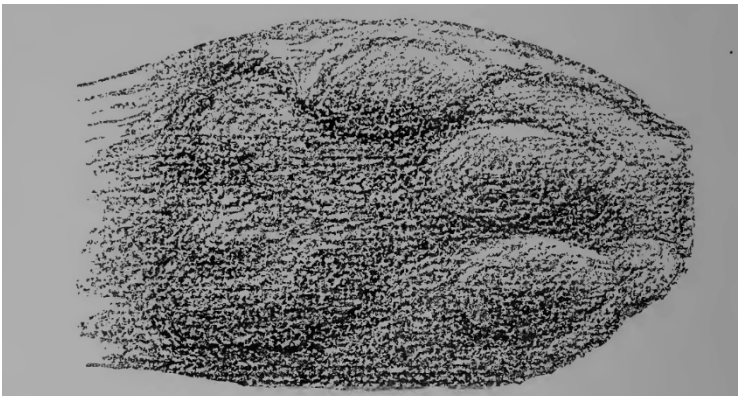
The Cat's Foot

One of the first things which the little child discovers about animals is that "kitty has pins in her toes." That soft velvet paw had seemed so harmless, until suddenly sharp little hooks slipped out of their sheaths to leave red scratches on the dimpled wrist. Baby never forgets it but doesn't learn the reason until some day when he sees her catch a mouse or a bird. The darting stroke would do little good did it not carry with it a set of grasping hooks that seize and hold.

Frank Bostock, the animal trainer, once had an experience with his lion "Wallace," which gives an idea of what it must be like to be a bird or a mouse under these conditions. To quote his own words: "In this instance Wallace struck at me merely in play and with little of the strength that he would have displayed in a willful attack. The stroke was a part of the trick he was used to, and he made it with good animal intention, but it was none the less direful. The claws fastened deep into the fleshy part of my leg, through boot and underclothing, and there stuck. A lion's claws would not be nearly so dangerous were they sharp and straight, but they have a sharp curve and go in like a cant-hook, penetrating the flesh at an acute angle. The lion has not the sense to draw them out as they went in, by the curving process, but pulls them out straight, Wallace found his claws in farther than he intended and, slightly frightened promptly drew them out not backward

but forward. Needless to say with them came a good sized piece of flesh which caused me excruciating pain."

However, these same claws would be greatly in the animal's way were it not that Nature provides for drawing them back when not in use. Even a dog's short nails will click as he walks across a wooden floor. The members of



THE LION'S SOFTLY-PADDED TOES

the cat tribe which hunt by stealth would be quite unable to get close enough for a spring were it not for the soft cushions, which make their walking noiseless, and the power to sheath their claws. Furthermore the claws would otherwise soon become too worn and dulled for use in hunting.

But there is one odd, big cat found in Asia and Africa which has this withdrawing power in such a slight degree that he is called "non-retractile-clawed." The cheeta, or hunting-leopard is not a creature of stealth and this long-legged dog-like animal is dog-like also in his style of hunting for he courses his prey in long, swift pursuit. The

natives in consequence tame the cheeta and use him in the chase.

The Dog's Foot

The dog, like the cheeta, runs down his game in the open and does not need the silent step of the cats with their retractile claws. For the same reason a dog requires much harder cushions which will not wear out with a long run on hard ground. The dog seizes things with his mouth instead of his feet and so does not have use for sharp claws, but his hard nails are of value in running and especially in digging to bury a bone or uncover a rabbit.

One who had never seen a cat or a dog might still be able to reason out these points of difference through the simple comparison of their feet.

The Bear's Foot

The bear comes down on his heels. Members of the cat and dog families have feet that are known as *digitigrade* since they walk upon their toes, but the bears have *plantigrade* feet—that is, they walk upon their soles even as do we of the human race. Hence, as hunters know, there is something curiously human about the track of the bear. Why this difference?

Let us suppose that you wish to run at the top of your speed. Notice how you throw your weight forward upon the ball of the foot and the toes. In other words you

become as nearly *digitigrade* as possible for if you shuffled along flat-footedly your progress would be slow. Come to a stop, however, and you will quickly tire on your toes. The heel must come down for support. That is the answer. The bulky bears have a much greater proportion of weight to support than have either cats or dogs, and are much less agile. Their foot is for supporting not for springing nor racing.

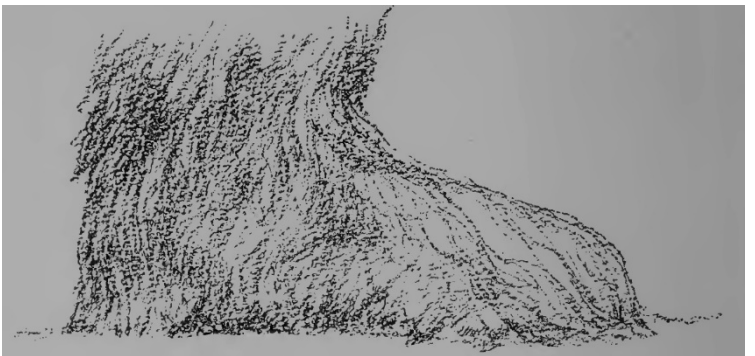
Naturally, with such feet the bear is a poorer hunter and does not depend exclusively upon flesh—save in the case of the polar bear. The ordinary varieties must frequently content themselves with young shoots, roots, fruits, berries and even ants and grubs while if they can raid an occasional store of wild honey their happiness is complete. Brown bears in Scandinavia are even said to have scratched away the earth around the telegraph poles having mistaken the humming of the wires for bees.

In place of the sharp, retractile claws of the stealthy cats and the short nails of the fleet-footed dogs they have long, blunt, powerful claws, of some use as weapons but still more valuable in climbing trees and in digging for the bear, like the pig, seeks a share of its food below the surface and some varieties have the habit of burying any surplus provision.

One hunter, struck down senseless by a huge grizzly, had the unpleasant experience of actually being entombed alive by the beast which evidently believed him dead and

had already satisfied its hunger with other prey. The man, recovering consciousness, found himself loosely covered with earth and apparently put away for a future meal. It is hardly necessary to add that he hastened to remove himself from the bill of fare.

In the country of the grizzlies, claw-marks will occasionally be found in the bark of some tree which the experienced frontiersman reads in this wise: "Know all bears by these presents that I, A. Grizzly Bear, have discovered and do actually claim, possess and occupy the surrounding territory; reserving the same for my exclusive use, title and enjoyment together with all of the food supplies thereof. Intruders will be punished to the fullest extent of my teeth and claws. In witness whereunto, I have herewith made my scratch."



THE FURRY PLANTIGRADE FOOT OF THE POLAR BEAR

Wandering bears coming upon this notice are apt to test its authority by standing upright and striking the bark with their own claws as high as they can reach. If they can

equal the height of the original marks they are not unlikely to stay and try conclusions in battle, but if their stature is less it will probably seem wisest to move farther. This simple device seems almost a sign of civilization.

The great white polar has paws of even greater size, which make admirable paddles, for their owner is almost as much at home in water as on shore and is said to have been seen swimming across a forty mile strait. Its soles are not bare, like those of other varieties but covered with fur, for warmth doubtless, and also for the double purpose of giving it a better footing on slippery ice, and muffling its steps when hunting. The polar bear is as already said exclusively a hunter and always on the lookout for a chance to surprise some sleeping or basking seal. For this same reason its claws are short and noiseless.

Bears with their plantigrade feet can stand and even walk a little, erect, an accomplishment very rare among the quadrupeds, and this is a favorite fighting position with some of them.

The Ant-Eater's Foot

A strange creature this, which comes hobbling along on the sides of his front feet, but one need only notice the huge, curved claw on each to realize why he cannot walk flat-footed. There are other odd things about his appearance as already noted, but that remarkable incurved claw may well make us wonder, unless we might

see him swiftly tear his way into the big earth-heaps which some of the tropical ants throw up like the swarming sky-scrapers of our business world. Multiply such a creature in your imagination until man takes the place of the ant in proportion to his size, and our greatest buildings could hardly stand against the pull of his mighty hooks.

The Sloth's Foot

The foot of this still stranger creature is even more remarkable. Not the fore-feet only but the rear as well are armed with claws so long and curved that one could see with "half-an-eye" how nearly useless they would be for ground travel. They look to be nothing more nor less than hanging-hooks, which is in fact exactly what they are. Their owner has no taste for any life but a topsy-turvy one. He eats and sleeps always hanging back down from some bough, and travels by hooking himself along in the same position. He cannot, of course, move quickly in such a manner. If he could he would not be a sloth.

Mr. Beebe cites the case of one family of sloths which lived for eleven years in a single clump of shade trees in Mexico without once descending to the ground. It was not unusual for them to pass weeks upon a single branch.

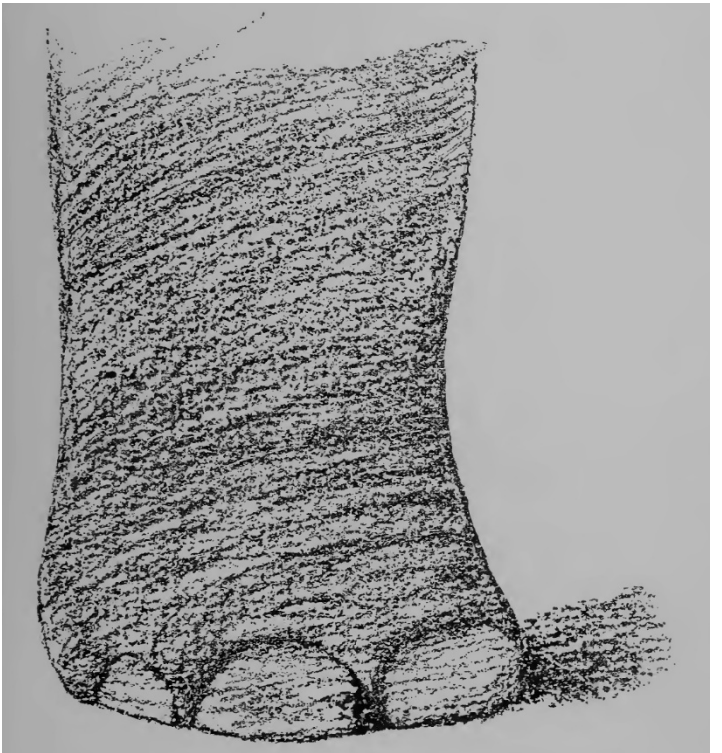
The Mole's Foot

Before leaving the claw-bearing animals it may be mentioned that there are several groups which are far better diggers than the bears. One of these includes the moles and another the armadillos, both having very short, strong legs, large front feet and thick powerful claws. In the case of the mole the legs are so short that their bones are largely contained in the skin of the body and little more than the feet project. The average gardener is all too familiar with their digging speed, and Hornaday gives an instance of 104½ feet in 25 hours. As to armadillos, Darwin tells us that "the instant one was perceived, it was necessary, in order to catch it, almost to tumble off one's horse; for in soft soil the animal burrowed so quickly that its hinder quarters would almost disappear before one could alight."

The Elephant's Foot

From these subterranean creatures it is a great leap to the hugest of all land animals, but the elephant can never be overlooked and his round or broadly oval foot makes an interesting contrast to those just considered. Our first glimpse gives us its explanation in that it strongly suggests the base of a column, as well it may, since four of them must sustain a weight of several tons. As the elephant does not strike, catch, dig nor climb with his feet he does not need claws, nor even an elongated foot, but pure support

he must have, so his feet are ideal for such a simple purpose, large and flat, distributing the load over a wide, cushioned surface and protected by broad nails which show where the massive toe-bones terminate.



THE ELEPHANT'S FOOT
Pure support.

These cushioned feet, which are esteemed a delicacy by hunters and natives, leave tracks which tell the experienced trailer much about his game, since twice their

circumference is about equal to the elephant's shoulder height and the female's footprint is more oval than that of the male.

The Camel's Foot

Close to the elephants in the circus-parade come the camels and although these big animals have little in common, Young America is apt to associate them. Very different are the padded toes and easy swing of the camel from the elephant's ponderous, flat-footed movements, as different as are their lives and their needs.



THE CAMEL'S TWO-TOED, SINGLE-PADDED FOOT

No one need be told that the camel is fitted for desert life and the average person will cite its power to store away water in proof of this. But the feet are quite as much of an indication. Two toes which expand under the weight of a step and yet do not separate since they are joined beneath by a single broad, spongy pad; these make an admirable footing in the yielding sand where a horse's small hoof would sink at every step. On the other hand the camel's foot would be too soft for much service upon hard roads and would be awkward in slippery mud. For such purposes as these we must turn to a great variety of hard-hoofed animals.

