

Stories of Insects and Other Bugs

NATURE SERIES

SELECTED AUTHORS

Stories of Insects

Selected Authors

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Stories of Insects

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Table of Contents

Wonderful Little Lives 1

The Lucky Little Grass Hopper 3

The Adventures of an Earthworm 16

Mischievous Madam Mosquito 29

The Most Beautiful One in the Garden 40

The Untidy Fly 57

The Spider Who Would A-Hunting Go 69

This is the House the Ant Built 83

How Doth the Little Busy Bee 99

Stories of Insect Life 115

Our Insect Musicians 117

The Songs of the Katydids 122

The Firefly 126

A Queer Little Nursery 130

An Insect Mother and Her Brood 135

The Life History of a Ladybird Beetle 138

The Usefulness of Ladybirds 141

The Tomato Worms 144

The Preying Mantis 148

The Tent Caterpillars and Their Nests 153

The Moth and Its Eggs 156

The Tent Caterpillar Parasite 159

The Common Potato Beetle 160

Table of Contents Continued

Cecil's Book of Insects 163

About Ants 165

About Bees.....184

About Spiders 205

About Dragon-flies.....220

About Wasps.....235

About Locusts 245

About Mosquitoes.....253

About Beetles.....261

About Butterflies 277

Wonderful Little Lives

The Lucky Little Grass Hopper

I. Grasshopper Green Learns to Jump

There was once a beautiful garden, and in the garden grew all sorts of delightful things. Blackberry vines spread in a tangle over the stone wall. An old apple tree stood beside a summer-house covered with climbing roses. A row of currant bushes stretched along the grape arbor. Violets and hepaticas bloomed beneath the cherry trees. Peach trees lifted their low branches in sheltered corners. Lilacs bordered the gravel paths, and peonies were planted here and there on the sunny lawn.

But trees and flowers were not the only delightful things that grew in the garden. Ah, no, indeed! This garden was the home of many wonderful little creatures. Butterflies hovered over the flowers. Bees hummed about the blossoming fruit trees. Ants hurried to and fro around their brown hills at the edge of the path, and pretty spiders with glistening eyes spun their silken webs from leaf to leaf.

Filmy-winged mosquitoes flitted out at twilight. Now and then a fly on its way to the cottage at one end of the garden rested for a moment on a budding twig. A fat toad blinked solemnly out from its hole under a stone. A nestful of young birds twittered in every tree overhead, and in the ground under foot hundreds of earthworms patiently burrowed their way hither and thither, making fresh soil for the garden.

Oh, this garden was a pleasant place in the gay spring weather, when Grasshopper Green came there to live! Now where do you suppose he came from? He came right up out of the ground.

All night long the warm spring rain had been falling gently. It trickled over the young leaves on the trees. It sent tiny beads of water rolling down the new blades of grass, and it soaked into the loose brown soil of the freshly spaded flower-beds.

Before dawn the clouds drifted away, leaving the sky clear blue. When the sun rose, it twinkled upon many a new little leaf that had uncurled during the night. The grass had grown longer. The cherry trees had budded. The violets were almost in bloom. Here and there, in the brown beds, the stem of a seedling was pulling its tip of folded leaflets from the soil.

On the lawn beyond the path a robin redbreast was hunting for earthworms. He cocked his head on one side and stood still for a moment, with his bright eyes searching the ground. Then he gave a quick little run across the grass and darted his beak down to catch a mouthful of breakfast.

Presently he scuttled across to the lettuce bed, and braced himself to drag out a worm that had hooked its tail bristles into the top of its burrow. It was lucky that he had his back to the path, and could not see something that began to stir at the edge of the gravel.

Something alive was pushing up from under the ground. It was not a plant, because a plant either comes pricking straight through with the pointed tip of its rolled up leaves, like a spear of corn, or else it heaves up its humped stem slowly and steadily, as a bean seedling does. But this was different. A bit of the hard soil rose slowly in a tiny arch and then suddenly cracked open. Out of the crack peered two round eyes in a funny little face. It was a baby grasshopper.

The mother grasshopper had laid her eggs just under the surface of the soil the autumn before. Now, when the warm spring days had come, her babies began to hatch out and push blindly up toward the air and light.

This lively fellow kicked his way out, waved the two thread-like feelers in front of his eyes, lifted his two front legs to wipe the dirt from his face, shook his two middle legs clean, and scraped his two hind legs over his back. Then he started out to see the world.

As I have told you before, it was lucky for him that the robin was so busy swallowing the worm that he did not pay any attention to the newcomer. All birds are fond of grasshoppers for breakfast—or for dinner or any other meal, doubtless.

After resting a moment to breathe the air into his wee body, the young grasshopper began to walk forward with all six of his legs till he reached the grassy border of the lettuce bed. Of course he was looking for something to

eat; that is what every baby wants the very first thing. When his feelers touched the nearest blade of grass, he gave them a twitch and went climbing straight up the stem.

Now how do you suppose he could do that without slipping down? It was because each of his feet had two claws, and between the two claws was a flat little pad fringed with hairs. When he climbed up the grass blade, he stuck his claws into it. From the tip of every hair on each pad oozed a drop of sticky stuff that fastened his foot firm till he was ready to lift it to take another step.

So up the grass he walked, and began to eat. His mouth was on the under side of his big little head, ready to bite off and chew whatever he found good to eat. The most convenient thing to eat was the very grass on which he was standing. He opened his strong little jaws, took a bite and chewed it fine and swallowed it.

He kept on biting out pieces and chewing them up fine and swallowing them till he had eaten a scallop out of the edge of the leaf. Then he walked on farther and bit out another scallop. He was having the best kind of a time, with his jaws going chump, chump, chump. The more he ate, the sooner he would grow to be a big grasshopper with wings as well as legs. Even as a baby he looked a good deal like his father, except that he was so much smaller and had no wings at all.

When evening came, he swung around underneath the blade of grass and glued his feet fast so that he might not fall off while he was asleep. Early in the morning he woke up slowly, but he did not move for quite a while. The cool air made him feel stiff at first. Or it may be that his wee jaws ached somewhat after his busy chewing of the day before.

By and by, as the sun's rays became warmer, he stirred drowsily and stretched out his long hind legs, combing one with the other. Yes, indeed, he could really use them like combs, for the longest slender joint of each one had a row of sharp spines like the teeth of a comb. He could rub them over his small green body too, brushing off every speck of dust. They were remarkable legs. Only fancy! As soon as he grew up, he would be able to sing with them. But best and most important of all to him was their power of jumping. Little Grasshopper Green was the champion jumper of the whole garden.

However on this particular morning he did not yet know that he could jump. He had never even tried it. He just went crawling over the grass-blade step by step, with his hind legs folded so that the knees hunched high above his back. His knees bent in the opposite direction from the way ours do. His knees were the best kind for him, and ours are the best kind for us.

When he reached the tip of the leaf he drew both legs close to his body and then suddenly straightened them

out. Away he went flying through the air as if he had been shot from a spring-board.

That must have been surprising. He landed with a bump right in the middle of the lettuce bed. It may be that the jar made him a bit dizzy at first. As soon as his head felt steady again, he found a tender young lettuce plant just under his mouth. He opened his jaws and took a big bite. Oh! but it tasted delicious. So he ate and ate till he ate it all up, way down to the ground.

Then he hunted for another plant, and ate that too. Some of his many brothers and sisters were already eating the lettuce. There was hardly enough to go around, for the plants had not had time to grow much yet. Before long every bit of green leaf had been eaten up by the hungry small creatures.

When Grasshopper Green could not find another bite anywhere near, he drew up his hind legs close to his body, and then quickly straightened them out. Away he sailed through the air again. This time he came down ker-plunk on a hard pebble in the middle of the garden path. If he had held his legs stiff and straight, instead of bending them at their limber joints, he might have broken a pair or two. You know how it shakes you up and down your spine if you land without bending your knees after taking a jump. You have to be taught how to jump in the right way, but the grasshopper knew how from the very first day of his life.

After touching the pebble with his feelers and deciding that it was not good to eat, he jumped again. This time, though he jumped in the right way, he came down in the wrong place. Oh, it was about the most dangerous spot for him in the whole garden. It was right in front of a hen that had flown over the wall and was scratching in the path.

There was a surprised cluck followed by a whirr of feathers and a scamper of two stout feet. Her wide yellow beak came swooping downward. He did not stop to think. He did not know who she was or what she wanted, for he had never met a hen before. But he felt the rush of air as she scuttled toward him, and he drew up his legs exactly in time, because somehow he thought that he had better be going. Away he shot over her head just as her beak snapped shut on a mouthful of gravel snatched from the spot where he had been standing half a moment before.

II. Grasshopper Green Learns to Fly

Soon after this narrow escape, a strange thing happened. This was the way of it. He kept on eating and eating and eating, and the more he ate, the fatter he grew. The fatter he grew, the tighter his skin seemed. The skin of an insect is made of horny stuff that never grows after it once hardens on the outside of its small owner. Naturally the bigger he grew inside his skin, the more pinched and uncomfortable he felt. Finally—what do you suppose?—his skin cracked and split open. He crawled outside of his own skin and pushed it off all his legs. There he was in a

soft new skin that had been growing underneath the old one.

The new skin was bright and fresh, and plenty big enough to fit without squeezing him. He waited a few minutes till it had hardened in the air, because it was dangerous for him to go out to eat while his skin was still soft. If he had done that, he might have hurt himself by bumping against a stick or a stone. Or a sharp tip of a grass blade might have pricked clear through his body when he came down after a long jump. He never knew where he would land.

He wore this new skin till he grew too big for it. Then it split as the first had done, and he crawled out in a newer, larger suit. He kept on in this way for two or three months till he was entirely grown up. Meanwhile he had changed his skin five or six times. After the first change, his wings began to grow. Each new skin had larger wings, till at last they were big enough to use in flying. His body was grayish green, and his wings were brown.

Ah, but that was delightful! It was better than jumping. The first time he tried them, perhaps he meant only to jump. He drew up his long hind legs and straightened them out as usual. When he was high in the air, somehow his wings spread open and away he went whirring for the longest jump he ever had taken yet.