The Horse's Foot

Of these the horse is the most familiar. Here is a compact hoof, small enough to be moved with great quickness and hard enough to stand the steady pounding of swift running on solid roads. This pounding would give a most unpleasant jar at every step but for a beautiful device of great simplicity, which absorbs much of the concussion, like a carriage spring. Have you ever wondered why the horse's hoof instead of being directly beneath in the line of the leg is placed somewhat in advance? Notice how in walking the fetlock-joint sinks and rises at every step and you will see why the hard blow of the hoof in running is still elastic and tireless. All of this tells us the same story as do his broad nostrils, namely that

the horse is built for long continued speed, and paleontologists have given us an interesting sidelight by studying the foot-bones of his most ancient ancestors.

At some period farther back than we can well imagine, back in the shades of that dim distance when huge reptiles roamed and ruled the Earth, there appeared a little mammal, not larger than a fox, with a somewhat horse-like head, four toes upon its feet and the rudiments of a fifth. This ancient creature could not have possessed the speed and endurance of its descendants, but must have walked upon soft soil where spreading toes would be of value. Later ages brought changes of surrounding and doubtless new enemies to be avoided, for the defenseless little mammal began to run more swiftly and its fifth toe no longer touching the ground grew smaller and disappeared. Meanwhile the third toe which now bore greater weight grew in length and strength and in the size of its nail. More and more grew the speed as later ages joined the long procession, until the second and fourth toes became in turn of no account, when like the fifth they too passed away. The remaining one increased to meet the added responsibilities, while its nail developed at last into the powerful hoof of our present-day horse. Two little splints of bone still seen in the skeleton of the horse between the fetlock and what we call his knee are all that remain to tell us of the long vanished toes.

The Cow's Foot



THE COW'S DIVIDED HOOF

Next in familiarity are the double hoofs of the cows, and we can realize at once how much superior is their spreading foothold for placid wandering in soft meadow lands. The shorter, thicker fetlock tells also that support instead of springy speed is the main purpose, while two hard little points at this joint show that the other toes have not so completely disappeared.

The Deer's Foot

The hoof of the deer has some of the characteristics of both horse and cow hoof. Compact and elegant like the former, with a long, springy hock to absorb concussion it is also double, or cleft, like that of the cow. And all because

the deer in spite of his occasional bursts of speed, prefers forest shades to open country and must move with ease over the yielding mould. A horse which might run down a stag upon the highway would quickly be left behind in woodland.

But there are varieties, such as the reindeer and caribou, which roam the reaches of the far North. Here through many months of the year the surface of all the land is deep in snow and just as man has devised the snow-shoe, Nature, ages earlier, applied a similar principle to the footing of these her children. A foot so broadly spreading, assisted by small lateral hoofs make the reindeer at such times practically a four-toed animal. Thus is the weight well distributed, and he runs so easily over soft or slippery footing that Northern races of mankind use him as we domesticate the horse.

These hoofs are also of value in digging for his favorite moss when covered with snow.

The Rocky Mountain Goat's Foot

Every one knows how much the common goat enjoys a chance to climb, but the mountain cousin has privileges in this respect far beyond the facilities of "Shantytown." His tiny hoofs find foothold upon such narrow ledges that sometimes his powers seem truly miraculous as he scrambles up or down the face of some wall of rock. Moreover his feet are placed almost directly in the line of

his stocky legs, instead of at the usual hoof-angle. This gives them a firmer hold in climbing.

In this respect he contrasts with those other mountain dwellers the chamois, ibex and bighorn which have strong, elastic, shock-absorbing joints, and make almost incredible leaps among the rocks. An ibex has been seen to spring down a perpendicular height of fully forty feet and alight easily and gracefully—an achievement which the goat would not attempt.

Ex-President Roosevelt and John Burroughs once had an impressive demonstration of the "big-horn's" ability in this respect in Yellowstone Park. The cañon at this point is five or six hundred feet deep. As Mr. Burroughs describes it: "Across the cañon in front of our Camp...a band of mountain sheep soon attracted our attention.... We speculated as to whether the sheep could get down the almost perpendicular face of the chasm to the river to drink. It seemed to me impossible. Would they try it while we were there to see? We all hoped so; and sure enough, late in the afternoon the word came to our tents that the sheep were coming down. The President, with his coat off and a towel around his neck, was shaving. One side of his face was half shaved, and the other side lathered. Hofer and I started for a point on the brink of the cañon where we could have a better view.

"'By Jove,' said the President, 'I must see that. The shaving can wait and the sheep won't.'

"Soon he came, accoutered as he was,—coatless, hatless, but not latherless nor towelless. Like the rest of us his only thought was to see those sheep do their 'stunt.' With glasses in hand we watched them descend those perilous heights, leaping from point to point, finding a foothold where none appeared to our eyes, loosening fragments of the crumbling rocks as they came, now poised upon some narrow shelf and preparing for the next leap, zigzagging or plunging straight down till the bottom was reached, and not one accident or misstep amid all that insecure footing. I think the President was the most pleased of us all; he laughed with the delight of it, and quite forgot his need of a hat and coat until I sent for them.

"In the night we heard the sheep going back; we could tell by the noise of the falling stone. In the morning I confidently expected to see some of them lying dead at the foot of the cliffs, but there they all were at the top once more, apparently safe and sound."

The Chicken's Foot

All of the foregoing types have been taken from among the four-footed mammals but there are many others quite as characteristic in the great bird family. We must not omit to glance at several of these in our hasty view.

Here is an entirely different plan for a foot: no hoof, no sole, merely a spreading bunch of slender toes. We see at

once that it gives great support in proportion to its weight and realize that a chicken must make two feet do the work for which quadrupeds have four. Still there is another reason for its peculiar form, one which is common to most of the birds. Did you ever examine the severed foot of a fowl? From the cut end of the leg you have doubtless noticed the stiff projecting tendons, and you may have amused yourself by pulling them and making the toes contract. You could pick up a stick by making the toes grasp it in this manner, and it is just because the birds so generally perch at night that the toes are thus arranged for grasping. At first thought it might seem a trifle strange that a bird should be able to sleep soundly in a position which compelled it to hold so tightly. In sleep one relaxes every muscle, yet a bird would fall if it loosened but a little; but here again is one of those beautiful devices of Nature, for it is just in its relaxation that the bird gains its strongest hold. The tendons already spoken of run back over the joint to connect with the muscles of the "drum-stick" and thus in bending the leg the tendons are tightened and the toes must draw together. When the chicken settles back upon its perch its weight keeps the leg sharply bent and thus the toes are tightly locked until it stands up again to release them. It is a simple principle and as perfect as simple.

Chickens, living so much upon the ground, have naturally short, scratching nails instead of the longer claws of tree birds.

The Osprey's Foot

Birds of prey use their feet in a much more forceful way, and when swooping from their observation height it is with talons that the victim is seized. We are therefore not surprised to find the feet of large size, very powerful and armed with great curved claws, which entering the flesh from different angles make escape impossible.

The osprey or fishing-hawk has an especially difficult task. Winging over a lake or river, his sharp eyes watch intently for some fish to approach the surface when dropping like a stone he strikes the water with widely spread toes which contract the moment they touch the victim. But any one who has tried to catch a minnow in a bait-pail realizes that a slippery fish is particularly hard to capture and hold. Hence the osprey has the lower surface of his toes roughened with small knobs or tubercles, and he is remarkable among the hawks in having an outer toe which can be turned backward to a position parallel with the hinder one, so as to grasp with two front and two rear toes.

Only too often the osprey must lose his hard-won breakfast to some robber eagle which strikes at the fisher until his prey is dropped when he retrieves it with a mighty swoop before it touches the surface. To the shame of our National bird be it admitted that he is prone to such

bullying tactics; but fortunately the water is populous and the osprey rarely goes long unfed.

Sometimes, however, he tackles a task too large for him. Dan Beard gives an instance of one near Atlantic Highlands which "had been seen to swoop down into the waters of the bay, imbedding its talons in a huge plaice. The bird rose with its prey, but the fish's weight was too great and dragged down the hawk. Several times the osprey struggled to ascend, but failed and at length became exhausted, and fell into the water still clinging to its captive. The bird's talons were so imbedded in the fish that it could not release them and it was drowned. The fish also died and both were washed ashore, and with difficulty were separated."

He also speaks of seeing "a hawk again and again pulled under water by a big fish in Yellowstone Lake. The osprey several times lifted the fish from the water, but such was its weight that the bird could only succeed in carrying the fish a few yards at a time; at length the prey was allowed to drop again in the waves and the exhausted bird had just sufficient strength left to reach the shore where it literally fell upon a dead limb of a small tree."

It is interesting to note that vultures and other carrion-eaters, which rarely kill for themselves, have in general much weaker feet and talons than those of the true bird of prey.

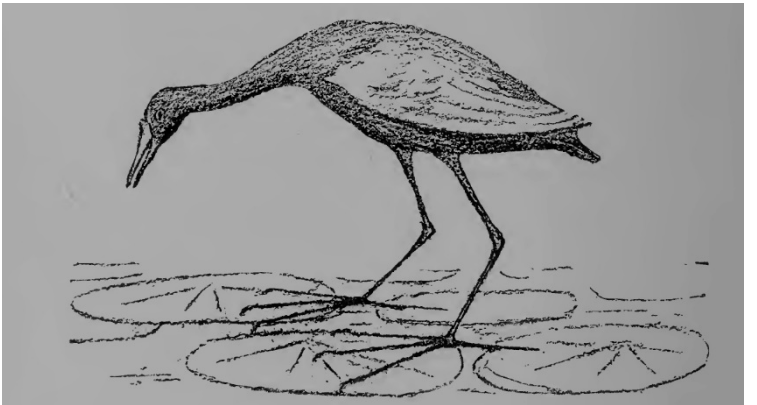
The Duck's Foot

Here again the plan and the purpose change, and we find the front toes joined by a web of skin which suggests a use quite different from grasping. No one need be told of this use for the duck and other water-fowl are among the most familiar bird forms. Everywhere the water abounds with attractive food and nearly everywhere are birds adapted to secure it. With a body rounded like the hull of a boat, legs set far back like its propeller and a foot which cuts forward folded into a thin wedge and kicks backward with a broad webbed surface—how clumsy our oars and paddles must seem to this graceful living craft! Man, the never-satisfied land animal, must navigate with artificial aids, while the duck, content to have his thinking done for him, placidly makes use of the perfect device of Nature and stays willingly in the surroundings for which he is best fitted.

The Jacana's Foot

There is a curious little bird, which may in some sense be called a water-fowl, since he haunts the broad-leafed water vegetation of certain tropical countries. His strange feet are of such remarkable size, have such extremely long, spreading toes which are still so slender and weak, that it is evident they are designed for no ordinary purpose. Surely there is nothing ordinary in a life spent in stepping

from one to another of the broad floating pads of waterplants in search of food, and it would be clearly



THE LEAF-TREADING TOES OF THE JACANA

impossible were not the foot designed to distribute his weight over a wide surface. It is practically the snow-shoe principle once more.

The Grouse's Foot

But here is a true bird snow-shoe. The grouse travels in the summer time upon bare and slender toes, but meets the snows of winter by developing broad toe fringes which more than double its foothold. As it is distinctly a ground bird and lives where snowfall is heavy, this is a useful provision.

The Ostrich Foot

With many others to choose from we will take but one more bird-foot and that place seems to belong by right to the giant of the group—the ostrich. This extraordinary bird is remarkable for the fact that his beautiful plumed wings are useless for flight; but Nature, having deprived him of one mode of travel has developed his running ability to a point where he rivals the horse in speed, or even "scorneth the horse and his rider" as we read in Job.

We have already seen how the horse developed his speed at the expense of his toes until he now runs upon a single toe-nail (or hoof) for each foot. The ostrich seems to be in a somewhat similar process of change. Having started in his earliest ancestry with a probable five toes, there now remain but two, and one of these is so small, nailless and rudimentary as to suggest that it also may disappear in time. The great running toe is strong and padded like the camel's, fit for high speed in desert wastes and armed with such a powerful claw that the big bird's forward kick may kill a man.

It does not seem possible that evolution can carry it much farther since the ostrich has only two feet to stand on instead of the horse's four, and could not well afford to lose the support of his toe-pad in developing a terminal hoof.

The Tree Frog's Foot

We shall pause for but two other forms from among the lower animals: both of these, belonging to species of tree frogs, are strikingly different from all so far considered.

At the end of each tiny toe in the more familiar variety is a little fleshy disk which has the power to adhere by suction to smooth surfaces, so that the owner may climb with ease or sit securely upon a swaying, glossy leaf, where no other type of foot could give support.

The Flying-Frog's Foot

The other one has possibly the strangest foot in all the great field of animals. Not strange in shape especially, for it is somewhat like the webbed foot of the swimming frogs, but to realize that this specimen from Java is a small living aeroplane and can launch himself from tree-tops in gliding flights upon the webbed surface of his outspread feet, is almost staggering. Yet such is the well-proved fact.

The Human Foot

The insect world contains many interesting types of feet which will repay the use of the microscope but we are confining ourselves at present to those which our own eyes may notice and interpret. We too of the human race

are animals, and our feet, which are quite as significant as any of the others, may well close this hasty survey.

Notice then that all of us, even the most aristocratic, have feet which average much larger in proportion to body weight than those of most other animals. A fact easily explained by the necessity of making two feet do the work of four.

Man must not only support his 150 or more pounds upon two feet, he must also be able to raise his entire weight upon a single foot in taking a forward step. Two things then are required to start with—surface and strength; and two other requirements follow from man's activity—ease of movement and adaptability. Probably few have stopped to realize how well their feet are planned for all of their needs.

A shoe-print tells us little—man's foot was not designed for shoes—but the print of a naked foot shows that only a portion of the lower surface makes its mark, viz.: the pads of the toes, the ball, the narrow outer curve of the sole and about half of the heel. The whole effect is long and narrow, a shape which makes for activity and precision. A broad, clumsy foot would have to be swung sidewise in running, in order not to interfere. The heel cannot press flatly upon the ground since in walking it strikes the ground at an angle and must be rounded for easy action. We see this by the way in which the heels of our shoes wear round with much walking. Again the

hollow between heel and ball speaks of the arch of the instep which rises above it. This upward curve resting upon its two ends has long been recognized in engineering as a form of great strength and elasticity. Without it the step would lose most of its spring. The step which begins at the heel passes off at the ball, at which time the whole weight rests so well forward that we can understand its breadth and the need of the spreading, downward-pressed toes which assist it. And finally the separate action of the five movable toes makes it possible for man to adapt himself to a great variety of surfaces and find foothold where a solid foot would slip. Primitive, unshod man did not have smooth floors and pavements prepared for his feet.

These are but a few of the more obvious facts about those faithful members which we imprison, squeeze and otherwise abuse, but we are looking with the eyes of amateurs not specialists, and must not longer delay to bring our subject to a far-from-completed close.

Tails

Man has no tail although the two end bones of his spinal column, the coccyx and sacrum, are said to suggest his kinship with tail-bearing creatures. But once step below man in the great kingdom of vertebrates and the presence of tails becomes so nearly universal that their absence here and there occasions surprise. No other member shows such differences in form, no other member has such a variety of uses; and though most animals might lose the tail through accident and still survive, it would generally be a serious loss.

The limits of a chapter give all too brief a glimpse of this subject; we can select but a few of the more characteristic types, but here again we leave to the possessor of sharp eyes and a ready query a rich field for the application of his "Why."

The Cat's Tail

This is not one of the more important tails for the bobtailed Manx looks generally as sleek and self-satisfied as any of her cousins, but it has an undoubted value in the matter of balance. A cat with her hunting nature is a creature of stealthy approach and sudden spring. Every movement must be calculated to a nicety. A well-fed cat rubbing contentedly against a dining-room chair

commonly carries her tail aloft, but the hunting cat or the cat on a back yard fence has an extended tail suggesting the balancing pole of the tight-rope walker, and when she lights from a spring the dropping of the tail helps to check the forward motion and aid in precision. A cat which has recently lost her tail is at first apt to tumble forward in springing.

And then there is another use—a rather curious one. The cat's tail is an emotional safety valve. Did you ever observe the twitching tail of a cat about to spring? Why? Notice the blazing eyes, the gathered muscles and see how excitement is written in every line. A dog in the excitement of the chase will give noisy vent to his feelings; but the cat does not openly chase, she must remain silent and the noiseless twitching of that tail helps to relieve too great a tension.

The well-known swelling of the tail when angry or frightened is due of course to nothing more than the contraction of skin muscles by which the hair is erected.

The Dog's Tail

Here is another of the less important tails, generally considered, and yet what an eloquent one! How we would miss the joyous, waving greeting of "our friend, the dog," for the whole of his affectionate, demonstrative nature seems summed up in that rapid vibration. Even a dog

shorn of his tail may be seen to twitch his rump muscles as he wags an imaginary tail to greet his master.

The explanation for this habit is much as in the case of the cat—the tail is an emotional outlet. Hinged at one end and free to swing it is the most natural means for expressing surplus spirits, and is usually the first member in motion. For this reason, too, it is of value in signaling. Dogs are gregarious and always feel an interest in their kind, but with their differences of disposition it is desirable to gain some indication of one another's intention before too close approach. The amiably disposed dog comes trotting up with a wagging tail but will stop suspiciously unless his signal of friendship is returned. On the other hand a dog in full retreat drops his tail or puts it between his legs, as an instinctive precaution from his wild state, against the teeth or claws of some enemy.

When the weather is cold a dog in lying down will curl his tail about him for added warmth, and if this member be shaggy, it will prove no inconsiderable protection particularly to his moist, sensitive nose which still retains its power of scent behind the hairy tip.

The Rat's Tail

The viewpoint of the cat and dog upon the subject of the rat is rather a different one from our own, for to them it is an altogether delightful addition to the attractions of

a house, a sentiment which the rodent does not reciprocate.

The rat's tail is long, slim and skinny as everyone knows and for obvious reasons. It, too, is a creature of stealth, driven often to perilous footing where balancing aid is valuable, and requiring to drag its long tail through many dirty passage-ways where a bushy tail would quickly soil. This slippery, tapering tail sheds dirt with ease and affords slight hold for the enemy when its owner is accomplishing one of its many hair-breadth escapes.

The Horse's Tail

The horse and the rat have little in common save the bag of grain which each enjoys, and their difference is especially marked in their tails. The purpose of the horse's tail appears plainly enough in fly time. The horse has a sensitive skin which suffers keenly from insect bites yet he is not agile enough to reach the surface of his large body with head or feet. Hence that tail is at some times in almost incessant use, and few things are more inexcusable than the fashion of docking the tails of carriage horses while clipping close the hair which is their only other protection.

The horse is able to move his tail with such rapidity because its fleshy portion is short and muscular, while the long, coarse hairs add but little to the weight and yet spread to cover a wide surface in striking.

The cow, less sensitive and more thickly coated has in her longer, heavier tail with its smaller tuft a much inferior fly whisk.

The Squirrel's Tail

Leaving the domestic "Zoo" and returning to the tribe of rodents, there is a little fellow in our tree-tops whose sure-footedness puts even the cat to blush. Have you ever watched from some hammock nook a squirrel traveling his aerial highway overhead? How swiftly he races along a slender bough; how unerringly he leaps to the next one; passing from tree to tree with the precision of an arrow. Of an *arrow*, yes that is the word, for strip the feathered tip from an arrow and it will wobble in its flight, and cut the feathery tail, which gives him accuracy, from our saucy little visitor—if you can be so cruel—and he too would become relatively clumsy. He might also forget his impudence in sudden doubt of the agile superiority over lumbering humans which now he expresses in every contemptuous whisk and chatter.

It is this same graceful member, by-the-way, which supplies him with a name. "Squirrel" comes from the Greek "Skiouros" which in turn is derived from "Skio" (shade) and "Oura" (a tail) so that the squirrel is literally an animal "shaded by its tail," referring doubtless to his appearance when sitting up.

The Beaver's Tail

His distant cousin, the beaver, sports a very different kind of tail, if such a frivolous word as sport may be applied to this sober, industrious and highly respectable animal.

While the squirrel races among the leaves and indulges in scampish practices toward birds' nests the beaver is working marvels of engineering in the stream below. From the fact that his dam is plastered with mud and that his broad, flat, naked tail is strongly suggestive of a mason's trowel it has been widely supposed that he used it for that purpose. Unfortunately observation does not bear this out and we are forced to look farther since it is not to be supposed that such a distinctive member is without its use. This use seems to be threefold. First, and possibly most important, the beaver does much of his work when erect upon his short hind legs. In felling a large tree this may be the slow, patient labor of many hours, and nothing could be better as a sustaining prop than this wide, strong tail. Secondly, he is largely aquatic and finds his tail useful in diving, useful as a rudder and also, it may be, as a scull when swimming below the surface.

The third use is a startling one to the unprepared auditor. One such (Mr. H.P. Wells) has described it in the following words:..."The many sounds which at night characterize the woods on the confines of civilization are wanting in the forests of the wilderness. In the absence of wind the silence is that of death itself—like the Egyptian

darkness, it seems as though it could actually be felt. And so the canoe steals slowly on, as silent as the shadow of a cloud, its occupants, their nerves at the highest tension, straining their ears to detect at the earliest possible moment the presence of the game they seek. Suddenly, without the slightest warning, the death-silence is broken by a sound, as though the guardian angel of the deer tribe had hurled a stone about two feet in diameter into the water in the immediate vicinity of the canoe. It is the protest of the beaver against the invasion of his domain.

"I had heard this sound many times....It seemed incredible to me that an animal less than three feet long could make a noise the size of a two-story house. But one moonlight night we stole on a beaver swimming in a narrow stream. Not till the stem of the canoe was within five feet of it did it detect our presence. Then down went its head, and rounding up its back, it struck a violent blow upon the water with its tail and vanished. I was liberally showered and thoroughly convinced at one and the same moment.

"When excited or alarmed a beaver will sometimes continue this performance, easily audible for half a mile or more, at half-minute intervals, for ten consecutive minutes."

The muskrat has a similar trick but cannot make so great a noise with its slender tail. In both cases the sound

is doubtless intended as a danger signal to other members of the tribe within hearing.

The Monkey's Tail

Up in the tree-tops again, although not in the northern latitudes, will be found most of the members of the monkey tribe, and if there is one creature more at home among the branches than even a squirrel, it is the monkey. Like the squirrel too his character is marked by gayety, impudence and mischief and indeed there is much in their modes of life to account for such a nature—no need to run or hide from enemies like the animals of the surface, for with the exhilarating freedom of the wide tree-tops and an agility which can laugh at all ordinary pursuers there is small wonder that life should appear to be something of a frolic.

With most tree monkeys the tail is of value as a balance, but among the American representatives are found the wonderful prehensile tails which reach their highest development in that of the spider monkey—almost a "fifth hand" as it is often called. As it curls and waves in restless motion, the long, thin hairs at the end act in a measure as feelers and tell of any branch they may chance to brush, when the flexible tail easily encircles it in a grasp so firm that the monkey may loose the hold of all four feet and swing securely thus suspended. And furthermore this selfsame tail may be used to bring food

to the mouth almost like an elephant's trunk. As it moves about among the branches its exquisite sense of touch may discover some edible dainty—an egg perhaps—in a crevice too small for the hand, and the tail-tip is able to hook it deftly out.

It is interesting to notice that as the grasping tail has become more highly developed the grasping thumb has tended to disappear, so that it is now only rudimentary in most of the spider monkeys.

The Opossum's Tail

Another flexible tail is that of the opossum which likes in feeding to hang from a branch, and sometimes grasps its food with all four of its hand-like feet. In some species the tail comes into a strange use when the mother carries her little ones upon her back, and it makes a curious sight to see her traveling along a branch, her back loaded with small passengers which hold themselves securely by wrapping their tiny tails tightly about the upturned tail of the mother. Sometimes as many as a dozen will be found thus enjoying their free ride in the trees, and this tail-wrapping arrangement serves in place of the pouch in which other varieties of opossums—in common with the kangaroos and most marsupials—carry their young.

The Kangaroo's Tail

The kangaroo, by the way, has a tail as distinctive as any and very different from those just considered. A heavy-bodied animal, with such tiny front legs that they are useless for traveling, this odd creature would seem at first to be almost helpless to escape pursuit; when as a matter of fact he has phenomenal speed and endurance, and can cover from twenty to thirty feet at a leap. Ordinary fox hounds have been found to stand no chance in the chase and a special breed of "kangaroo-hounds" has had to be developed from grayhound stock. In one recorded case the prey led his pursuers a trip of twenty miles in two hours, of which two miles was a swim in the sea. All of which may seem to have little connection with the tail, and yet without it he would be well-nigh helpless. Every line in his strangely-shaped body is made with reference to that strong, fleshy member which sometimes reaches a length of 4½ feet. It serves him as a portable stool, and he sits upon it as securely as ever man sat in an armchair; and when he starts off in his long, flying leaps it is the tail which balances him in the air and supports him when he strikes the ground. He rests upon his tail in delivering those terrific downward kicks with his hind legs which make the hunter hesitate to come to close quarters, and it is also to his tail that the successful hunter looks for his greatest reward since kangaroo-tail soup is considered by epicures to be an especially choice dish.

The Fat-Tailed Sheep's Tail

We will notice but one other land mammal, one which uses its tail not as a whisk, a balance, a hand or a stool but, still more strangely, as a pantry—if one may use the figure—at least as a storehouse of nourishment. There are several breeds of sheep found principally in southwestern Asia and in Egypt, which have fat tails weighing from 12 or 15 lbs. to an occasional 75 or 80 lbs.! As may be imagined such weights are an incumbrance to the animals and their masters frequently fasten boards beneath them to drag upon the ground and help support the weight. A board with wheels attached is another form.