He really had two pairs of wings. One pair were straight and stiff and hard. While he was flying, this pair

were spread out and hooked so that they would stay open. Beneath them were two gauzy wings. He flew with these, beating them to and fro very fast. When he stopped moving them, they folded up like fans close to his body. The two stiff wings unhooked and shut down close over the flying wings. These wing-covers, as they are called, kept the gauzy wings from getting scratched and torn.

One summer afternoon, when the garden lay drowsing in the sunshine and even the birds were quiet among the branches overhead, suddenly the young grasshopper began to sing. Shrill and loud his song rose in the stillness,—fizz, fizz, fizz! Then it stopped all at once. Maybe he was astonished at himself. He did not sing from his mouth and throat. He was only standing in a tuft of grass and rubbing the broad joint of his long hind legs against the edge of his folded wing-covers. He may have been lonely there all by himself. He sang so that some other grasshopper might know where to find him.

But his song was so loud that something else heard him too. A bird darted down from the boughs of a maple tree and fluttered above the spot where Grasshopper Green was singing. She wanted to catch him to feed to her nestful of hungry young ones. She went hopping around, hunting for him.

Grasshopper Green saw her shadow flitting hither and thither. He could hear the rustle of her wings and the patter of her feet. He stopped singing and sat so still that

he seemed like a bit of wood or grass himself. Perhaps she would not notice him, for a bird cannot see motionless things nearly so well as those that are moving.

But nearer and nearer she hopped, now pecking at a twig, now twitching at a leaf, now cocking her head to look under a drooping blade of green. Tap, tap, tap! She was hammering at a pebble wedged among the roots of the sod. A small spider ran from beneath it and scampered farther into the fairy wilderness of tall thick grasses where the grasshopper was hiding. Mother Bird darted after him, stretching out her neck and opening her bill.

Grasshopper Green heard her coming. He was so frightened that he could not keep still another instant. He drew up his legs suddenly. Ah! she had spied him. That small ridged bump there was not a twig at all. It was a fat, delicious little grasshopper. Forgetting about the fleeing many-legged brown spider, she made a swift dash toward the juicy morsel within easy reach.

Snap! She had missed him as he jumped. But a moment later she was flying after him. Swoop! She had caught him by the tip of one whirring wing. Flap, flap, flap! he beat the other to and fro as he twisted and squirmed to get free. It was lucky for him that these gauzy wings were so delicate and easily torn. Before Mother Bird could seize a firmer grip, the sharp edges of her beak had snipped through the frail bit of gauze. Down dropped Grasshopper Green to the ground and quickly slid under a leaf to hide.

Just then the biggest baby bird in the nest in the maple gave such a shrill peep that his mother flew home as fast as she could to see what was the matter. Really the only trouble was that the little fellow thought he was starving and could not wait another minute for something to eat. It would have been better for him if he had kept quiet a moment longer till his mother had caught the grasshopper. Now, after losing so much time, she could not find him, though she hunted under every leaf near the spot where he had dropped. He had already taken a fresh jump upward and gone sailing away toward the row of currant bushes. His wings were quite as useful as before, even if one of them did have a ragged notch in its tip.

All summer long Grasshopper Green lived in the beautiful garden. Every day was filled with exciting escapes. Many a time he was chased by a hungry bird, or snapped at by a greedy dragon-fly. More than once he just missed being gobbled down by the old toad that sat blinking in shady corners. Two or three times, after a joyous whirring flight above the flowers, he landed plump in the middle of a spider's thick silky web. He always managed to kick loose from the entangling threads before the owner came hurrying to see what she had caught in her snare.

He had a chance to get acquainted with all the small creatures who shared the garden with him. When he went walking, he could meet those who lived on the ground. When he went flying, he could see those who spent their

time in the air. Sometimes he swung on a grass blade beside a hungry caterpillar. Sometimes he crawled from leaf to leaf of a plant where ants were hurrying busily to and fro.

Once he met a little cousin of his own who happened to come jumping over the stone wall on his way toward a meadow near a pond some distance farther along. This visitor's slender body was such a bright green that it made our garden grasshopper look a dusty brown beside him. He was different, too, in having much longer feelers. Perhaps he told how cool and delightful it was to live amid the tangled grasses in the damp meadow instead of in the garden.

But Grasshopper Green was too happy where he was to think of leaving his home. Very likely he might have felt different about it if he had not had plenty to eat. Some years, when thousands and thousands of his brothers hatch out all at once in the mountain parks, they cannot find enough food there. So, after devouring every leaf, they rise in the air and fly in an immense whirring cloud toward the green farms on the prairies. They march on over the land, like a hungry army, leaving the trees stripped and the fields bare behind them.

Our grasshopper, however, was almost the only one who lived to grow up in the garden this summer, and his small jaws could not do much harm. No wonder he was contented! Every day brought some new excitement.

Now he jumped this way to find a tender leaf to eat. Now he jumped that way to avoid being eaten himself. Hither and thither he flew, this minute hopping into danger, and the next minute hopping out of it again. Indeed, you see, Grasshopper Green was a lucky young fellow to have been born in this beautiful garden.

The Adventures of an Earthworm

I. How He Walked Without Legs

One evening when Grasshopper Green was fast asleep, with his feet glued safely to the under side of a grapevine leaf, a new little creature came squirming up out of the ground below. It was a baby earthworm. He had hatched from a tiny egg buried in the soil. The first thing he did was to twist and wriggle this way and that as he pushed his pointed head up through the soft earth to the air above.

After he reached the top, he raised his head and swayed it to and fro to find out what the world was like. And now what do you think? He could not see a single thing, or hear a single sound. He had no eyes or ears or nose. He had no arms or legs. He was only a soft round worm with a bit of a mouth on the under side of his pointed head.

In the darkness he kept swaying to and fro. He could feel the damp air against his skin. Some of the air soaked into his body through tiny holes in his skin, ever so much tinier than the prick of a pin. The fresh air kept his blood red and pure. It made him feel happy and lively. He moved his head faster and pulled his tail out of the ground. He was ready to hunt for something to eat.

So he set out on his travels. Travelling was slow work for him, because he had no real legs to use in walking. The

best he could do was to wriggle over the ground with the help of some stiff little bristles that grew on his body. His body was made up of many joints or rings set close together. On each ring grew eight of these bristles.

When he wanted to travel, he stretched out his head as far as he could, and hooked the bristles nearest his head into the ground. Then he unhooked the bristles that had been holding him steady at his other end, and drew his body up thick and short. When he was as short as he could be, he dug his tail bristles into the ground to hold him steady again, while he stretched his body out long and thin. When he was as long as he could stretch, he dug in his front bristles again, and drew himself up short just as before. It was too hard work to be very much fun, you see.

Luckily for this wee worm, his mother had laid her eggs in the middle of a bed of onions beside the grape arbor. He had hardly wriggled two inches before he almost touched the stem of a young onion plant. He stopped and began to move his head to and fro, as if he were sniffing the onion. Perhaps he smelled it through his skin. When at last he really rubbed against the plant, he seized a bit between his upper and lower lip, and sucked it into his mouth. Ah, but it tasted delicious! So he swallowed it down as quickly as he could, and pinched off another bit of onion with his soft lips.

He swallowed each mouthful by squeezing it down his throat. He had no teeth for chewing, but after the food had

been swallowed, it was ground fine between specks of stones inside him. Very likely he had swallowed these specks of stones while he was pushing his way up from his empty egg shell to the air above. Now they were exactly what he needed for grinding up his food.

Of course he could eat much faster than if he had been obliged to stop and chew every bite. He ate and ate and ate, and his little body stretched out like India rubber to hold the food. When he was so round and tight and full that he felt almost as if he were going to burst, he stopped eating and rested for a while.

The baby earthworm lay quiet and happy under the onion plant. He was happy because he had eaten all he wanted, and because the dewy night air felt pleasant on his skin.

Far above him the stars twinkled in the sky; but he could not see them. A breeze whispered among the leaves of the trees in the garden; a bird overhead chirped sleepily; the grasses rustled here and there under the foot of some small hurrying creature. But the baby earthworm could not hear these sounds. He felt the earth under him, and the air around him, and the food inside him. And just then he did not care about anything else in the whole, wide, wonderful, beautiful world.

While he rested, the food inside his body was ground up fine and began to be changed into blood. The new blood made him grow a little larger. Even as a baby, you

know, he looked like the grown-up earthworms, except that his body had not so many rings. As he grew, he would have more rings; for the last ring at the end of his tail would divide into two rings. Pretty soon the last ring of the two new ones would divide into two, and then the last one of those two, and so on till he was all grown up.

On this very first night of his life, however, he did not grow fast enough to get a new ring right away. There would be plenty of time for that later. Now, as soon as he felt like working after his first meal of vegetables, he began to hunt around for a place to live.

II. How He Dug His House

In some wonderful way he knew just what to do, though he had never been taught. He had never watched any other worm dig a hole in which to live. And yet he set straight to work without pausing to think or plan. Indeed he could not think even if he tried to do so, because he did not have that kind of a brain. He simply went on without thinking and did the things that all earthworms do naturally because their parents have always done the same things.

First he stretched out his head and felt of the ground, now here, now there. He was hunting for a firm smooth spot where he might begin to dig. When he found it, he put his mouth down close to the earth, opened his lips, pinched off a mouthful, and swallowed it. Wasn't that an

astonishing way to dig! Then he took another bite, and another, and another, till he was full of dirt. He had eaten a hole in the ground. When he was so full that he could not swallow any more, he pressed his body small so that the dirt was squeezed out. He let this curlycue of earth fall outside, at the top of his hole. It was the shape of a tiny worm, and is called a worm-cast.

He dug all the rest of the night as hard as he could, because he was in a hurry to have a home of his own. Once in a while he found a speck of good food in the mouthfuls of earth. This food stayed in his body and helped to make new blood and give him strength to go on working. At intervals, very likely, he crawled to the onion plant and took a bite of it to cheer him on in his labor. He just loved onion!