This peculiarity has been of course, largely increased by breeding since the tail is esteemed a delicacy, its fat being often used in lieu of butter. At first it was simply Nature's method of storing away fat when food was plenty in order to help the animal survive when pasturage dried up. During a fast its tail would gradually shrink, but it could still live through famines in which an ordinary sheep would die. This is no unusual device in Nature, for the camel starts upon its desert trip with a well fattened hump; bears and many other animals lay on an extra supply of fat before their winter's sleep; and at least one other creature—the stump-tailed lizard—is supposed to use its tail as a storehouse. The latter is known to endure long fasts, and Lydekker cites the case of one which ate only two or three flies during a voyage to Australia.

The Whale's Tail

The whale's tail, which at first glance seems so much like the tail of a fish, becomes, when examined and questioned, the best kind of evidence that its habits and needs are entirely different. Fishes' tails are set vertically in the water—that of the whale is horizontal—a fact of great importance. Why? We must examine the breathing arrangements for answer. Fishes have a device for extracting the air which is in the water, caught and stored there largely by the action of waves. Remember this when next you complain of a storm at sea. It is capturing air and bringing life to the vast population of the waters and they too have their rights. But the whale possesses no gills and can breathe only at the surface. He must therefore come up to the air every time he would fill his cavernous lungs; so his whole life becomes a series of trips to the surface and back again to the depths, endlessly repeated. Tiresome as this may seem, the whale does not find it so for his flat, *horizontal* tail makes rising and sinking in the water the easiest of acts; probably it becomes as unconsciously automatic as do our motions in walking.

The Fish's Tail

The fish proper—the true lord of the waters—could hardly imagine life without a tail. The fish is in many ways a highly favored creature. On hot, sticky days in summer

when discomfort is great among us of the human race, there is something a bit tantalizing in standing before the glass front of an aquarium tank and viewing the complete comfort of the fishes. Clad only in perfectly fitting suits of smoothest scales; surrounded by cool, clear water, which supports them so admirably that there need never be a sense of aching muscles, while yet it offers no resistance to their movements; balanced by their fins and needing but a whisk of their flexible tails to send them darting across the tank; well may we envy them when we compare such freedom of motion with our own laborious need of lifting 150 lbs. at every step.

And the effectiveness of that tail may also make us wonder that man was so long in inventing the propeller. For countless ages, millions of fishes have been flashing through the water, not by making a great disturbance at their sides like side-wheel steamers, but with an easy, waving, curling motion of their tails that is more than a little suggestive of a propeller's action.

The Sting-Ray's Tail

We enter the subject of weapon tails while still in the world of fishes. The sting-ray would hardly be recognized for a fish at first sight with its flat body, broad side flaps and a long, tapering tail like a whip lash. Reason tells us that such a tail could not be used for swimming and judgment adds that Nature would hardly have made it so

prominent without some special purpose, but we might hardly guess what that purpose is without examination. Then we would see that this strange creature, apparently so inactive and harmless carries really in that tail a deadly weapon in the shape of a dagger-like poison spine. The long tail is used to wrap about its victim and force it upon this spine with fearful effect.

The Scorpion's Tail

Another weapon tail is borne by the familiar scorpion common to many of the warmer countries, and ranging from small species to tropical monsters of 9 inches. These dreaded pests have a long-jointed tail armed with a sharp, down-curved sting at its tip so highly poisonous as to make a dangerous wound. In striking, the tail is raised above the back and brought down with force sufficient to drive in the sting-point.

The Alligator's Tail

A still more formidable weapon is that of the alligator. When seen lying like a log on the bank of a southern river he appears too inert to be of special danger. Under such conditions he will indeed, if possible, take to the water where he is most at home, but if cornered it will be a rash man who will come within the reach of that powerful tail. Broad, hard and tremendously muscled it can be swung like the club of a giant, disabling a man or even a larger

animal. Smaller creatures would be swept into the water where they would become an easy prey for the monster—as swift and active there as he is unwieldy on shore. His swimming speed, too, is largely due to his tail, although his feet are webbed. But they are small in proportion to his great, compressed tail which with its broad, flat surface and enormous strength is an effective sculler. It has been flippantly suggested that the alligator has thus a skull at both ends.

A smaller reptile, the monitor, has a very long, tough tail, slender as the thong of a whip, and by lashing with it fiercely he deals stinging blows.

The Rattlesnake's Tail

But if the tail may be a formidable weapon, it may also become a warning of danger. Our rather unpopular compatriot, the rattlesnake, stands the tip of his tail erect and vibrates it so rapidly that its loose, horny rings shake together with a peculiar, keen, hissing buzz, apt to suggest to the one who hears it that he has urgent business elsewhere. This seems at first to be the purest chivalry of a creature unwilling to act the part of an assassin, but one glance at the hard glitter of his eyes dispels such a thought. The warning has saved many from danger—perhaps from death—but the rattler is less concerned in others' safety than in his own. Heavy-bodied and clumsy he might be accidentally trodden upon by some larger animal, and

even if he punished such mischance with deadly poison it would be little satisfaction if he were also maimed. Most snakes will avoid an encounter, but the rattler, less agile than some, finds it of value occasionally to threaten the careless intruder, and this threat is pretty widely understood in Animal World.

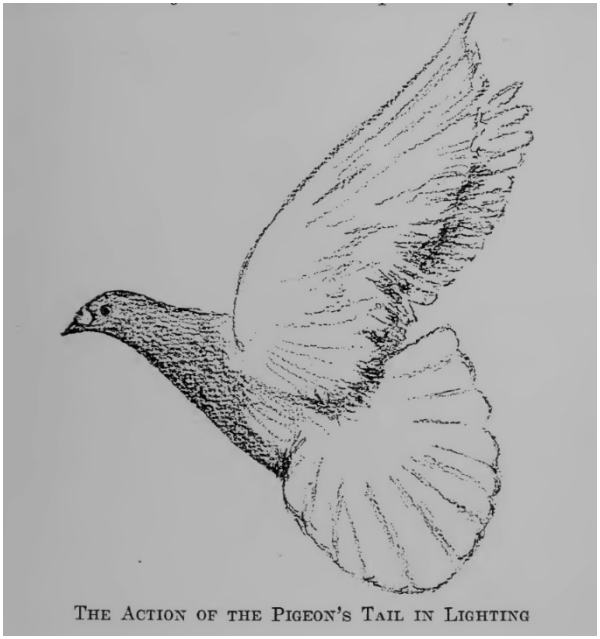
It is popularly supposed that one may learn the age of a rattler by counting the rattles and allowing one year for each. This is not accurate for under favorable circumstances as many as three may be formed in a year and it is common for the end rattles to become broken off after nine or ten are formed. More than ten are rare in any instance, although there is said to be one case on record showing thirty.

The Green Lizard's Tail

If a pursuer should catch a man's coat-tails and these should tear off in his hands allowing the man to escape, it would not speak well for the quality of the cloth; yet the little green lizard, together with some of his cousins, occasionally finds a somewhat similar arrangement of great value. His tail is long and graceful—a tail to be proud of—but it is far better to let part of it go than to become himself the prey for some prowling appetite. Also, through a kind provision of Nature, he need not appear unfashionable for long, since she begins to renew for him that which was lost, and at last he has again nearly as proud

a tail as before. The detached tails of some of the lizards are said to twist vigorously in the hands of their would-be captors for some little time, thus distracting attention and giving the owner a chance to make good his escape.

The Flyer's Tail



THE ACTION OF THE PIGEON'S TAIL IN LIGHTING

From the lizards through the long processes of evolution came the birds, so scientists tell us, and fossil remains show how steering feathers began to appear in the tails of some of the ancient flying creatures, half-reptile, half-bird, before the age of man. From these have come at last the adjustable tails of present-day birds. Aviators have

learned that their most difficult problem is not that of rising into the air, but of controlling and guiding flight. The air is full of currents which must be taken into account, and the bird does instinctively what man is working out through study and experiment.

For this purpose and especially in checking and steering flight in landing, the tail is invaluable, since its long, strong feathers can be opened or closed like a fan, or somewhat raised or lowered if desired. It is easy to observe the action in a flock of pigeons. Some pigeons have indeed been developed into grotesque distortions by pigeon-fanciers but the searcher for "Whys" should not be misled by changes wrought by the hand of man. There is a great difference in the flying agility of different birds. Those which turn and twist in the air with the greatest freedom are usually long tailed, while straight flyers, like the grebes, have generally much less development of these aerial rudders.

The Woodpecker's Tail

Our energetic little friend the woodpecker adds still another valuable characteristic. When engaged in his earnest quest of the insects which we so gladly spare him from our trees, he needs strong support for the vigorous hammering of his wedge-like bill. For this purpose he has large feet and sharp claws, but it will be noticed that he also presses his tail against the bark, and one who will examine it will learn the reason, for the tail has stiff quill

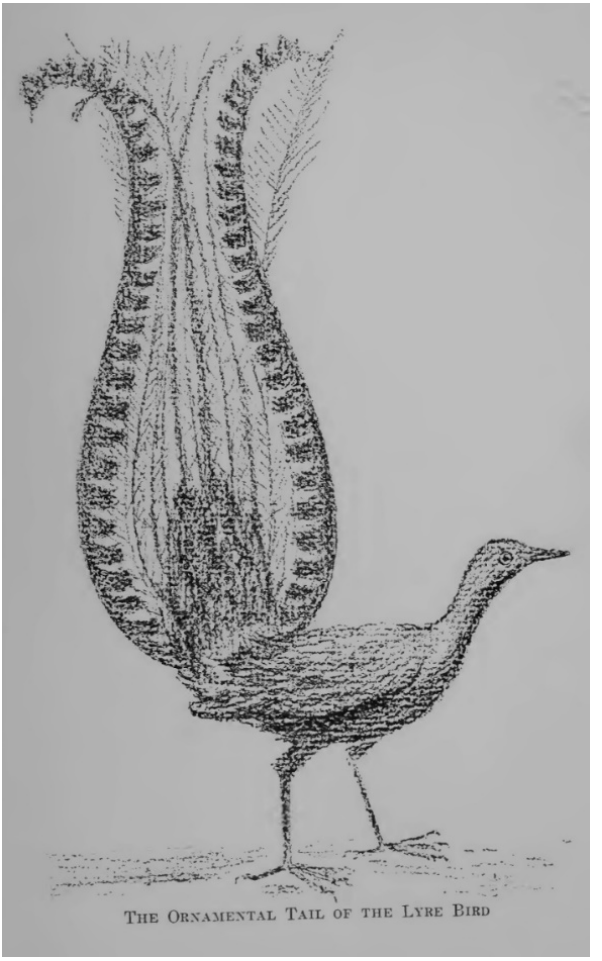
points which help support him like the climbing-irons of telegraph line-men.

The Lyre Bird's Tail

But in concluding it must not be forgotten that beauty as well as usefulness has a part in the plan of Nature. Indeed Nature often makes beauty a factor in usefulness; for the bright colors of the flowers attract the insects which transfer the pollen from one blossom to another, while the glorious wings of the butterfly help to blend it with the blossoms and so conceal it. So also is the brilliant plumage of many birds a feature of the courtship which Nature uses to preserve the race.

The lyre-birds of Australia have little beauty apart from their tails, but these, in the males, are wonderful structures of such grace (suggesting the sweeping curves of the ancient lyre) that they are most attractive to the plain but critical female, and also, alas, to the human collector. As the lyre-bird carries its tail erect it is evident enough that he cannot be a tree dweller—such a lofty structure would not be adapted to life among branches—so we are not surprised to find that he is a swift ground runner. The peacock with his still more wonderful display is unfortunately out of our subject. His beautiful plumes

are really not a tail at all and the short stiff tail which supports them has no attractiveness.



THE ORNAMENTAL TAIL OF THE LYRE BIRD

Coverings

Every animal is a package, with the most valuable portions inside and much attention paid to the wrapping. There are naturally wide differences in the coverings according to the different conditions to be met, and each great group has its characteristic form. Thus there is Hair for the Mammals; Feathers for the Birds; bare, embossed or scaly Skin for the Reptiles and separable Scales for the Fish; not to speak of the Shells of many Molluscs and the "Exterior Skeleton" of the hard-bodied Insects. Within these groups there is great variation of degree and arrangement making this subject a most important one.

The Cat's Coat

Nothing could look much less like protection than one individual hair. If the problem of clothing a large section of the animal world had been given to us and we had known nothing of hair, it is perhaps the very last device our invention could have hit upon. But Nature is wiser than her children and now that we have a chance to study it, what could be more admirable? Take the case of the cat. From head to tip of tail there is one unbroken covering consisting of an incredible number of fine, soft hairs, each one springing from its separate root which continues to renew it as the end may wear or break—oh, the infinite care of Nature!—and all set so closely that it is hard to find

the skin. A cat needs warmth, flexibility and smoothness and her coat gives them all; warmth, because the crowded hairs confine a great deal of finely divided air-space, that best of heat insulation which keeps the body warmth from being lost; flexibility, since the separate hairs are too soft and fine to offer resistance to the quick, lithe movements, and smoothness, in that each of them presents an extremely small, rounded, polished surface offering slight hold for moisture, or soil, and all overlie in a continuous direction which makes them easy to clean. A cat will not tolerate dirt upon her coat and the little pink tongue with its rasping surface goes thoroughly over it very frequently. This fastidious cleanliness makes the animal a pleasant house companion, but it probably has its origin in an instinct to reduce the body odor and keep the warning scent from the keen nostrils of the prey she seeks.