At last, when his hole was almost deep enough to hide in, the sun rose. The wee worm had that minute carried a load of earth to the top and was emptying it outside. A level golden ray of sunlight shot across the sparkling dewdrops and glistened on the busy little brown body of the baby earthworm. Doubtless he had no idea what was causing him to feel so queer and feverish, for he had never before been in the sunshine, you know. He shrugged his ringed body and squirmed and twisted his tail, and lifted his head and swayed it to and fro. Then he wriggled back into the hole, and cuddled down as close as he could in the cool moist earth.

But that did not do him much good, for the sun rose higher and shone into the top of his little cave. In the queerest way he knew, without being told, exactly what he ought to do next. He reached out of the hole with his pointed head and took hold of a piece of dead grass with his lips. Then he pulled and pulled till he had dragged the grass to the opening of his hole, or burrow, as it is called. He pulled the pointed tip in as far as it would go. It covered the top so that the sunlight could not shine in. Finally, in his cool shady home the wise little worm curled down cosily and rested all day long.

Outside in the garden, the sun shone and the birds sang; the butterflies fluttered their lovely wings and the bees buzzed over the flowers. The grasshoppers swung on the grasses, and the spiders spun webs or went hunting. Under the ground the little earthworm, hidden in his new burrow, which he had dug all himself, lay quiet and waited for the dewy dark night.

When daylight faded and the air grew damp and cool, the young worm woke up and came squirming outdoors. The first thing he did was to hook the bristles at the end of his tail into the wall of his burrow. Then he stretched out his head, now this way, now that way, till he touched a leaf of onion. After eating all he wanted, he wriggled back into his hole and began to dig it bigger. He rubbed the inside of his house smooth with his slimy body. Something like glue oozed from his skin and covered the walls with a firm

lining. When he had finished it, he had the cosiest kind of a little home, just large enough for one.

III. How He Escaped With His Life

Nothing very exciting happened for a while. All day long he hid in his burrow, and all night long he worked and ate. Sometimes he dragged pieces of leaves inside his hole and ate them there. As he grew bigger and longer, he had to make his hole bigger and longer, too. And the longer he grew, the farther he could stretch to reach his supper. But by and by came a time when he had eaten every bit of green leaf within reach.

That night he stretched out his head as far as he possibly could stretch in a circle all around his hole. He could not find a single bite of anything good to eat. So what do you think that reckless little worm did then? He unhooked his tail from the top of the burrow, and wriggled away over the ground till he touched another onion plant. Then he ate and ate and ate till he nearly burst, for he was dreadfully hungry. After resting a time, he wanted to return to his home. He squirmed off in a hurry, but he never, never found his way back again. He had lost the first little burrow that he ever dug in his life.

So the next thing he had to do was to go to work and dig a new one. This new hole was like the other, except that it was larger and deeper. He dug it deeper, because the ground was getting dryer than it had been earlier in the summer. There were not so many showers to keep the soil

at the surface soft and moist. It made him feel sick to swallow dry soil. So he burrowed down deep where the earth was damp and pleasant to his skin.

One morning he had a terrible adventure. It was just at sunrise, and he had crawled into his burrow and lay resting near the top. The night had been rather chilly, and he felt a little numb. Though he certainly hated to be too hot, he also hated to be too cold. He was waiting perhaps for a bit of warmth from the sun to steal over him before he wriggled down to the deep end of the hole. Or it may be that he liked to stay near the dewy leaf that covered his door. Whatever was his reason, he was lying there quiet and comfortable, when suddenly something happened.

A quick patter of little claws, a swift twitch of the dewy leaf, and a robin's beak darted into the hole like lightning and snapped at the worm's soft head! That was a narrow escape. He had wriggled out of reach just in time. He squirmed on down to the bottom of his burrow as fast as he could go, and stayed there curled up safe and still till after the birds had all gone to sleep at night. Then he could come out and hunt for his own supper without getting into danger of being gobbled down by a hungry robin.

Anybody would think that such an experience would teach a worm to stay hidden at home in the daytime. But one queer thing about worms, and many other creatures, too, is that they never learn anything new no matter how long they live. When they are born they know as much as

their parents do, and they can never be taught anything more.

You could never imagine how foolishly that little worm acted one day. It had been raining all night in the garden. As soon as he knew that a shower was falling outside, that silly worm came wriggling out as fast as he could wriggle, and squirmed away over the wet ground. He did not even try to stay near enough so that he might possibly find his home again if he hunted carefully all around. He just went crawling on and on and on, without thinking what might happen when morning should dawn. He enjoyed being out in the rain.

He crawled across the onion-bed to a row of cabbages. There he stopped to take a few nibbles. Then he hurried on over the gravel path. On his way, he passed a drowned fly, and ate several mouthfuls of it, for he was fond of fresh meat. Once or twice he felt a soft round body exactly like his own wriggling against him, or under or over him. The rain had brought other earthworms out of their holes that night, and started them on their reckless wanderings.

Finally the rain ceased, the clouds drifted apart, and the sun rose. Our little worm lay stretched out pale and thin on the path. He was no longer dark-colored, because he had swallowed no earth for hours. His skin was so clear that his two veins full of blood showed red inside his body. He was so tired that he could hardly move.

But as the sunshine fell on him, he squirmed slowly on across the gravel, and dragged himself inch by inch on and on and on. He did not know what was ahead of him, or where he was going. All that he wanted was to wriggle somewhere out of the burning light and heat of the sun.

It was lucky for him that he happened to crawl toward a spot of soft loose soil where a root of celery had been pulled up the day before. He pushed his head beneath a wet lump of earth and drew the rest of his body on into the damp delightful dark little cave. There he rested all day, while out in the sunshine many other foolish worms dragged themselves blindly on in the glaring heat. Some were gobbled down by hungry birds, and others curled their aching little bodies round and round in tight coils, and lay still till they dried up and died. An earthworm cannot live a day in dry air.

After this our young worm dug another burrow for a new home. You see he really had to have a hiding-place to save him from his enemies. He had no shell to protect his soft body from being trampled on by animals or snapped up by a hungry bird. He had no teeth or sting with which to fight. He had no legs that he could use in running away from danger. The only thing he could do for safety was to hide in a hole.

IV. How He Helped the Garden to Grow

And what do you suppose! This is most wonderful of all. Earthworms help to make all the gardens in the world,

because they dig so many holes. They help by swallowing their bodies full of soil and carrying it up to the top of the ground when they dig their burrows. This makes the soil fine and rich so that plants can grow in it. The leaves which they drag into their burrows and tear into shreds make the soil rich too. There are so many millions of worms working in the ground that all together they dig up tons of earth and turn it over and mix it fine and make it rich.

Besides this, the air from above moves through their winding burrows and keeps the soil loose and sweet. When rain falls, part of the water trickles down deeper because of the holes. Some plants grow faster when their roots find the smooth little tunnels in which they may spread and branch. The deaf and dumb and blind little earthworm is the most useful of all the small creatures that live in the garden.

When our young worm had finished his new home, very likely he felt that he was safe there at last. He was careful not to lie too near the top in the morning, when robins were out hunting for their breakfasts. He was particular to hook his tail fast to the wall of his burrow whenever he went out in the evening. But one night a still more frightful adventure happened to him. He was chased by a mole.

It happened in this way. He had been working busily for hours in digging out a tiny room at the very bottom of his burrow. He wanted to get it ready for the winter, as the

summer was almost gone, and the nights were becoming long and chilly. He was pinching off one mouthful of earth after another, and swallowing them as fast as he could squeeze them down.

Doubtless he must have made some sort of noise under the ground there. Perhaps his squirmings and wrigglings and munchings sounded for inches through the earth around him. Well, anyhow, a hungry gray mole, who was making a tunnel through the celery-bed, heard the earthworm at work. She turned around in her tunnel and began to dig like mad in the direction of the sound. She was very fond of earthworms for dinner. She clawed away the dirt with her tiny shovel-like front paws, and kicked it out behind her furry little body as fast as she could dig.

Now, as she was almost as big as a rat, she could not help making a stir with her shovelling and kicking. The pounding and thumping shook the ground around the busy earthworm. The instant he felt it, he stopped eating and wriggled up out of that hole faster than he had ever wriggled before. Though he had never heard of a mole, something told him to get away from that spot as soon as he possibly could.

He squirmed up to the top of his burrow, and waited a moment. The thumping and pounding seemed nearer than before, so he wriggled away at his very best gait, stretching out his head and drawing up his tail, stretching out his head and drawing up his tail, stretching out his

head and drawing up his tail, till he bumped into a celery stalk and curled down to rest. He kept still and did not move even the ring at the tip of his tail. This was lucky for him, because the hungry mole had plowed her way clear up to the top of the worm's empty burrow and was poking out her head to sniff around in the dark at that very minute.

As soon as the earthworm felt able to work, he was obliged to dig another hole. This one he wanted to make deeper than any of the others, because winter was coming. In winter the ground freezes hard on top, just as water freezes into ice on the surface of a pond. Digging on a cool night in autumn was slow work, because the cold made the worm feel numb and lazy. Sometimes his soft body felt too stiff to stretch another inch. But he kept on burrowing deeper and deeper till he had finished a safe and cosy little room far down in the ground where the soil around would not freeze, even in the coldest weather.

When he was ready to begin his long winter sleep, he dragged some dead leaves into his new burrow and plugged up the opening so that the frosty air could not creep inside. Then he crawled down to the very bottom and curled up in a soft little brown bunch to sleep till the spring sunshine melted the frozen earth above him, and the warm sweet showers came trickling through the soil which he had helped to make.

Mischievous Madam Mosquito

I. Where the Little Wigglers Lived

One spring morning, long before the sun rose, a little mother mosquito went flitting over the garden. She was looking for water in which to lay her eggs so that there would be some baby mosquitoes by and by. She hunted along the path, and around the bushes, and in the corners of the hedge; but she could not find even a broken bottle or empty tin can that might have held some drops from the last shower.

Then she flew to the house at one end of the garden and crawled over the rainwater barrel in search of a crack in the cover. When she was sure that she could not possibly squeeze inside to lay her eggs, she went to the hydrant on the lawn to see if the hose had been leaking in a puddle underneath. But she could not find a single muddy spot. So she spread her filmy wings again and flitted away over the hedge and across the street and around a barn to a pond in a vacant lot beyond.