The larger members of the cat tribe belong mainly to the warmer climates and hence are short-haired, but some specimens like the ounce, or Tibetan snow leopard, have long fur which can resist considerable cold.

The bristling hair, in anger or alarm, already referred to in "Tails," is due to tightening of the skin muscles and is merely a physiological effect of this form of excitement. It also has its advantage, in increasing the apparent size and formidable aspect of the animal, and may be of some little use in deceiving an enemy as to the real location of the skin. It is said that the mongoose when battling with a

snake, often makes the serpent strike short by means of its bristling coat.

On the other hand the hair under any condition has much to do with apparent bulk. A man walked into a Philadelphia restaurant, some years ago, announcing that he had a rare animal in the covered basket which he carried. There was much curiosity as he exhibited the strange, skinny creature, and gave a fictitious account of its capture, but all agreed that they had never seen anything resembling it. Just then a stray dog wandered into the room, and seeing the curiosity made a joyous dash for it, while the latter leaped to the top of a table where it arched its back and spit in such a familiar manner that the by-standers realized they had been imposed upon with a shaved cat!

The Beaver's Fur

The opening up of a large portion of Canada is said to be due to the fur of the beaver and the Dominion has made the animal her crest as an atonement for the countless pelts which have been ravished within her borders. Beavers abounded in her lakes and rivers to an extent that made hunting and trapping very profitable and the famous Hudson Bay Company existed largely for this purpose. A beaver skin became the unit value for purposes of barter.

And yet, at first glance, one would hardly think of fur value in the chunky animal with his long, coarse hair. This hair is strong, protecting, and sheds water easily from its polished surface, but concealed beneath it lies the real treasure—a dense pile of finest, softest fur. So fine is it that it was long used for making men's high hats, "beaver hats," until the cheaper silk hat was invented, and it still is a valuable item in the fur trade although now and then out of fashion. Fur-bearing animals, could they follow our Fashion notes, would probably be delighted when a receding wave of taste left them for the time unpopular. Here indeed is a case where the blessing designed by Nature to make her children warm and comfortable in the midst of cold and wet, has been turned to a curse for them by that restless, destroying interloper—man.

The beaver's cousin, the water rat, looks as though rubbed with mercury when seen swimming beneath the surface, for each hair is tipped with a tiny, attached bubble of air which helps protect it from the wet. One shake of its body when again on land sends the water flying off and leaves it dry.

The Mole's Fur

There are many kinds of hair coverings, which increase or diminish mainly with the climate, from the short-haired, or sometimes nearly naked animals of the tropics to the long dense fur of arctic dwellers. This latter

usually shows a protecting "overcoat" of strong, coarse hairs and warm "underwear" of very fine, densely-massed fur. With a few notable exceptions such as the sheep, animals when yielding their coats to the envy of man must also yield their skins and their lives. It is one of the tragedies of Nature to see how many of them have thus been exterminated in sections where they were once abundant. This slaughter may be somewhat justified in places of severe Winters, but it is unpleasant to think of the vast sums of money which many cities expend for fur coats which can be worn with comfort on but a few days of the year.

However, this is digression, and the point to be noted about the mole is that his fur may be brushed either way without damage, lying smoothly toward the head or toward the tail. This is very different from the definite arrangement of hair in other animals—you know how a cat dislikes to be brushed the wrong way—but it is valuable to the mole which must travel forward and backward in a close fitting tunnel. Fur of the usual kind would be quickly roughened and spoiled.

The Elephant's Hide

Living in the tropics are to be found certain large animals grouped under the general term of pachyderms and including especially the elephant, rhinoceros, hippopotamus and tapir. These are practically naked for

their sparse hairs are too few to take account of, nor need this surprise us when we consider the warmth of their climate. But protection of another kind they must have, for where frosts never come, there are myriads of biting, stinging insects and countless thorny plants and vines. Therefore they are *pachyderms*, a word from the Greek meaning "thick-skinned," and these great beasts have skin of such extraordinary thickness—sometimes 1½ inches or even more—that they will walk nonchalantly into a clump of thornbush where a man on foot or on horseback could hardly follow.

They are also well protected from animal enemies, and an adult elephant has nothing to fear from any creature save man. Even a hunter must have a gun of special penetrating power if he expects to pierce that hide, and he takes considerable risk when he goes after the big game.

When a Siberian glacier gives up the carcass of a huge, long-haired mammoth with much of the appearance of the elephant—frozen there many thousands of years ago—we have evidence that pachyderms are quite capable of developing the hairy coating when living in a severe climate.

Some of the big pachyderms, notably the rhinoceros, are often seen with attendant birds which perch upon their backs when at rest and give the alarm at the approach of the hunter. This is due to the parasites which lodge in crevices of the thick hide and are sought out by the birds.

The crocodile birds of the Nile, already referred to form a somewhat similar partnership.

The Whale's Blubber

The still huger whales have a covering of an interesting nature. Sometimes in opening parcels from the store we will find packing of cotton or excelsior within the paper to protect the contents from damage. In very much the same way the whaler after cutting the skin finds a mass of blubber encasing the monster in a thick, fatty cushion of sometimes 30 tons. This cut into strips hoisted on board, together with the baleen, his interest in the "package" ceases and he leaves the carcass to those sea scavengers, the sharks and gulls, while he tries out the oil. In the palmy days of whaling, before the use of kerosene, whale-oil furnished the reading light for countless households. There is record of a single bow-head whale yielding 275 barrels.

But why should the whale possess this blubber? Hardly for the purpose of lighting the homes of his enemies, for here again man has gone counter to Nature's plan and made the creature suffer for what was intended to be his blessing—as in the case of the fur-bearers. Shall we say that our race has altogether blessed the planet it rules? The real answer as to blubber is one consistent with the horizontal tail, the air-breathing nostrils and every other characteristic. The whale may descend to great

depths but must come frequently to the surface. Water pressure varies considerably at different depths so that man with his most perfect apparatus has never been able to descend more than comparatively short distances. At a great depth his diving-bell would be crushed flat. Fishes that live in the deeps, being specially designed, could not as a general rule survive at the surface, and vice versa, but the whale with his fatty cushion, elastic as rubber, is protected from sudden change of pressure.

He is also a great traveler and is similarly protected from the differences in temperature of different latitudes. We must remember that it is in surface water that such differences are principally felt. Furthermore the whale has enemies in the seas against which this cushion—sometimes two feet thick—serves like the quilted armor of old Japan. Even a savage sword-fish running amuck, may bury his weapon in the great cetacean's side without fatal damage.

The Porcupine's Quills

"—And each particular hair to stand on end Like quills upon the fretful porcupine."

The ghost of Hamlet's father apparently had not forgotten his natural history in the spirit world for a porcupine standing at defense and bristling with quills is one of the distinctive sights among animals. With this rather uncouth little creature we touch a different phase of

the subject—coverings used as protection not from cold or wet, but from active enemies. He is an interesting exception to the general rule, not particularly strong nor active, having neither dangerous claws nor jaws, living in the vicinity of hungry, flesh-eating animals and rarely trying to escape danger, one would think him doomed to quick extinction while as a matter of fact he continues placidly indifferent and little disturbed. A bear or lynx will take big risks in a farmer's barn-yard rather than meddle with a fat, easily captured porcupine, and all because set thickly among the hairs of his coat and tail are many sharp, barbed spikes. These he will erect at the approach of danger into a savage, bristling hedge. Moreover these spines, or quills, are so loosely attached to the skin that they stick in quantities to any hostile paw or jaws where the barbed points cling tenaciously and painfully. Small wonder then, perhaps, that the porcupine should not seem an attractive morsel to the prowlers of the forest.

Roosevelt, in speaking of a "bobcat" hunt, says: "The hounds soon picked up the trail again and followed it full cry; but unfortunately just before they reached where it had treed they ran on to a porcupine. When we reached the foot of the aspen in the top of which the bobcat crouched, with most of the pack baying beneath, we found the porcupine dead and half a dozen dogs with their muzzles and throats filled full of quills. Before doing anything with the cat it was necessary to take these quills out. One of the terriers, which always found porcupines an

irresistible attraction, was a really extraordinary sight, so thickly were the quills studded over his face and chest. But a big hound was in even worse condition; the quills were stuck in abundance into his nose, lips, cheeks and tongue, and in the roof of his mouth they were almost as thick as bristles in a brush. Only by use of pincers was it possible to rid these two dogs of the quills and it was a long and bloody job."

The fisher is said to have acquired the difficult art of seizing the porcupine by the throat where he is least protected, and occasionally some of the big cats are driven by hunger to violate their best judgment—and pay dearly for it. Pumas and lynxes have more than once been killed in a half starved condition, and found to have their mouths so filled with porcupine quills that they were practically unable to eat. In other cases the quills once entering the flesh have continued to bury themselves deeper with every muscular twitch because of the great number of their tiny barbs until at last some vital part was pierced and the slayer in turn slain by the victim, many days after the original tragedy.

There is a persistent old tradition that the porcupine has the power to shoot his quills, due probably to the fact that when he strikes with his tail these may become loosened and fall upon the ground where active imaginations later find and interpret them.

The Hedgehog's Quills

While often confused with the porcupine the hedgehog is really a very different animal although protected by spines in a somewhat similar manner. These spines, however, are shorter and instead of being loose and barbed, to fill the enemies' flesh like miniature spears, are firmly fixed to their owner's skin in a most interesting manner. Imagine a good sized pin with a rounded head, rather sharply bent near the head and stuck or pinned through the skin, and you have a fair idea of an individual quill. Because of the bend these pointed defenses lie naturally backward, but when the hedgehog contracts the governing muscles they begin to bristle, and when he rolls himself into a small, prickly ball he is not usually disturbed by other creatures.

Another advantage, also, he has from this bristling coat. Quills are both stiff and elastic, and the hedgehog knowing this does not hesitate to drop from moderate heights upon the ground when rolled into a ball. The quills protecting him from injury, he merely unrolls and trots away unconcernedly. In this respect he is resembled by that curious armored anteater, the manis or pangolin, whose pointed scales, formed by the fusion of fine hairs, are so elastic that their owner will sometimes descend from a branch by merely allowing himself to fall.

The Armadillo's Mail

Sometimes you will see in a florist's window a peculiar flower basket, which, upon examination, proves to be the pathetically empty shell of a little armadillo, its head-plate and tail being ignominiously joined together into a handle. Although this empty shell is proof that man as a hunter will not be denied, one cannot fail to be struck with the wonderful completeness of this armor against all ordinary enemies. The covering is hard, tight, and bony, consisting of many small scales fused together and divided into one large buckler for the shoulders, another for the hind-quarters, and, between these, pliable armored rings running around the body. These rings make it possible for the armadillo to roll himself into a ball as the hedgehog does. At such times, the tail, although covered with hard rings, is tucked inside, while the head shield closes the front and the little creature becomes a slightly flattened globe too large for the mouth of a hunting animal and impervious to teeth. Secure in his coat of mail the armadillo will submit to being rolled about or even trodden upon, and when the baffled enemy has withdrawn he is quite uninjured.

Man, of course, is not to be foiled so easily, and having discovered that some of the armadillos are toothsome, roasts them in their shells, thus turning again their protection against them. The little fellow is also said to be occasionally an involuntary post-mortem musician in that his shell may be used as the body for a kind of crude guitar,

while the Botocudo tribe of Brazilian Indians make a trumpet from the hard-ringed tail of the kabalasson variety.

The Tortoise Shell

It seems but a step from the hard-shelled armadillo to the hard-shelled tortoise while in reality it is a step from the mammals to the reptiles—a great distance in zoology. If the armadillo with his somewhat flexible covering may be compared to a mediæval knight in suit of armor, the tortoise travels about in a combination of house and fortress from which he cannot be evicted while life lasts. It must be a trifle inconvenient at times but there is surely comfort in the thought that one can never be homeless.

This house, or shell, consists of a large, rounded back-piece called the "carapace" and a smaller plate beneath the body known as the "plastron" although in some forms these are welded firmly together. These make a wonderfully complete protection as every country boy knows when their owner withdraws his blunt nose, clubby legs and funny little tail and permits himself to be handled in perfect security. He need not be in the least concerned at that lack of speed which has gained him a place in fable, since the casing is too hard a nut for the four-footed hunters to crack and the tortoise is therefore known to attain to a venerable age. Some of the gigantic specimens

from the Galapagos Islands are supposed to be as much as 400 years old.

There are many variations in the shells of the tortoise and of the closely related turtles and terrapins, one of which, the hawksbill, produces the beautiful tortoise-shell, so highly prized for combs and other ornaments.

The Alligator's Hide

With the tortoise tribe as the supreme example of defensive covering among four-footed animals, there are many lesser grades and few are more familiar than this checkered, knobby skin which is in such demand for traveling bags. The same qualities of strength and toughness giving it commercial use make it still more valuable to its original owner. The alligator is a beast of prey which must capture active creatures and could not be hampered with a shell. Indeed it seems almost strange that defensive covering should have been provided in his case, since great size, terrible jaws, a dangerous tail and a savage disposition are all protective. When it is remembered that the alligator because of his elevated eyes and nostrils can remain on the lookout when practically submerged in water, that even on land he is inconspicuous because of his resemblance in shape and color to a log, and that in addition to all of these he has a flexible coat of leathery armor which has often deflected bullets, it will be seen that

he is one of the most perfectly equipped members of the Animal Kingdom.

The Snake's Skin

We will take but one more example from the once royal and still powerful group of Reptiles, and that the one for which human beings feel the most instinctive enmity. All of the creatures thus far considered have been permanent packages, fitted at the start with coverings which grew with their growth and outlasted their lives. The snake breaks in upon this rule by shedding its outer skin and getting a new one at frequent intervals. We might, perhaps, consider it the dandy among animals, requiring many new suits to express its vanity, but for its desire to keep out of sight and the fact that each new suit is like the old one in appearance. Why this necessity? Growth has something to do with it, but all of these other creatures grow also, and meet that problem with a growing skin. The snake however differs from them all in the fact that it has no legs and must travel continually upon the surface of its skin. Indeed, remarkable to relate, it travels to some extent by means of its skin. Upon the lower surface are broad overlapping scales, attached to the strangely movable ribs, and in addition to the wriggling method of travel, these scales acting in swift succession, raise their overlapping edge to press backward against the ground and help the forward motion. The sinuous curves are

really the very embodiment of grace if we could only overcome our dislike enough to be fair. All of this may seem to have slight connection with the reasons for skin-shedding, but the fact is that the snake using its skin so actively against hard, uneven, often stony surfaces cannot protect it from the wear and damage which are unavoidable and with skin once injured, it would easily be attacked by insect pests. Hence it must occasionally go through this process of pulling itself out of the old, worn casing and wriggling off upon the shiny new one which has been forming beneath.

The Toad's Skin

Our wrinkled, brown friend of the garden walk belongs to a subdivision which includes the equally familiar frog and is dependent upon its covering to a peculiar degree, for amphibians do not drink after the manner of most creatures but absorb, through pores in the skin, the moisture which their bodies require. The skin in some species has also glands which give a protection quite different from the hard or prickly defense of turtle or porcupine. It secretes a disagreeably acrid fluid that would tend to make the little, squat, helpless fellow an unpalatable morsel. In some cases this secretion is even poisonous. It is hard for us of the human race to realize how large a part of the animal kingdom must always be on its guard against being eaten. The ingenious variety of

ways in which protection is furnished is an interesting study.

But there can surely be no other skin-use so strange in the whole Animal Kingdom as that of the far-famed Surinam toad. This animal is a traveling incubator and this is the manner of it. When the eggs are laid the male picks them up with his clumsy feet and places them upon the back of his mate, her skin having become abnormally thickened for the occasion. There they stick fast, because of a gummy secretion and gradually become embedded, thus forming a series of skin cells which in course of time close over with a kind of membrane. So passes a period of nearly twelve weeks, during which the mother's back is like a piece of hopping honeycomb. At last there comes a day when three, four or five score of tiny toads begin to push here a head and there a leg through the retaining membrane, until the mother's broad back becomes grotesquely animated with a struggling little brood. When these have freed themselves the cells begin to fill up and once more disappear.

It may be added in passing that the prickly little lizard misnamed the horned toad, does not in reality belong to the family. His defense of sharp skin protuberances is an effective one although it does not add to his beauty.

The Eagle's Feather

Away back in the Jurassic period, many ages before the dawn of history, there lived a strange, winged, toothed creature, which has been variously considered the earliest known species of bird or a transition type between lizard and bird. This was the archeopteryx, found embedded in the lithographic stone of Hungary, and thus have come down to us the most ancient feathers of which we have a trace. It is interesting to notice that these feathers are practically the same as those of our modern birds. In other words Nature had at this early date perfected a covering so admirable for her children of the air that in untold centuries since she has been unable to make improvement.

A feather is thus well worth study on its own account as also from the fact that it is the one characteristic covering of the great division of birds. There is no variety of bird which has not some form of feather, and there is no animal, not a bird, which has any kind of feather. There are indeed so many variations of form that a whole volume might easily be written upon this single subject, but our object is not the packing of information into printed pages. We are studying the "Why" of things, and when we examine an individual bird or pull to pieces an individual feather, our information for the time is supposed to go no farther.

Here then is one of the long, strong wing-feathers of the eagle. What does it tell us? Observe first its wonderful lightness. Over a foot in length and two inches in breadth it hardly flutters a letter-scale. There is no need to inquire the value of lightness to a flying creature. Notice next its construction—a long, hollow central quill, rounded above, flattened below, tapering to a fine point at the end and bearing a web for most of its length. Torn open this quill is found to consist of an extremely thin, horny material which is yet so strong, because of its tubular form, that considerable pressure is required to break it. A short distance from the base begins the flat part or web of the feather and this is seen to consist of filaments which grow from either side of the quill, here known as the shaft. Each one of these filaments is so slender that one wonders at the firmness of the web, and here a magnifying glass may well be used, for the exquisite workmanship of Nature is seen in few common objects to such advantage as in this feather. Pull apart a portion of the web. Notice how tenaciously the filaments, or barbs, cling together and then look closely at the separated edge where are placed the extremely minute barbules, tiny hooks which spring from either side of the barb as does the barb from the shaft. The barbules upon one side of each barb curve upward, those on the other side, downward, so that those up-curved in one barb may hook into the down-curved ones of the next just as we might hook our two hands together. This is the secret of the web's firmness combined with

flexibility, although it is hard to realize that anything so small can prove so effective.

The shape of the web is next noticeable. Broader upon one side of the shaft than on the other the whole rounds gently from side to side and presents a surface of glossy smoothness. This curve is but a part of the larger curve of the wing and is very similar to that which modern experimenters have figured out for the planes of their flying-machines, while the smoothness makes it possible for the feathers to slip over each other when folded or unfolded in opening and closing the wing. The fact that one side of the web is somewhat shrunken is an indication that the feathers overlap like the weatherboarding of a house and the lesser side is the one concealed.

Very different from this firm, glossy web is a little tuft of downy softness at its base. This is the accessory plume, easily overlooked in such a wing-quill but more important in the body feathers, and in some birds as large as the web, adding much warmth to the covering.

If the reader be in position to carry his investigation beyond the feathers to their owner, he will find that in most cases the former do not grow in a miscellaneous way but are arranged in special and regular groups with naked or downy spaces between, although these are concealed by the overlapping feathers. A moment's reflection will show him that this plan of growth is necessary to secure smoothness of plumage to such an active creature as a

bird. And this unbroken smoothness from head to tail is highly important to the swift traveler of the air.

In general, although this is the merest glimpse at the subject, we may say that the bird, with its overlapping shingling of strong, light, glossy feathers, unresisting to the air, flexible to motion, shedding moisture, imprisoning the heat of the body, yet permitting ventilation to the skin, varied to fit all needs, from warm, downy underplumage to the strong air-beating quills of flight, and finally, when worn with use, easily shed and renewed from the mysterious workshop of the skin—the bird, so covered, is provided beyond the utmost ingenuity of human contrivance. How as elsewhere when we use our "Why" in a halting effort to understand we can only stand in reverent wonder before the immeasurable grasp of Creative power.

The Owl's Plumage

We will stop but long enough to note that the strong, firm feathers we have just been considering are with the owl replaced by a mass of downy softness which might make us think this bird to be similarly a creature of gentle softness. Certain mice and other small creatures of the night, however, think otherwise, knowing of the sharp talons and beak. Reasoning from analogy is not always safe.

It is not to be supposed that the owl with such feathers is equipped for the strong, swift flight of the eagle, nor would this manner of flight be fitted to the hours of darkness, when, as he wings along close to the ground gazing and listening intently to surprise some timid victim, he looms suddenly through the shadows, himself a noiseless shadow, and seizes his prey. The slightest rustle of stiff feathers would make such approach impossible, and we can realize that he owes his nightly meal to his fluffy cloak.

We are not surprised to learn that most owls do not migrate. Plumage of this sort is warm enough for winter wear and does not lend itself well to long journeys.

The Fish's Scale

There are many other kinds of feathers including those curious ones of the penguin, in which the size of the shaft has been so increased and that of the vane, or web, so diminished that they rather resemble scales. And if this is the effect of an aquatic life upon these birds it is logical to expect a high development of true scales upon most of the members of the race of fishes.

Here is another absolute departure, differing from feathers as greatly as they differ from hair, differing also from the apparent scales of some reptiles which are merely folds of the skin instead of distinct horny elements. The average fish is clothed with many small, hard plates,

broadly rounded and overlapping like the shingles on a roof. This is not the place to go into distinctions of "ctenoid," "cycloid," "placoid," "ganoid" and "prickly" scales. "We are amateurs on a large field instead of ichthyologists with a lifetime for the study of fishes alone, but we still may note that they are arranged with a beautiful regularity and offer no impediment to lithe motion. Perhaps the first point to strike us is their slippery smoothness. It is not easy to catch a fish unless the fish will help by swallowing one's hook or entangling himself in one's net, and his natural enemies have neither hook nor net, hence the value of such hard, slippery scales. This elusiveness is increased by the slimy mucus of the body which calls our attention to the interesting "lateral line"—a line easily seen running lengthwise of the body upon each side and marked by a series of perforated scales which excrete the mucus. Some observers believe this to be also some kind of a sense organ.

But escape is not the sole advantage of smooth-lying scales. The average fish is built for darting through the waters with swift ease and needs slippery sides, just as a boat with hull fouled with barnacles needs to go into dry-dock to be restored to smoothness. Sea waters abound in forms of animal and vegetable life which attach themselves to every available surface and if the fish remains unencumbered it is because his body does not offer satisfactory hold to these growths.

Scales are hardly to be considered clothing in the sense of warmth, like fur or feathers, since they do not imprison air space. Had we time to examine the many varieties we would find great differences in size and arrangement, from the tiny, close-set scales of the trout, to the few, large ones upon some of the carp, would find practical nakedness among the mud-loving eels and catfish, sand-papery shagreen on the sharks, bony plates upon the sturgeons, and would indeed soon discover many questions utterly baffling to our amateur "Why." And yet this need not discourage us for the most eminent scientists must in turn confess their inability to solve some of the secrets of even a subject so apparently simple as the scales of fish.

The Human Skin

And now we come to the true wrapping of the package. Below the fur, spines, shells, feathers and scales is the wonderful workshop from which they spring—itself a living, self-renewing binding such as was never had by the most precious volume. This is the skin. If we have failed to speak of its presence in preceding instances, it is because the external coverings were more conspicuous, but now that we are ending our rambling excursion as usual with the human family, the skin becomes at once the natural subject. Man, being a mammal, has also hair—has hair, indeed, upon every portion of his body save the

palms and soles, and the end joints of the fingers and toes, and yet this is so slight in comparison to other animal coverings that he considers himself a creature of naked skin.

Thereupon, weak in body but crafty in brain, he circumvents those other creatures which Nature had apparently more kindly protected, and takes from them fur, feathers, scales, or the very hide itself, not to speak of the various products of the Vegetable Kingdom, thus making himself the most completely clothed of all earth dwellers. Thereby he becomes also the most independent in respect to climate. No animal traveler would think of penetrating the tropics one year and joining a polar expedition the next, but to man with his range of artificial covering this is perfectly feasible. However, we will leave man's hair to the barber's consideration, his clothing to that of the tailor and return to our first interest, his skin, only pausing to state that some of the points to be mentioned would apply as well to the skins of other animals.

If you had to wrap up a package for rough handling you would wish a strong cover; if the package were a lively one—full of active motion—the cover would need to be elastic; if it were intended for exposure to the weather it must also be waterproof. So we might go with other requirements which would suggest themselves and still fall far short of the wonderful truth of our own skin covering.

The skin being at the surface is liable to injury. Were these injuries permanent, a few weeks of the accidents of childhood would render it unfit for future use. But the red scratches quickly disappear and the surface is whole as before, for the skin with the ministration of the blood is self-renewing. Even where large portions are destroyed by burns it has proved possible to cause small grafts of healthy skin to grow into a new surface. Thus it differs from all artificial wrappings in that it is a living covering. Living, too, in power to enlarge. The new born baby is a tiny package which may increase to fifteen or twenty times its original bulk and yet never for a moment will its covering fail it. The skin has great power of adaptability. Where roughly used it quickly thickens into callous spots and those who customarily go barefoot have soles so tough as to be almost insensible. A naked savage may walk upon sharp rocks or break a thorn with his foot, without pain. It becomes accustomed to changes in temperature. Darwin tells of the half-naked Fuegians in their severe climate and of seeing one mother with her babe at her naked breast with the snow upon both. Some one asked an Indian how he could stand it with so little clothing, and he replied: "You got no clothes on your face. Indian face all over!"