The pond had begun to dry up at one end. The ground near it was wet and spongy, with long yellow grasses bending over little pools here and there. These pools were exactly what the mother mosquito wanted, because there were no fish in them to eat her babies. Perhaps she knew that the fish in the pond could not flap across the grassy spots to reach the puddles scattered over the marshy place.

Anyway, she flew to one of the patches of quiet water and dropped her eggs upon it. She laid as many as three hundred or more. They were all stuck together in a tiny raft which floated out on the surface of the pool. The sun came up and shone on the ripples. A bird swung on a reed and fluttered down to drink. She dipped in her bill, splash! so near the wee brown raft that it was almost sucked inside. Away it went, dipping and tossing in the fairy wavelets, when suddenly, kerplunk, a big green frog hopped right on top of it. But the tiny raft was light as cork, and instead of sinking beneath him as he swam down to the bottom, it bobbed up to the top of the water again, and danced wildly hither and thither in the whirling billows caused by his plunge.

All the sweet spring morning the raft floated in the sunshine, and early in the afternoon the baby mosquitoes hatched out.

Now you would have been surprised! The babies that came squirming out of those eggs did not look a bit like their mother. They were nothing but soft dark little wigglers. The first tiny creature that wiggled out of the largest egg dived from under the raft and swam up to the surface of the pool to breathe. Instead of poking her head up to the air, she hung upside down, with one point of her forked tail pushed up to the top. She breathed through a tube which was in her tail instead of in her head.

As soon as she was full of fresh air, she began to flap the other point of her tail. Away she swam, bending and twisting and squirming, this way and that, as fast as she could wiggle. While she was darting and doubling, she kept waving the hairs near her mouth to and fro. This quick steady motion drove the water toward her mouth. In the water were the very tiniest bits of food for her. When they floated into her soft open mouth, she swallowed them and waited for more to be pushed along by the busy little hairs.

After swimming and eating for about a minute, she flapped up to the top again to take another breath. Then she hurried down to eat. Going up was hard work because she was heavier than the water.

She had to jerk her tiny body very fast and wiggle her tail and flap all her little swimming-hairs at once. She had six swimming-hairs on her tail and others on the rest of her body. She rowed with hairs as you swim by kicking your legs and throwing out your arms.

As soon as she reached the top of the pool and poked her breathing-tube into the air, she felt lighter, because the new fresh air in her helped her to float. So she could hang there upside down without any trouble. When she was ready to go swimming around below again, she wiggled away downward as easily as a real fish.

Now one day a very dreadful thing almost happened. When she came hurrying up to breathe, after being a

whole minute down at the bottom, she could not poke the end of her breathing-tube through the top of the water. Though she pushed with all her might, and flapped and twisted and jerked, she could not reach the air above. It seemed as if there was a layer of thin rubber over the surface of the pool. Finally she gave a last wild squirm, and managed to slip out from beneath that dangerous spot. Her tail stretched up to the air in a twinkling. She hung there, breathing and breathing and breathing, deep down and all the way through her soft body. She had almost drowned that time.

What caused all this trouble for her had been a drop of oil that had floated from over a dead frog at the edge of the pool. The oil made a tough film on the water, just where she tried to push through at first. If she had not wiggled away from under it and found a clear space, she would surely have drowned. Sometimes, when people wish to get rid of mosquitoes, they pour kerosene oil on the ponds and puddles near their houses. Then all the wigglers drown because they cannot poke their tails up to the air to breathe.

Not long after this narrow escape, the young mosquito had an adventure that was really a joke, though very likely she did not find it funny. She was wiggling hither and thither while she swallowed her dinner. A hundred or more of her brothers and sisters were twisting and dancing and squirming around her in the pool. Suddenly, with a swish and a rush, a terrible monster of a tadpole dashed

among them. His tail went flap, flap, flap, as he darted this way and that, with his round horny mouth opened hungrily.

Now how were those frightened little wigglers to know that tadpoles are vegetarians and eat bits of plants instead of gobbling up lively mosquito babies by the dozen? They were doubtless quite as much scared as if he had been a great greedy fish instead of a harmless tadpole. They skipped in every direction to escape from the tossing and twirling of the ripples which surged about his thrashing tail. A tadpole, or pollywog, as it is called, may not seem very large to you. But you just try being a tiny wiggler once, and you will see. Perhaps you would feel like making up a fairy tale about a horrid big fat ogre called Pollywog-the-Wiggler-Killer.

In spite of such perils, the mosquito baby grew fat as she ate more and more. When she was too big for her old skin, she wiggled out of it, and wore a new one a size larger. The third time she changed her skin, she looked so different that she would hardly have recognized herself with her own eyes, if she had happened to have any.

The head end of her body had swollen out big and round. She breathed through two little horns at the back of her neck, instead of through one of the points of her tail. She felt so light that she stayed at the top of the water most of the time, with her horns poking through to the air above. She did not care about eating now. She was happy

enough just to float there, breathing and resting at the surface of the pool.

It was not a very safe place for her, because there were dragon-flies living near that pond. More than one of them caught a glimpse of the two tiny horns sticking through the water, and came swooping down to catch the little fat morsel below. It was the queerest thing how that soft, dark, wee body, without eyes or ears, knew when the dragon-fly was coming. It may be that she could feel the shadow of the gauzy wings flitting above the water. At any rate, she always vanished like a flash before the hungry dragon-fly could snap her up. Away to the bottom she flapped, bending and twisting her slender body. She found now that swimming down was harder work than floating up, because her head end was so light and full of air.

Dragon-flies were not her only enemies during the two or three days that she swung there in the water. Once a frog jumped at her, and another time, as she hung breathing at the surface, a bird spied her and darted at her just a moment too late. She had paddled downward like a flash. That was exciting enough, you may be sure. But the worst danger of all her babyhood was yet to happen.

Somehow or other there chanced to be a few fish eggs in that pool. Maybe they had been laid there before the pond had dried away, leaving the marsh with its separate pools here and there amid the long grasses. Well, anyhow,

one morning some minnows hatched out of those eggs, and began at once to chase the little wigglers.

It was, of course, sad for the wigglers, though possibly not so bad for the minnows or for the people who might have been bitten by the mosquitoes if the wigglers had escaped. But those energetic young minnows ate every wiggler in that pool except our wee creature who was the oldest of them all. She squirmed away while the minnows were busy catching the others. She wiggled close to the bank where there was not enough water for them to swim after her. There she stayed till night brought sleep to the young minnows who had been joyously darting to and fro all day long in that pool, once the home of three hundred merry little wigglers.

There at the edge of the water floated the mosquito baby in the darkness. She did not worry about the next morning when the hungry minnows would surely wake and swim around hunting for breakfast. Maybe the smallest one might flap along on his side through the shallow water to catch the little wiggler. But an animal like this young insect cannot think, and therefore she never worries. She only cares about the way she feels at the moment. And all that night she felt quite comfortable except that her skin seemed to be getting tighter and tighter.

II. What Madam Mosquito Did in the Garden

In the morning—now perhaps you have been expecting this—her skin split, and out of the crack crawled a grown up mosquito with a small head, a long slender body, and two gauzy wings. These wings were not much use to her just at first, because they were damp and limp and creased from having been folded up inside the wiggler skin for so many hours when they were growing. While they were drying, she sat on her old skin that was floating there empty.

Presently she fluttered to a blade of grass and walked along it with all her six jointed legs. It may have felt odd to have legs for walking, instead of hairs that were only useful for paddling in the water. And then, besides all those legs, she had two wings to carry her far away from the dangerous pool! Wasn't that fortunate for her? You see, it had not been really necessary to worry about those minnows after all.

However, she was soon to learn that the air also was full of perils. She was just lifting her wings to fly up from the grass, when a dragon-fly darted toward her. It may have been the same one which had almost caught her when she was a baby in the pool. She had hardly time to slip to one side and crawl under the grass, but the dragon-fly did not stop to hunt for her, because he liked better to chase insects flying in the air.

Several times that day the young mosquito started to fly up from her hiding place, only to slip hastily back to

safety. Many dragon-flies lived near that marsh, for their babies as well as the mosquito wigglers hatch out in the water. The neighborhood was certainly a bad one for a mosquito. Little Madam Mosquito must have felt this fact to be true, for she wisely flew away as soon as the terrible-jawed, four-winged, big-eyed dragon-flies had gone to sleep at nightfall.

Off she flitted across the pond in the dusk. It seemed a long journey to her, for her wings were not very strong. The light evening breeze that blew over the water tossed her hither and thither as it carried her onward. She was glad enough to reach the shore and flutter to the ground, where she clung to a weed till she felt rested.

Then she started out again and flew humming toward the garden. This humming song was caused by the air beating against a certain part of her breathing tubes, as she hovered with wings outspread. Another mosquito heard her song, and came flying among the trees to find her. He could tell in what direction to go by the way the sound stirred his feathery feelers, or antennæ, as they are called. When he first heard her, the humming note ruffled the hairs on the outside of the left one. He turned his head till he could feel both his antennæ ruffling just alike. By that he knew that she was straight in front of him. So he flew on till he found her. Then they flitted together through the garden in the sweet spring twilight to a blossoming cherry tree.

The young brother mosquito did not care much about eating, for he could not bite through anything. The sister mosquito was different. She had at her mouth a long sharp beak no thicker than a hair. She could push it through tender skin as if it were a needle, and suck up the juices inside. This evening she pricked into the center of the cherry blossoms and drank the nectar there. Then she flew to the vegetable beds and settled on one plant after another to taste the sap.

By and by, as she flitted here and there, she happened to go near the house at the end of the garden. In a hammock under a maple beside the front piazza two children were swinging. The mosquito wanted to alight just then and rest her wings. So she settled down on one of their hands. It was natural for her, when she felt the soft skin under her feet, to press her mouth close, stab her beak in, and suck, as she had been sucking the juices of the plants and flowers.

The fresh warm blood flowed up into her mouth. Ah, but this was the best thing she had ever tasted! She sucked and sucked and sucked till suddenly, slap! A small hand had almost smashed her into a flat red stain. The wind that it made as it struck toward her had startled her barely in time. She pulled out her beak and dodged in a hurry.

But instead of flying far away from that dangerous place, she kept hovering near. Every chance she could get, she alighted on a hand or an arm or a forehead, and tried

to get another delicious mouthful. She even bit through the little boy's stocking, and pricked the little girl on her shoulder under her dress. They kept slapping at her till their mother called them in to go to bed.

That young mosquito, now that she had tasted blood, never ate anything else. She did not care for sap or nectar any more. If she had stayed in the marsh, or gone to live in a wood where there were no people, she would have eaten only the juice of plants, with now and then a bite perhaps of some dead animal. Millions of mosquitoes never have a chance to suck warm blood as this little one did.

Sad to say, the more blood she drank, the greedier she grew. Every evening she flitted out from her daylight shelter under a bush and hovered teasingly about the children in the hammock, or hummed around their parents on the piazza. She became so bold that she no longer dodged the very first instant she felt a hand slapping toward her. She kept waiting just a moment more, and then another moment, and another, before she pulled out her beak and flew quickly to one side.

At last there came a sad evening when she waited one moment too long. Slap, crack, and Mischievous Madam Mosquito was dead!

The Most Beautiful One in the Garden

I. The Caterpillar Baby at Home

Near a gooseberry bush in one corner of the garden a milkweed plant was growing. On one of the silvery green leaves was a white dot of an egg which a big red butterfly had laid there four or five days earlier. Now something alive was beginning to move inside the tiny egg. Wee baby jaws were cutting out a hole in one end, about as big as the point of a pin. Up pushed the bit of shell like a lid, and out peered the queer crumpled little face of a baby caterpillar.

He was hardly big enough to notice, and he certainly did not look as if he would ever grow to be a butterfly with four beautiful wings. He seemed to be nothing but a little striped worm on a weed. The first thing he did was to turn around, after he had squirmed out of the egg, and eat up the shell. This took some time, because his mouth was so very small. Though the egg itself was tiny, it was, of course, far larger than his speck of a mouth with its wee lips and jaws.

The caterpillar did not eat the shell because he liked the taste of it. He did not even know why he ate it, but I can tell you. If he left the empty shell on the leaf, some hungry bird, or fly, or spider might notice it. Then they would know that a baby caterpillar was somewhere near, and they would hunt among the leaves till they found him. So, naturally, it was safer for him to get rid of it as soon as he possibly could. He did it because his father and mother

had done it when they hatched out of their eggs. His grandfather and his grandmother had done the same; and his great-grandfather and his great-grandmother, and so on back for years and years and years. That was one reason why they had lived to grow up and have children of their own, instead of being eaten up themselves while they were babies. This habit of eating the empty eggshell is so strong with caterpillars that they all do it the very first thing without understanding the reason why. Such an inherited habit is called an instinct.

After our little striped caterpillar had swallowed the last bit of shell, he rested a moment, lying very still on the leaf. Perhaps his mouth was tired. Eating is rather hard work when the thing one is eating does not taste very good. But in a few moments he felt hungry for real food. Now do you think that he had to hunt around and go squirming this way and that to find it? No, indeed! The mother butterfly had laid the egg on the very plant which her baby would like best to eat. There he was lying right on top of his dinner. All that he needed to do was to push out his lip against the leaf under him, suck back a bit of it into his mouth and cut it with his strong jaws. It was tender and juicy, and it tasted so delicious to him that he ate and ate and ate till he had eaten a hole through the tip of the leaf.

By that time he was ready to rest again. Of course, if he had wanted to, he could have taken a little nap right there where he had been eating. But somehow he knew that it

was safer for him to crawl to the under side of the leaf, and lie hidden in the shadow. Then a hungry bird, or a spider out hunting for his dinner, could not find him so easily as if he had gone to sleep in plain sight on top of the leaf.

He did not rest very long, because he was in a hurry to eat again. In fact a caterpillar's chief business in life is to eat and grow. All day and part of the night he kept on doing the same thing. Now he crawled to the tip of the leaf and gnawed away till he was tired. Then he squirmed back to the under side and rested till he was hungry again.

When he moved, he did not drag his body on by stretching out his head and drawing up his tail, as an earthworm does. Though he looked like a worm, he really was not a worm. He was a baby insect, and he had six true legs, as all insects have. These six true legs were under his body next to his head. They had horny claws and were jointed so that he could use them in walking.

Besides these legs, he had ten others farther back toward the tail end of his body. These ten prop-legs, as they are called, were short and stubby. They helped to prop his body up above the leaf. They paddled along behind when his six front legs started out walking.

The ten prop-legs helped him in another way too. On the tip of each one were tiny hooks that hooked around the little hairs on the stem of the milkweed, and kept him from falling off. At first he was so careful in stepping from one spot to another that he spun a silken thread ahead of

him as he walked. On his lower lip was a horny tube. Out of the tube came a thread like that of a spider's web. Wherever he moved, he kept swinging his head from side to side and fastening the thread over the leaf like a zigzag ladder. That made a safe path for him, because he could hook his hind legs fast at every step.

If it had not been for his spinning thread, he might have had a bad accident one morning. He was hurrying over the edge of the leaf on the way from his nap to his dinner. Just as he was half across, with the last part of his body swinging loose in the air as he scrambled from one side to the other, there came a thump and a bounce. A bird had alighted suddenly on the stem of the milkweed, and made it teeter up and down. The little caterpillar hung on as tightly as he could, digging the claws of his six forefeet into the edge of the leaf, but the plant gave such a jerk upward when the bird flew away that he lost his hold. Down he fell; down, down, down,—for as much as an inch.

All at once he stopped falling and hung there in the air. The thread of silk from the tube on his lower lip kept him from dropping to the ground. One end of it was still fastened to the zigzag ladder which he had been spinning as he crawled over the leaf. So there he swung at the other end of it, with his tiny, striped body squirming and twisting. But he soon found that he was safe and in a moment he climbed up the thread and went to eating again.

II. Lost in the Wilderness

After he had been eating for about two days, he began to feel as if his skin was getting too tight for him. Of course, the more he ate, the fatter he grew, but his skin remained the same size it was at first. Naturally he felt crowded inside. Now perhaps you can guess what happened next.

He walked to and fro over the leaf, moving his head from right to left as he spun a little carpet out of his silken thread. When the carpet was quite thick, he lay down on it and tangled the hooks of his ten prop-legs in it. He lay very still and waited till his skin cracked and slipped back over his body to his hind legs, then he walked out of it, and after resting a while he turned around and ate up his old skin.

There he was in a new bright skin. He was big enough now to be easily seen. He was about as long as a grain of rice. He was very pretty, with his striped body and his little yellow face marked with two black arches. Behind his head he had two slender black horns which kept twitching backward and forward as he walked. He was not so careful now to spin a thread in front of him as he moved. This was the reason why he had a dangerous adventure one day.

It happened one afternoon that he was hurrying to crawl under a leaf before a thunder-storm could catch him and wet him. The drops began to patter down just as he was wriggling along the stem of the milkweed as fast as he could wriggle. He was in such haste that he did not take time to hook fast to the hairs on the plant at every step. So, when three big drops of rain came trickling down behind

him and rushed against him with a swish and a splash, he lost his balance and slid off to the ground.

If he had been spinning out a thread as he moved, he would have been able to climb up it to the plant again. But now he was lost in the grass below, for he did not know how to find his way back. Though he had a curved row of tiny eyes on each side of his head, he could not see well at all. He knew when it was light, and he knew when it was dark, but probably he could not see things any better than you could if you had a cloth over your eyes.

The poor little caterpillar lay still for a moment after he had dropped with a bump. Then he uncurled and began to crawl away as fast as he could scramble. When he moved, first the horn, or feeler, on one side twitched forward, then the horn on the other side. If a feeler touched a pebble or brushed against a leaf, he knew that he must turn out and wriggle away in a different direction. It was just as if you were running in the dark, with your hands stretched out in front to feel your way.

On scrambled the lost baby caterpillar through the forest of grass. His slender horns twitched backward and forward. The skin on his back wrinkled up in tiny folds over his jointed body and then unwrinkled, as his front legs trotted along too fast for the stubby hind legs to follow without dragging. Being lost was very confusing. He hurried in one direction blindly till the tip of a horn brushed against a root, then he turned and crawled swiftly

in another direction till he felt the steep hard wall of a pebble in his path. After wriggling around it, he set out straight ahead again in a greater hurry than before. He did not know what was the matter, or where he was. He only knew that he was lost in a strange dreadful place, far away from the soft hairy stem and tender leaves of his milkweed home.

Before he had scurried forward three inches, he almost bumped into a dead stick. He dodged to one side in such wild haste that he could not stop himself in time when he felt his front pair of feet clutching at the empty air. He was right on the edge of a hole which had been dug by a squirrel. Down he tumbled, rolling over and over till he reached the bottom.

The fall did not hurt him, because he had no bones to break. But what do you suppose? A big gray spider lived in that hole. She was hanging in her web in one corner. When she felt the threads jerk and tear as the caterpillar fell through, she ran out to discover what was the matter. But he lay so still, curled up in a round little ball, that she could not see him, for he was as much as four inches away from her. If he had moved, perhaps she would have noticed him, because spiders, and many insects and birds, too, can see moving things more easily than things that are not moving. It was lucky for the caterpillar that he did not begin to wriggle out straight till after the spider had turned and crept back to the middle of her web again.

However he never learned what a terrible danger he had escaped. As he could not see her or hear her, he did not even know she was near. It just happened that she was not looking when he uncurled and started scrambling up the side of the hole. After reaching the top, he kept on in the direction his head was pointed. He hurried along till his horns touched a plant. Instead of squirming away from it, somehow he wanted to crawl up the stem. And so he did. The moment he felt the soft hairy covering under his feet, he flapped out his lip and took a big bite of a tender leaf. He knew that he had found a milkweed home at last.