Again, at some points, the skin is very thin. This is where thick skin would interfere with quick movements as in the outsides of the finger joints and especially the eyelids. In other words the whole covering is varied to suit

the particular needs of the individual and of his various parts.

It is no part of our purpose to go into a microscopical study including glands, ducts and pores. Most people realize that there is a division into the true and scarf-skin, or the cutis and cuticle, or dermis and epidermis if you prefer the technical terms. These separate readily as we see in blisters or in the "peeling" after sunburn, and the more important true skin is protected by its covering, for this cutis is really more important than the average person begins to imagine. Besides being the binding of the body, it is a workshop in which are created nails, hair and all of the external coverings; it is the great organ of touch with its inconceivable numbers of nerve ends; it is an organ of excretion ridding the system of an immense amount of poisonous waste; is an organ of absorption, and even of respiration.

The old story of the boy who was covered with gold leaf in an Italian festival procession and soon died in consequence, shows how important are some of these functions. In the single matter of excretion the sweat-glands which are so active in warm weather are really acting unconsciously in every weather and every hour. The amount of watery vapor put forth through their tiny pores averages something like two pounds daily and contains urea, lactates and other impurities which are left upon the surface as the moisture evaporates. Hence the

value of baths. Close the pores and the poison must stay in the body to work swift harm.

As to absorption, it exists to a limited extent and medicines are sometimes administered by being rubbed into the surface. Finally, this same marvelous skin helps the lungs in their task of purifying the blood, being able to absorb oxygen and exude carbonic acid gas although both in small quantities.

This is not to speak of the sebaceous glands which secrete wax for the ear passages, the interesting structure of the hair follicles, the arrangement of the papillæ and many other fascinating points open to the microscopist of time and taste, for our purpose throughout is to depart very little from those things which may be seen and grasped by the average, untrained observer.

Protection

It is not at all times easy to keep subjects from overlapping. Under this heading of Protection might be placed those various weapons of the mouth, foot, tail, etc., by which animals naturally defend themselves from attack, and also the protective coverings touched upon in the preceding chapter. But as these have been more fully discussed by themselves we shall limit this subject to but a single phase—that of *concealment*—and will consider this mainly in the light of those remarkable peculiarities of form or marking which so often surprise and delight the observer of animals. We must approach this subject with some care. "Cock-sureness" is a dangerous attitude in the amateur, for not every "Why" will find its easy answer. It is not safe to assume that we can explain all colors and markings upon a basis of protection, for many of them must be charged to sex-distinction and others to still more hidden reasons. But having thus cautioned, there still remains so great a field that we shall select but a few illustrations and let the reader continue at his own pleasure.

For our purpose it matters very little whether we charge these peculiarities to deliberate design or to the action of light and natural selection since the fact remains that such peculiarities *do* serve to protect, and that the animal generally acts as though aware of the protection.

The reader may have noticed that heretofore we have with one or two exceptions avoided the insect world. Insects, common as they are, are generally too small for the study of their parts to be possible without the skillful use of a microscope and we have tried to keep as far as possible within the range of the average observer. But in this subject we will relax our rule and notice a few in their entirety, since these offer some of the most remarkable examples.

The Tiger's Stripes

One of the really beautiful objects in nature is the tiger. Lithe, graceful, with long, sinuous lines, the very embodiment of alert, controlled power we cannot but admire, nor can it fail to surprise us at first that he should be so brilliantly marked. The tiger is a creature of stealth, not open chase. He must stalk his prey and concealment is needful. Why then has he a bright yellow coat, boldly streaked with irregular vertical stripes? We should have to go to India for our answer. There in his favorite haunts are the stretches of tall, dense jungle grass through which he roams almost invisible. Have you ever noticed the play of bright sunlight upon a field of grass or standing grain—how instinct the whole color effect is with a kind of vibration, or life, very difficult to reproduce on canvas? This is because of the infinite number of vertical shadows, continuously shifting position and dancing in and out

among the "high lights" as the blades quiver in the stirring air, but hardly analyzed by one who sees the whole effect in a single glance.

Upon a larger scale the bright glare of the Indian sun upon the tall, coarse blades of this jungle grass is copied in the yellow sunlight of the tiger's skin, and their long moving shadows reappear so faithfully in his vertical stripes that it takes an experienced eye to distinguish his figure from its surroundings. Even the tail is ringed crosswise to its length, so that when lying upon the ground or extended in a stealthy approach the "shadows" still are vertical.

The Leopard's Spots

Another savage cat, the leopard, presents a striking coat, marked from head to tail with many sharply-defined, dark spots which also seem natural enough upon reflection. If the tiger's long stripes resemble the shadows of tall grass, some other kind of shadow may be indicated by such spots—and what could these be but the mottling shade of leaves? We are not then surprised to learn that the leopard is logical enough to spend much of his time in the trees, where stretched upon a limb near some animal trail, he may remain unnoticed although in sight.

The Fawn's Spots

The young among the deer are also almost universally spotted but with many small white spots, instead of the dark markings of the leopards. In maturity these spots disappear save in a few varieties, and some of these such as the sikas and swamp-deer of Asia are spotted only in Summer time. All of this is significant and has a protective value.

The full-grown deer is famous for its swiftness and what with its horns and sharp hoofs is well armed for defense, but the fawn can only hide in the brush and lie motionless in the hope of escaping notice. In the thicker parts of the forest, sunlight reaches the ground only in flecks and spots through the leaves while white wildflowers are abundant, so that the fawn, brown like the brown-stemmed bushes and flecked with white, may well be passed by.

Later, when old enough and strong enough to face the danger with his horns or fly from it in a magnificent burst of speed he does not need to depend upon concealment, but even then his brown coat is inconspicuous among the tree-trunks and his pronged antlers bear a strong resemblance to dead branches.

The Varying Hare's Coat

When winter comes on in our northern latitudes, the landscape undergoes a change. Protecting leaves have

already fluttered from the branches to the ground, there gradually to resolve into loam and await the time when, reabsorbed by the roots, they shall mount once more to the branches in their own slow cycle. Meanwhile the forest stands bare and open, with a white background of snow. The creatures meet this changed condition in various ways. Some fortunate tourists spread their wings and fly away to their favorite resorts in the South. Others lay on an extra supply of fat in the fall and then crawl contentedly into warm holes for a winter's sleep. But there are a certain few which brave out the cold and snows with the kind assistance of Nature who has given them a coat for the purpose. Among them is our little friend the varying hare. Reddish brown during the warmer months, he begins to shed his summer coat late in the fall when the new and warmer winter coat is making its growth. This latter is spotlessly white and so the owner while mottled for a little time, becomes white by the time snowstorms are due. Thus when the background of Nature has changed to its winter guise he is as inconspicuous as ever, and even a keen-eyed hawk would find him hard to distinguish against the snow. With this excellent chance to remain uneaten through the winter Spring finds him commencing again to shed his heavier coat and display patches of brown through the white, at about the time when bare ground and dead leaves begin to show brown through the melting snows. Save for exceptional seasons it is

interesting to note how he changes like a little timepiece regulated to Nature's great clock of the changing Seasons.

His deadly enemy, the ermine, and some of the winter birds like the ptarmigan show similar change.

The Arctic Hare's Coat

This larger cousin of the varying hare keeps to his white the whole year round, and proves himself a polar explorer of the best description. With wonderful hardiness he is able to resist the cold and find a scanty living in lichens, stoneworts and the other slight vegetable growths of those frozen regions. Where snow is present so much of the year he finds it not worth his while to change his color, and his fellow-polar-citizens, the polar bear and snowy owl, keep likewise to their white, although the arctic fox spends some of his twelve months in grayish blue or brown.

The Ant-Eater's Tail

Down again from the Arctics to the Tropics our previous acquaintance, the giant ant-eater, has a very different problem from that of blending with snow and ice. Living entirely upon the ground, too large to be easily hidden and not active enough to escape, his advantage comes in the possession of a very large brush-like tail of long, coarse hair. With this he covers himself when curling

up upon the ground and the passerby would be merely conscious of such a plausible heap of dry grass that it would seem hardly worth further examination.

The Sloth's Protection

In our Chapter on Feet we had a glimpse at this remarkable animal, and certainly if there is one inoffensive and indefensive creature in the whole Kingdom it is this topsy-turvy one. He is ordinarily hidden among dense foliage, with too little motion to attract attention, while he sleeps, still hanging, but with his feet drawn close together and his head placed between his forelegs. Thus he loses all animal outline and might be taken for the stump of a bough. But there is one most interesting provision that helps still further. The sloth has hair which is not only long and coarse but peculiarly grooved, and in these grooves there lodges a small vegetable growth, a form of alga, which encrusts the coat with a greenish hue. Thus, sleeping throughout the day, the sloth is extremely hard to recognize as an animal even though seen.

The Colugo and Koala

Here are two other small creatures which have a somewhat similar protection. Seen awake they are about as unlike as two creatures could be, and neither is related to the sloth, but all three are largely night-moving animals which sleep in the trees during daytime. The colugo, or

cobego, at first sight suggests the bat, with its broad membranes until we notice that these constitute a gliding, not a flying, device to carry it in great leaps from tree to tree where it feeds upon the leaves. When ready to sleep it merely hooks to a branch with its closely drawn feet, tucks in its head and makes no further effort at concealment but its shape thus suspended is so strongly suggestive of some kind of fruit that most observers would be quite deceived.

The koala, on the other hand, is a quaint little marsupial from Australia where he is called the native bear. In reality he has no connection with the bears but is a chunky, deliberate little fellow which browses among tree-tops like the other two. In sleeping he does not suspend himself but hugs tightly the supporting branch and tucking in his head is at once "in bed." Thus seen he is only a rounded moss-like mass, like the parasitic tree-growths of his native trees.

The Night-Jar's Position

Another night-feeder, a bird this time, is found in our familiar night-jar, which skims moths and beetles from the air in the hours of darkness and then retires for rest and digestion when most of the world is astir. Sometimes it hides in ground cover but if, as often, it chooses a branch it avoids those of perching size and clings lengthwise to a thick limb. Here it blends perfectly in color, shape and marking with the bark.

The Bob-White's Color

As a general rule the ground-living birds cannot indulge in the bright colors of many which live in the tree-tops where they are more difficult to approach. Our sober little bob-whites are surely not garbed to attract attention. Speaking of them, Mr. Job in his interesting "Sport of Bird Study," says: "Once, in September, I saw a number of them on a stone wall. They flew down as I drove by, into some bushes close at hand, and I hitched the horse and went after them. Standing on the wall, I studied over the ground under the bushes very carefully, but could not make out a single bird. But when I tossed in a big stone up they all went like rockets, nearly twenty of them, right from the very place I had so carefully examined.

"How well they are protected by their colors I once had a fine chance to see. A single bird flushed before the hunting dogs and took to a patch of scrub pines. I went in to look for it and, as I was standing where the shade was dense but the ground clear of undergrowth, I happened to see it lying flat on the ground on the smooth carpet of pine needles, only two or three steps from me. Before I had time to get my camera ready it realized that it was discovered and flew off."

The bob-white with brown or chestnut back and sides shading down to buff or white on the under parts, is a good example of another interesting fact in protecting

coloration, viz.: that those parts upon which the light shines most strongly are usually darkest while the body is colored lightest where naturally in shadow, *thus counteracting the darkening effect of such shadow*. Mr. Abbot H. Thayer in a series of experiments with wooden decoys proved this conclusively. These figures, in size and shape like a woodcock's body, were placed upon wire uprights standing about 6 inches above the ground. One was colored uniformly, above and below like the earth. The others were similarly colored for the upper half but graded down to pure white beneath. When approached from a distance, the uniformly-colored decoy could be plainly seen from a distance of forty or fifty yards, while the others remained completely invisible until the observer came within ten yards.

The confidence of birds and other creatures in their own invisibility is striking. Mr. Chapman cites the case of one woodcock which "sat tight" and even permitted itself to be stroked without leaving the nest, but when a light snow fell the bird seemed to recognize that it was now a dark object against a white background and became suspiciously wary.

The Phalarope's Livery

Almost everyone has noted the fact that among birds the female is so much more plainly clad than the dashing male, whereby it comes that those ladies of our superior

race who will wear bright feathers, must borrow male plumage for the purpose. This rule is so general among the birds that its reason must be apparent upon a moment's thought, viz.: that the hen-bird sitting patiently upon her nest, would be an easy prey for enemies, and would attract them also to her eggs, were not her color such as to escape notice. The preservation of the species depends upon that nest being kept undisturbed while there is transpiring within each shell the sacred mystery of transformation from "yolk and white" to a hungry little birdling. And yet Nature's real love of brightness is shown by the way in which she often lavishes color upon the male. Too active to need protection, with the freedom of the wide air for his range he is fitted to express to us other aspects of Nature than mere prudence and efficiency as he dances from our tree-tops, a flash of beauty and a burst of song. There is more in Life than living, he seems to say.