III. The Caterpillar Baby Goes to Sleep in His Cradle

He must have been the happiest little caterpillar in all the garden that day. The first thing he did was to rest a while, for he was tired from his wanderings. Then he crept out on a juicy leaf and ate and ate and ate. He had never been so hungry before in all his life.

Day after day he ate and rested. Sometimes he ate at night, too, although he moved more slowly and slept longer when the air was cool on his skin. Four times he changed his skin, and appeared in a bright new suit. When he had grown to be almost two inches long, a wonderful thing happened to him. He went to sleep a striped green and yellow caterpillar, and woke up a red butterfly, the most beautiful little creature in the garden.

This is the way it happened. After coming out in his last new skin, he ate greedily for two or three days. Then

he did not seem to care for more food. He crawled over the leaves without stopping to eat. He roamed up and down the stem till finally he felt so queer and restless that he crept to the ground and went hurrying off through the grass. He walked on and on till he reached a stone. Up he crawled, and over the top, and down the other side. He did not stop, however, because he had not yet found what he was seeking. He was seeking a safe, sheltered spot where he could prepare for his long nap.

Beyond the stone he came to a tree. Up he climbed, wriggling across the rough places on the bark, squirming through the cracks and hollows. When he felt a branch stretching above him, he walked out along its under side and began to spin a carpet of his silken thread. This carpet was like the little mats he always spun whenever he was getting ready to crawl out of an old skin. The only difference was that he made one spot in it very thick. After he had finished it, he crept out upon it and hooked his last pair of legs into the thick spot. Then he let go with all the rest of his legs and swung head downward, almost as a boy hangs by his toes to a trapeze.

All day and all night he swung there on the under side of the limb. Instead of hanging down straight, he curved his head up toward his tail. That made his skin stretch so tight over his rounded back that soon it split and began to shrivel away. When it had shrunken to a dry little bundle clinging around his last pair of legs, he jerked out the tail end of his body by twisting and whirling. Then he caught

hold of the thick part of the carpet with the hook on his tail. The old skin with its two horns and ten prop-legs dropped off, and left him hanging there, all wrapped up in a soft green chrysalis.

Through the pale covering of the chrysalis the new butterfly could be seen with its wings folded around its jointed body. It was not ready yet to awaken and fly away. It must sleep till its wings, and eyes, and legs, and tongue, and feelers could grow strong enough to be of use. So it hung there under the branch for more than a week.

The early sunbeams stole in level rays across the garden and shone on the green and gold cradle of the sleeping butterfly. Once Grasshopper Green went whirring by on his way to find a fresh tender leaf. Sometimes a spider scampered past on its eight long legs, or a woodpecker paused in her hunt for insects under the bark to nip at the chrysalis. She could not peck a hole through, because the covering of the pretty case had hardened and thickened to protect the delicate young creature inside. Once in a while a puff of wind set the cradle swinging gently; but there was no motion within, except a feeble wriggle now and then.

IV. Butterfly Red Wings Wakes Up

At last came a beautiful morning after a night of warm drizzling rain. The dampness softened the shell of the chrysalis. When the sun burst through the gray clouds, it set all the wet leaves twinkling. Gleaming drops of water

trickled around the limb and dripped softly upon the green cradle. Was it moving? Did something stir within? Yes, surely it had quivered, and begun to swing lightly to and fro, though there was no breeze to bend even the grasses.

Click! The shell cracked, and opened slowly like a fairy door. The butterfly had awakened. He bent this way and that, struggling to escape from the chrysalis case. He drew his head from beneath the covering. He pulled out his six legs and, setting them upon the outside of the case, he crawled up to the limb above. There he hung, damp and weak, his wings drooping downward, his large eyes shining like jewels in the sunlight. He was a real butterfly now, in a garden world of leaves, and light, and flowers. He would never again be a greedy little caterpillar who cared for nothing else except eating all the time.

While he clung to the limb, his four wings grew slowly larger and stronger, as blood flowed into them from his body.

He waved them gently to and fro. The air hardened the tiny shining scales that covered his wings like satin. This particular butterfly had wings of deep orange red, veined with black, and dotted on the edge with white. Such butterflies are common everywhere in America, and are called by the name of "monarch," perhaps because they are such splendid, big beautiful creatures.

Though this young butterfly had great, gleaming eyes, he could not see his own body, and so very likely he did not care what color he happened to be. Just at first he was more interested in his tongue than in his wings. It was a queer tongue, made of two long hollow pieces. He had some trouble in fitting these halves face to face to form a tube. He kept trying again and again, laying them together and then drawing them apart till he succeeded in hooking them right. Then he coiled the tongue, like a watch spring, up to his mouth.

His mouth now was not in the least like the mouth he had while he was a caterpillar. Instead of a tiny flapping lip and horny jaws for nibbling, he had only this slender tongue between two short feathery horns. Never again in all his life could he take a bite of tender, juicy green leaf. He could not eat anything except what might be sucked up through the tube of this long tongue.

At last he was ready to fly. He lifted his wings slowly upward till they were folded close together over his back. Then he unclasped his feet from the bark of the limb, and spread his beautiful wings. Away he sailed through the air. On in the sunlight he fluttered like a living flower. He was searching for a real flower from which he might suck up the sweet juice of honey. He had eaten nothing since the day he had fallen asleep in his green and gold cradle.

V. Life Amid the Flowers

Over the garden he flew, past the very milkweed where he had lived when he was a baby caterpillar. He did not notice the pale green and white blossom that swayed on the tip of the slender stem. Though his eyes were large and bright, he could not see things very distinctly. Only the gayly colored flowers attracted his attention.

Beyond the milkweed some poppies were growing in the grass around the currant bushes. The butterfly caught a glimpse of spots of glowing yellow, and fluttered toward them. He hovered near, now drifting with the breeze, now soaring with wings outspread, till he was close enough to smell the flowers. He could smell with the two long thread-like antennæ, or feelers, above his eyes.

Slowly he fluttered down upon one of the yellow poppies, and uncoiled his long tongue. Here and there, into the golden heart of the flower, he thrust it again and again till he had found the honey. Then he folded his wings above his back and stayed motionless on the petals while he sucked up the sweet juice. When he had taken all the honey in that flower, he flitted on to another and another. Oh! it was delightful to be a butterfly in a fragrant garden.

Long before evening he crept under a leaf on a bush, and slept till the morning light grew bright and warm, then he was off again to hunt for fresh flowers or rest lazily on the leaves in the sunshine. One day while he clung to the tip of a twig, half opening and closing his wings drowsily,

he felt a sudden rough dash of wind blow his antennas backward. He had barely time to fly quickly to one side, just as a straw hat came swooping down over the spot where he had been resting. The rim of the hat snapped against the tip of one wing and tore a nick in its velvety edge.

The boy who had tried to catch him ran laughing along the road, while the injured butterfly fluttered away over a field. If the hat had broken his beautiful wing, he would never again have been able to fly, but would have crawled hither and thither, dragging it drooping and crushed by his side, till he died of hunger. For how could he have found enough honey to keep him alive, if he had lost the wings that carried him from flower to flower?

The butterfly did not know what had hurt him. He soon forgot all about the past danger, as he drifted onward to a hillside sweet with blossoming clover. There were other butterflies there, some white, some yellow, some blue, some purple. Bees who lived in the garden were gathering honey to take back to their hives. They worked hard all day long, making honey and wax, caring for the baby bees at home and doing a dozen other things. You shall hear of them when you read the story about bees. But the idle butterflies did no work from morning to night except seek nectar among the flowers. Nectar is a kind of watery honey. It must have been pleasant to be a butterfly in summer, especially to be a big red monarch with strong wings spread to the breeze. When this one of ours went

soaring high among the tree tops, he was not afraid of being caught by a bird. His parents had never been afraid either; and somehow, without thinking about it, he knew that birds did not like the taste of any of his family. So, while many of the other kinds of butterflies flitted quickly here and there, or dodged and hid low amid the bushes, he sailed on in plain sight. Sometimes he sported alone or played with another butterfly, circling around his companion as they fluttered up, up, up in the sunshine.

V. Away to the South and Back Again

If only it were summer all the year, what a lovely time the butterflies would have! But at last the autumn came, as it always does; and the days grew shorter and cooler. It was only during the sunniest hours now that Red Wings fluttered over the garden like a lovely flower. He did not feel like stirring as soon as he awoke in the morning, because the cold air made him dull and lazy. He did not even want to lift his wings, but dozed comfortably till the sun shone warm enough to open fresh buds on the marigold bushes. Then he came flitting out to hover over the blossoms.

One day he slept so late that the bees had time to take all the honey from every flower in the garden before he began to hunt for any. There were not many flowers in bloom now, for the clover was gone, and an early frost had nipped the nasturtiums. The butterfly was so hungry that

he flew across the hedge to seek wild asters and goldenrod in the fields along the road.

On he sailed, pausing now and then to alight on a plant or to sip a drink from a quiet pool. Once as he was resting, with his wings folded above his back, he smelled another monarch butterfly somewhere near. He waved his antennæ to and fro so as to smell better. Yes, surely he had not been mistaken. Though he could not see them yet, he knew that many big red butterflies like himself were gathering among the bushes not far away. They were getting ready to journey southward for the winter, as some birds do. The monarchs, being the strongest fliers among butterflies, are the only ones that can travel very far.

So he flew joyously onward till he found them. There were thousands and thousands, some resting on the ground, others clinging to the leaves and twigs and limbs. In a few days they began to fly toward the south. For weeks they sailed through the air about as fast as a man can walk. Of course our butterfly did not know how many there were in the great swarm about him. He could see, perhaps, moving dim spots of bright color here and there, above and beneath and behind and ahead of him. He could smell many more. When they came near enough, he could touch some with his antennæ. At night he clasped his front pair of feet to some twig so close to his companions that he had no space to spread his wings. In the daytime they all soared steadily southward till they reached a land where the sun shone warm and flowers bloomed all winter long.

There the swarm separated. Some flew this way, and some flew that way. Our butterfly stayed in the South till spring. When the lilacs began to bloom in the beautiful garden where he had lived as a baby caterpillar, he came flying toward the North again.

His wings were a little ragged by this time, and quite faded, for he was getting old and had flown many miles with the wind ruffling the delicate scales that clothed him. Of course every time he folded his wings or beat them together in flying, he wore them out the least little bit. But, joyous as ever, here he was again, floating over the fields where he used to seek nectar from the flowers.

Three or four young milkweed plants had sprung up from seeds where the old milkweed had been growing the summer before. On the tip leaf of each one was a white dot of an egg laid by a mother monarch butterfly. On other plants and weeds were eggs of caterpillars of other kinds of butterflies. Here and there a new young butterfly, with wings of pale yellow, or white, or blue, came crawling from its chrysalis cradle and clung to a leaf while it waited to grow strong enough to fly. In the garden the lilacs and the lilies and the apple-blossoms opened their golden hearts to the sunlight and waited for the bees and butterflies to come visiting for honey.

The Untidy Fly

I. The Place Where He Was Hatched

Now it happened that some distance down the street from the house with the garden was another house where an untidy family lived. This other house had a garden also; but the flowerbeds were crowded with straggling weeds. In the back yard so many ashes had been scattered carelessly over the ground that not a single earthworm burrowed there to help make the soil rich and light. The cover to the cistern was so loose that dozens of mother mosquitoes had laid their eggs in the water. Worst of all, a heap of dirty straw beside the barn door lay steaming in the August sunshine.

Above this rubbish from the stalls hundreds of flies were buzzing lazily. Now and then one of them alighted on the heap, and crept down into a crack. In a moment she crawled out again and went to buzzing as before. But she had left something tucked away beneath a clod or a straw. What do you think it was? It was a bunch of tiny white eggs that would hatch into baby flies the next day.

Perhaps you would have been surprised if you had seen what kind of a baby came wriggling out of one of the eggs the next morning. He looked like a fat little white worm with a speck of a mouth at his head end. Of course the first thing he wanted was something to eat. Luckily for him, his mother had laid her eggs right in the very food that her babies would find best for them. If they hatched

out on sand or clean fresh-smelling earth they would have starved to death, or else dried up and died, as they squirmed this way and that in seeking a place soft and moist and slimy with rotting things.

This manure heap was exactly what they needed. The mother had been a wise little fly to choose so well with her dot of a brain. She had laid more than a hundred eggs in a bunch, and as she could not take care of so many babies all at once, she put them where they could take care of themselves.

For a whole day the baby fly, or maggot, as the name is, squirmed amid his brothers and sisters in a corner of the heap, and ate the soft wet parts near his mouth. He did not eat the hard bits of hay and straw. He felt warm and damp and happy. His round little body grew too large for his skin. So when it cracked open, he wriggled out in a new white skin. Then he went to eating for another day. Once again he changed his skin, and squirmed around livelier than ever, as he sucked away at the rotten mass.

After three or four days more, the maggot seemed to lose his appetite. He began to feel so queer and drowsy that he dragged himself off under a straw and went to sleep. While he slept, he turned brown and grew hard outside. He was shut up in his own skin as if he were lying in a tiny barrel. The greedy little maggot, who could do nothing except wriggle and eat, was changing into a big-eyed gauzy-winged fly.

When the young fly began to wake up, doubtless he felt queerer even than when he fell asleep. How could he know what had happened? He could not look at himself, for he was all doubled up in the dark case formed by his old skin. His six new legs were bent under him, and two limp wings pressed close to his sides. Perhaps he tried to squirm around as he used to do when he was a maggot. Instead of a pleasant, simple, little wriggle from mouth to tail of a soft tiny body, his two wings quivered, his six legs twitched and tickled him, and his new head waggled on his speck of a slender neck. He had never had a real neck before. Now he found a neck very convenient, for what do you think he had to do? He had to hammer a hole in the hard case with his head.

So up and down he hammered away without exactly knowing why till crack, the shell split, and out crawled the young fly! Dear me! but it was thrilling to have legs. He ran a few steps this way, and then turned and ran a few steps that way. He crept along a straw, his damp limp wings hanging by his sides. The light made him feel dizzy; for this was the first time he had ever had real eyes. Now that he had two big ones and three little ones on the top of his head, he must have found the world much more interesting than before, when he was a blind little maggot. Perhaps the world itself seemed to have changed after he went to sleep, though in fact it was only he himself who was different.

Since he found mere legs and eyes so exciting, fancy how he felt when at last he discovered that he could fly! While he was running nervously to and fro, his wings had time to dry and expand to their full size. He was a full grown fly now, although so new. Winged insects, when they first come out from the chrysalis, are as big as they will ever be.

This young fly, being still weak from his long, cramped sleep without food, wobbled a little as he walked along a slippery straw. Somehow he slid off, though he certainly should have known better than that, for his feet were even stronger for clinging to smooth surfaces than the grasshopper's. Well, off he staggered in the moist rotting spots where slimy maggots were squirming happily. Queer! but now that he was changed and grown up, he did not enjoy manure much at all. He hated to draggle his slender legs and soil the edge of his wings, for one reason, perhaps, because it was so much trouble to clean them.

He crawled upon another straw as fast as he could, and rubbed his front feet together to brush off the dirt. Then he lifted his last pair of legs and scraped them under and over his wings. And then—wonder of wonders! Even he himself did not understand quite how he did it. Away he was sailing in the sunshine, his gauzy wings beating the air so fast that they did not seem to move at all.

II. His Adventures in a Kitchen

Now wouldn't you have thought that flying was fun enough for a while? But, no, of course the first thing that fly wanted was something to eat. He seemed to feel that the chief use of wings was to carry him to find food. So away he buzzed over the ash-strewn backyard and tangled flowerbeds, till he reached the porch of the house where the untidy family lived.

Ah, but something smelled enticing! It was a beefsteak being fried on the stove in the kitchen. The hungry fly flew straight toward the smell, nearer and nearer, till bump! he struck the screen door. Naturally, being so new to the world, he did not understand that a screen door is intended to keep flies outside the house. All he knew was that the delicious smell came from the other side of this provoking wall full of holes not nearly big enough to let him squeeze through.

He crawled up and up till he struck the top. Then he scrambled buzzing down to the ledge and began to crawl up again. The browner the steak sizzled, the faster he buzzed and the oftener he bumped his head and the angrier he became. Finally—oh, joy!—he happened to alight upon the edge of a torn place in the screen. Immediately he crept through, as easily as anything. On he flitted toward the frying-pan over the fire.

Now even the most foolish fly that ever lived is not so silly as to take a bite of piping hot steak, no matter how delicious the smell. This young fly hovered as near as he

dared while the steak was cooking. Sometimes he floated buzzing in the air.

Sometimes he crawled along the edge of the greasy sink and then flew across to the table without waiting to clean his feet. On a corner of the table was the peeling of a decayed banana. The fly crept over it and then walked up the side of a sticky sugar-bowl and down into the sugar. Wherever he stepped, specks of the rotten banana and other stale food, that had clung to the hairs on his feet, were scattered on the sugar.

This was unpleasant enough, but something worse followed. When the mother in that untidy family gave the baby a spoonful of sugar, she could not see the tiny specks of rotten banana on it. But they made the baby feel sick and fretful all the next day. The mischievous fly, however, knew nothing of this. Of course he had not meant to cause anybody to have colic. The trouble with him was that he was too lazy to clean his feet properly after walking through sticky refuse. It was not so much his fault as the fault of the family who let their kitchen go dirty and their screens remain unmended. Sometimes flies carry the germs of typhoid fever from one place to another.

As for the fly's supper that evening he ate so much sugar that he lost his appetite for the steak. He had no jaws with which to bite his food. His upper lip grew in the form of a tube, with two tiny flat files at the end. When he

wanted to eat, he unfolded his long tongue, scraped off a bit of sugar with his files, and sucked it up to his mouth.

That night he slept on the frame of a picture in the dining-room. When he smelled breakfast cooking in the morning, he flew toward it, leaving a black speck where he had been resting. But then there were so many fly specks already on the frames and windows that one more or less did not make much difference.

On his way to the kitchen he passed near the dining-table. Five or six other flies were buzzing around the syrup jug. He circled nearer and nearer till he settled down on the sticky rim of the jug. He unfolded his tongue and took a sip. That was even better than sugar, because it was easier to suck. After he had eaten all he wanted, he lifted his wings to fly. But they just flapped up and down without raising him in the air. All six of his feet were stuck tight in the molasses.

That was a terrible plight. First he stood on five legs, and tried to pull the other free. Then he leaned on four and struggled to kick with the last two. He pulled and kicked and jerked and twisted. Once he dragged one foot loose, but he forgot to hold it high enough. In a moment it was stuck deeper than ever. He sank down on his side to rest an instant, and one wing was glued fast, then the other. The harder he struggled, the stickier he became and the less he could move.

At last he was almost dead of fright and weariness, and lay still. When the baby's mother started to pour some syrup on a pancake, she saw the fly and fished him out on the tip of her fork. She shook him off into the air without watching to see where he fell. He went tumbling clumsily over and over, and dropped splash right into the baby's cup of milk.

This new adventure was not so bad as you might at first imagine. Of course he was now in danger of drowning. But very likely it is pleasanter to drown kicking in clean cool milk than to smother to death motionless in thick molasses.

The little fly, however, did not intend to drown if he could help it. As soon as he felt the milk wash over his head, he began to struggle again. And this time, happily, the more he struggled, the easier it was to jerk and twist and flap. You see, the milk was washing the molasses from his tired legs and draggled wings.

Finally he was all untangled from the stickiness and was free to swim as best he could. But alas! by that time he was so very weary that he stopped kicking and floated quietly. Really he was beginning to drown, for he could not breathe, even if his head was held above the milk. Insects breathe through tiny holes on each side of their bodies. This fly would surely have died as he floated, if the baby had not poked at him with a small fat finger.