But general rules have oft-times their exception, and one such is that of the henpecked little phalarope male, dull-colored and demure, staying at home with the housework, i.e., incubating the eggs, while his wife wears the bright plumage, does the wooing and otherwise conducts herself like a triumphant suffragette. Even in this case, however, Nature has preserved the principle of protection for the nest.

There are still other exceptions, wherein both sexes are brightly colored, but here the usual custom is to build

the nest in a hole where it cannot be seen. The king-fishers with their nest in the bank of some stream are an example.

The Tern's Eggs

With some birds the eggs lack the concealment of nests or holes and hence must be given other protection. Such a case is that of the tern which deposits its eggs among the sand and pebbles of the beach where they have so much the coloring and general appearance of waterworn pebbles, that one must look carefully to make them out.

The Young Koel's Livery

There is an outrageous habit among certain members of the cuckoo family of shirking parental cares by laying their eggs in the nests of other birds. The gullibility of some of these other birds seems boundless, and makes one wonder whether the bright-looking little creatures are nearly as bright as they look. There are some cases, however, in which a degree of protection appears to be afforded. One of these is that of the great spotted cuckoo of Southern Europe, which chooses to invade the homes of certain crows and magpies. Now crows and magpies are no fools, as everyone knows, but they seem to be poor at figures for the cuckoo does not hesitate to leave several eggs among those of the rightful owners, which they

resemble closely, and these are apparently accepted without question. Later when hatched the small intruders by behaving themselves and not ejecting the rightful heirs, as do some kinds of young cuckoos seem to earn the right to stay on amicably with the others.

But this protection is carried one step farther in the case of another number of this interesting, disreputable family. This is the koel, of the Philippine Islands, and it selects the myna's nest for its invasion. The mynas are black and their young are also black, hence the "color line" is strictly drawn in their homes. Among the koels the male is black and the female brown. Since it is the common thing among birds for the young to wear the color of the female here is an obvious difficulty, but it is solved by the young koels reversing this rule and appearing black like the male, thereby conforming to the tastes of the mynas which seem thus willing to accept them.

The Moulting Mallard

While birds offer many illustrations of protective coloring we will take but one other feathered example since it presents a little variation of the subject. The male mallard is a bright, conspicuous fellow, with his dark, glossy head, yellow bill, white collar, chestnut breast and grayish-white body. His safety lies largely in his strong power of flight and he concerns himself very slightly with the family cares of his brown little mate. But when he

moults all of this jaunty self-confidence slips from him, for the strong "flight-feathers" of his wings are shed simultaneously, instead of in the usual, slow succession, and thus he becomes helpless. Kind Nature then permits him a temporary dull coloring not unlike that of his neglected spouse, so that he is at least inconspicuous until the power of flight returns.

Frogs and Toads

Among Reptiles and Amphibians the instances are many. The brown log-like body of the alligator has already been referred to, the gray, horned toad of the West is as dusty in hue as his desert home and our familiar little hoppers reproduce the colors of their surroundings. The frog loves a green-edged pool where his color blends to perfection. If he choose to hang motionless in the water his very observant eyes might easily be mistaken for water bubbles, while if he come ashore his body is suggestive of a moss-covered stone. The little tree-frogs have the leafy green of the leaves and are not easy to distinguish. More familiar still, our common toad, good friend to every gardener by his destruction of the insect pests, is so completely like a lump of soil that he is often unseen while in plain sight unless he betray his presence by hopping. This dirt-colored coat not only protects him from his enemies, but also causes careless prey to venture within tongue-reach.

In some parts of South America is found a large, brightly-marked "horned frog," which forms something of an exception to the general rule of inconspicuous appearance, but this creature has other resources. After the mating season he is said to retire to some moist place in which he buries himself until his broad back, green like the moss-covered ground, is the only part to be seen and here awaits the approach of anything edible.

The Changeable Chameleon

This odd little fellow is the most famous "turn-coat" in the whole Kingdom although several other lizards have nearly equal powers. But the chameleon is so picturesque in so many respects that he seems almost an animated joke, With his separately rolling eyes, which are skin-covered and perforated with tiny openings at the apex, his parrot-feet, his prehensile tail, his absurdly slow movements, his extraordinary tongue, his pompous puffing when enraged and lastly his power of changing tints he is interesting from every point of view. This coloring property is popularly over-estimated and many people give him credit for instantly matching any brilliant background, but as the showman said about an elephant walking on his hind legs: "The wonder is not that he doesn't do it better, but that he can do it at all."

The chameleon cannot become vermilion or turquoise to order, but within a range of certain shades of

green, blue, yellow and gray, it is truly wonderful to see the small body slowly change its hue when shifted from one background to another. He has also some control over certain spots or markings and altogether is one of the quaintest objects in animal study.

The Fish's Tints

Protective coloring is widespread among fishes. Our most common varieties have a dark back and light-colored belly. Looked at from above, the back shades into the darkness of the water, while an enemy from below would look upward toward the light against which the light undercolor would be less conspicuous. A dead fish, however, undergoes internal changes which disturb its balance so that it floats belly-upward on the surface and becomes a noticeable object—apt quickly to attract some of Nature's scavengers. Thus the water is kept from pollution. The reed-haunting yellow perch has vertical stripes. Brilliant-hued fish haunt the bright coral formations of tropical seas with their gaudy marine growths. Some fish harmonize with rocky bottoms, others are of the color of mud and sand-tinted flat fish are found resting upon the sand.

Many fish have also something of the chameleon's power of changing color.

Shapes Among Fishes

In form as well there is a considerable range of concealment. With most forms of fish the chief dependence is upon activity and the shape is best adapted to movement, but this is not true of all. Flounders, skates and others of the broad flat fish are protected by shape as well as color, as they lie spread out upon the bottom of which they seem a part. Slender, dainty pipefish and sea-horses twist their tails about a stalk and sway in the current like some form of sea-growth, and one species, the "fucous-like sea-horse," has remarkable leaf-like processes or streamers upon its body which bear a wonderful resemblance to sea-weed.

On the other hand, there is that monster known as the angler fish, already referred to in our chapter on "Mouths," which lies among the rocks of the bottom with their coating of marine growths and wonderfully reproduces them at every point. Squat and rocklike in outline and body color, its surface is marked out in irregular polygonal areas after the manner of the growth of a compound tunicate common to rocks, its eyes are close imitations of the rock-barnacle's shell, and to complete the deception its body is clothed with various filaments which wave in the water currents like sea-weed. It is small wonder that careless fish, having found food on other similar rocks should pause to nibble at the tempting vegetation only to disappear into the vast mouth which yawns beneath them. These are but a few instances.

The Cuttle-Fish's Cloud

Among the fishes but not of them, and a mollusk despite its name, the cuttle-fish, that uncanny, many-armed creature of the waters, furnishes food for canaries and a color for artists. This sounds truly incongruous and yet we all know how the canary appreciates his piece of cuttle-bone from which to pick bits of limey food, while sepia is too familiar to need introduction. But this latter has a value, not artistic, to the cuttle-fish for its original purpose is to cloud the waters. When the creature believes itself in danger it has the power to force from a large gland called the "ink-bag," a dense cloud of this dark fluid which so obscures the water as to permit escape.

This, however, is for more active defense, and the cuttle has additional protective coloring and power of changes to a very remarkable degree. One observer (Matthias Dunn) says:

"Considering the home and life of these creatures, there can be no doubt that in our shallow waters, where masses of red, olive and green sea-weed abound with their varying shades, interspersed here and there with jutting rocks and neutral sands, at times when the sunshine is on them they must present vistas of harmonious and unique beauty. And further, outside the laminarian zone, or the range of the sea-weeds, amid the many varieties of the sea-bottom, where the hoary, rocky pinnacles pierce up

through the blue seas, where patches of gray sand lie here and there in contrast to these looming heights and stretching shadows, and where all is toned and softened by the sun throwing its dim light on countless millions of red Gorgonia, creamy Alcyonidæ and white bivalves, in the sometime quiet of this oceanic sylvan wilderness, there must be a dreamy condition of stillness and color almost impossible elsewhere.

"In regions like these the *elodene* (cuttle) lives. To match and blend with all these gradations of tints and hues, when wandering through these vales of beauty, so as to be prepared for the worst and to evade their piratical and plunderous enemies, these cuttles have at will a great variety of vanishing and fleeting colors, many of which I have seen displayed. Among them I have noticed a bright mahogany on the back with a whitish blue on the chest; also reddish streaks running down the back and sides, fitted in with bluish gray, the latter color covering the under part of the mouth; also a chocolate red on the back with a green chest and surroundings; then a French gray color on the back mottled with a creamy white throughout.

"I have seen, too, a mottled skin of salmon color and gray with flashes of spotted green, the green showing brightest on the web between the arms. Another color has been a heliotrope on the back, with peacock blue mixed with salmon below, and these were all made to move and shade into each other as freely and gently as the blushes

on a lady's face; while at other times they could be so suddenly mixed and fused together as to be beyond any description of mine."

The Walking-Stick

Crabs, shell-fish, spiders and a great variety of other forms of life are frequently protectively colored or shaped but it is in the great world of Insects, systematically neglected in our other Chapters, that the most remarkable examples of all are met with and of these we can glance at very few.

There is always a feeling of surprise, almost of incredulity, when looking through dead twigs and other small ground litter, to see one of the smallest and deadest-looking of all march off with angular movements. Had it not moved we might have looked at it steadily without suspecting that it was really an insect, and very much alive at that. The walking-stick is literally in appearance, what its name suggests and, while common enough, is one of the truest curiosities in Nature's Museum.

The Leaf-Winged Insect

The dust-colored locust in the country road, invisible until it spreads its wings in alarm, the green grass-hopper in the grass, the fairy katydid upon a leaf, the bright-winged butterflies among the blossoms, the various brown and gray trunk insects upon the trees, these are all familiar examples. There is one common though generally

unnoticed little leaf-hopper, the echinopa binotata which bears such a horn-like projection upon its head as almost exactly to resemble a thorn when squatting closely against a stem; some caterpillars assume sticklike attitudes, and many other instances might be cited; but perhaps most curious of all is an Oriental butterfly which gives a wonderful imitation of a leaf. Its folded wings have precisely the curving, pointed outline of a leaf, they are marked by a dark central line like the midrib and branching from this are the appearances of the leaf's side veining. When the butterfly is at rest this insect-leaf stands at exactly the proper angle to the branch and practically defies detection, for the head and antennæ are hidden from view. Most wonderful of all the coloring is that of a dead and not a living leaf—one in process of decay. These butterflies vary considerably in their markings as would such leaves and show different combinations of browns, grays, with blotches of apparent mildew, the powdery black spots of tiny fungus or even holes, and they never alight save among dead leaves. In flight, however, they are entirely different creatures, since the upper surfaces of their unfolded wings are rich with orange and blue.

The walking-leaf insect of the East Indies is only less remarkable and resembles a living, green leaf most faithfully.

Insect Mimicry

In bringing this subject to a close there is one entirely different phase which must not be overlooked. This is the way in which some insects imitate, not their surroundings but other insects. In fact this principle is not unknown among snakes and even birds. In speaking thus we are not implying conscious mimicry nor discussing the processes of natural selection which may have perfected them, but merely in terms of convenience of the effects themselves.

It has come to pass that certain insects are protected from their natural hunters by disagreeable characteristics, and it is furthermore found that in many cases there are other insects without these characteristics, which reproduce the former so closely in appearance as also to be free from attack.

One of the most wonderful cases of this kind is that of the heliconidæ and the leptalides. The first-named are showy, slow-flying butterflies which could be easily captured by many of the butterfly-eating birds and yet are not molested. This is probably due to a strongly pungent, yellowish fluid which fills their body, and seems highly nauseous to birds. Therefore, they have learned to let them severely alone. In the same South American forests are found the second-named butterflies, the leptalides, having none of this peculiarity and therefore presumably acceptable dainties to a bird palate, but the resemblance to the heliconidæ is so great that birds are rarely willing to

take the chance. "Give them a wide berth— do not meddle with anything even resembling the disgusting creatures," seems to be the tradition of the forests, and the happy, inoffensive leptalis is thus a strange beneficiary.

In a similar way some of the wasps, bees and beetles have their imitators, and a large caterpillar bears a close resemblance to a certain small but poisonous snake.

Perhaps there is no more fitting point at which to leave the subject of "Whys" than with the thought of "Protection." Vistas for the exercise of wholesome curiosity open up in so many directions that the foregoing Chapters must be considered as the merest introduction. But the inviting field of Nature lies before us, rich with information, teeming with reasons and welcoming the investigator to a close and delightful intimacy.

THE END