The instant the fly felt something touch him, he gave a flap and a kick, and scrambled up slowly over the finger. The baby laughed when he felt the crawling feet tickle his skin. In a minute he tossed the fly off into the air just as he had seen his mother do when she fished the insect from the molasses. Down dropped the fly to the floor, for he could not use his wings while they were wet. As soon as he stopped feeling dizzy from the whirl and bump, he crawled slowly under a chair and rested till he was strong enough to clean his legs and wings and rub his eyes dry. Then away he flitted toward the sunshiny window, buzzing as gaily as if he had never known the dangers of milk and the perils of molasses.

III. His Visit to the Garden

His troubles for the day were not yet over. The baby's mother lay down after luncheon to take a nap. But the flies bothered her so much that she could not get to sleep. First one crawled over her forehead, and then another tickled her nose. A third alighted on her cheek, and a fourth crept across her hand. When the woman grew tired and cross from slapping at them, she jumped up and snatched two towels and began to drive the flies out-of-doors.

Around and around the room she went, waving the towels. Some of the flies hid behind the pictures, others crept into cracks in the plaster, others scurried on before the swirling breeze caused by the towels. Our young fly was sunning himself quietly on the window-ledge when

smack! A corner of a towel snapped down close beside him and almost killed him. Away he tumbled in a terrible hurry, banging his wings against the pane, bumping his head, and bending his feelers. He really was a stupid little creature, even if he did have six legs and five eyes and two beautiful gauzy wings.

At last he happened to get started toward the open door and was driven along by the whirling towels. Out he sailed into the sunshine and joined a swarm of other flies who were soaring contentedly above the porch steps. They floated in the air, their wings whirring softly and swiftly. Now one darted toward another, then flew apart, or circled this way and that. It was fun to be a cheerful young house-fly on a pleasant summer afternoon, especially if an untidy family lived near enough to be convenient for meals.

If our young fly had been wise enough to stay where he was happy and well fed, he might have lived till the autumn frosts numbed his busy wings. Perhaps, if he had been lucky, he might have slipped into the house again and hidden in a cosy crack all winter till the warm days called him out in the spring. But, no, he was meant for another fate. That afternoon a breeze sprang up and the fly carelessly drifted on before it till he reached the beautiful garden.

At first he seemed to enjoy being there. He alighted on a twig of the hedge and rested for a few minutes, his wings

glistening in the sunlight. Then he flitted to a flower and hovered above it, for it smelled like honey. Just as he settled upon a petal and began to unfold his tongue, a woolly black spider darted out from beneath a leaf and jumped for him. He slipped away barely in time.

A moment later he was floating hither and thither above the clean gravel path. Of course he was hungry again and hunting for something to eat. Now, would you believe it? In all that garden there was hardly a thing that he liked. There was no rubbish thrown out from the house to lie rotting in corners. There were no spots of grease or stains from spilled food on the kitchen porch. After a long search, the fly found an apple that had fallen from a tree and had begun to decay. He ate a little of that, and then took a few sucks at a dead beetle hidden under a tuft of grass near an ant-hill.

When the people in the house began to cook supper, he caught a whiff of something most delicious. As quickly as he could beat his wings, he followed the smell to the kitchen, and bumped against the screen door. Up and down and around he buzzed and tumbled and fluttered and crawled in a blundering hurry to get inside. But not even the smallest rip could he find in the screen.

Every time somebody opened the door, he tried to fly in but was brushed back by the careful cook. She did not want any untidy flies trailing their dirty feet over her food. Finally—sad to say!—that hungry young fly managed to

hide near the knob, and just as the door was swinging swiftly shut, he tried to dart in. But alas, alas! he was one instant too late. He was caught in the crack, and he never went buzzing again through the garden.

The Spider Who Would A-Hunting Go

I. A Nursery Full of Babies

The mother spider carried her nursery of babies up to the top of her hole and held it where the morning sunshine fell warm upon it. From the outside it looked like a silky yellow ball as large as a hazel nut. But inside—dear me!—you should have seen the crowd of tiny spiders tangled together. Each one was no bigger than the head of a pin, even with all his eight legs spread out. A spider is not exactly an insect, for true insects, such as the grasshopper, mosquito, butterfly and others, have only six legs.

The last baby spider, who came kicking out of his speck of an egg, had hardly room to wriggle. Such a squirming and tickling and sprawling and crawling under him and over him and around him! He had more than a hundred brothers and sisters. When they all began to creep out of their own skins, that nursery was certainly a lively place. Some hung on to the walls, and some hung on to each other, while they pushed off their old suits with their hind legs.

Before the youngest one had finished pulling his feet free of his own ragged clothes, he was nearly buried in a heap of empty skins. He kicked his way out and caught hold of one of his bigger brothers with his claws. That kept him steadier while the others jostled and scrambled and tumbled. Their new coats were larger and hairier than their old ones. Their jaws were stronger. Close to his

mouth, each baby had a pair of extra legs, or palps, which he could use like hands.

Suddenly the whole nursery began to move, bouncing the family around worse than ever. Really, though of course they knew nothing about the dangers outside, a bird had hopped along to the top of the hole. The mother spider had felt him coming in time, and scuttled down to the deepest end of her house with her silken cocoon full of babies held tight in her legs. The youngest one clutched his brother closer and hung on till the shaking and jerking stopped. Perhaps he would have shut his eyes to get rid of the dizzy feeling if only he had had eyelids. But after all eyelids were not necessary in such a dark little round room. It had not a single window or door. The spider could sleep just as well with his eight eyes wide open. Now very likely that is a convenient way to have your eyes, if you wish not to miss anything that may be going on. Soon—what do you suppose?—the biggest baby bit a hole in the wall of the nursery. A dim gray spot of light shone in. As soon as the youngest one saw it, he started to crawl toward it, without waiting to wonder why he wanted to go. He pushed up beside his brother and looked out. He could not see anything except the hairs on the mother's body. The hairs on her legs were so sensitive that they seemed to hear what the little spiders were doing. She turned the cocoon over and jumbled them all safely back in the dark again.

The next morning when she carried her nurseryful up to the sunshine, the warmth made the babies feel lively. One after another, they came scrambling through the hole in the cocoon, and crept upon her back. There were so many of them that they covered her all over. The later comers climbed up on the others. Then those underneath squirmed out and tried to crawl on top of the crowd. By the time the youngest one managed to squeeze his way into the tangle of brown legs and soft dots of yellow bodies, he could not find a bit of room except on the tip of the mother's head.

When the cocoon was empty, the old spider let it drop. She had all she could do to take care of her hundred or so children. They rode on her back wherever she went for two or three weeks. Naturally it was rather a nuisance for her to take such a large family along with her when she wanted to go hunting. If she had been the kind of spider that lives in a web, it would have been easy to sit quiet and wait for a fly or some other insect to come near enough to be caught. But she happened to be a ground spider who lived in a hole and went out to hunt for food when she was hungry.

II. How Their Mother Took Them Out Hunting

The youngest baby had a narrow escape the first time they all left home together. The mother crept to the top of her hole with the little ones riding on her back. Just below the opening she stopped to listen with the hairs on her

legs. The ground above her was still. She could not feel the faintest tap of a bird's claws, or the scurry of a lizard, or the thud of a clumsy hopping toad. Though she enjoyed hunting small creatures, she did not wish to be hunted herself. So of course she was very careful to keep her eyes open and her legs busy and her sensitive hairs alert when she journeyed away from her safe deep hole.

As soon as she was satisfied that no enemy lurked near, she crawled a few steps higher, and then halted again. The shadow of a falling leaf flitted across her and frightened her so that she scuttled back out of the light. After that she waited for several minutes before creeping cautiously up once more. The babies clung together without jostling impatiently. Though they did not understand why their mother was so slow in getting started, they felt that she was wiser than they were.

In a minute she began to move onward again. At the opening of her burrow she raised the front half of her body and peered out watchfully. She could not twist her head this way and that, as an insect can, for she had no neck. Her body seemed to be in two round pieces joined by a slender waist. On the front half were her legs and her head. In the rear half were her tubes for spinning webs. Spiders, you know, are the champion spinners in the animal world.

Though she had eight eyes, she could see clearly only a few inches. However she really did not need keener sight. All the spiders that had lived before her had

managed to get along pretty well with that kind of eyes. Her duty was simply to make the best of what senses she had, and to use them to take care of herself and her children as well as she possibly could.

After she had looked all around, she ran swiftly over the ground to a clump of grass. That was fun for the babies. The youngest one on the top of the heap clutched his claws more tightly upon those below him and tried to brace himself steady.

A breeze raffled his hairs. The fresh air soaked through his breathing-holes into his tiny body. That made him feel so happy that he forgot to hold fast. He loosened his claws for an instant, and took a joyous little jump to one side. Alas! just as he came down lightly on the back of another brother, the mother slipped beneath a low-hanging blade of grass. In brushing over her, it scraped off the youngest spider, and sent him sprawling down upon the earth.

He lay there as if dead, with his legs curled under him. Spiders often play dead like that when something unexpected happens. In a moment he stirred and began to crawl away—that speck of a baby spider, lost in a wilderness of grasses.

What would become of him in a world where dangers might be hiding behind any leaf or pebble? If a hungry bird should spy him, or a lizard should come darting past, he would be gobbled down in a twinkling. A strong-jawed ant might leap on him and sting him to death, or some strange,

grown-up spider might catch him and eat him. The lost baby would certainly have died somehow or other if his mother had not come rushing back.

She had not missed him. Oh, no! She had not noticed his fall, and as she could not very well count her family she would not have known it, even if a dozen or so had been scattered along her path. She had another reason for hurrying that way again. She was chasing a hundred-legged worm. Now although the worm could run fast, the spider could jump. And anyway, I should not wonder if eight long legs are better for many purposes than a hundred short ones.

However that may be, it is sure that the mother spider jumped, and caught the worm just as he was wriggling swiftly past the lost baby. When she grasped the worm with her palps, and began to eat him, the baby scrambled up on her back in a jiffy. It was a lucky adventure for him, but not so pleasant for the worm, of course.

For two or three weeks the young spiders rode with their mother wherever she went.

The bigger they grew, the more they jostled and crowded when they climbed on her back. One day they crept all over her legs and crawled out above her eyes till she could hardly see. She raised her long forelegs, and brushed off about ten of the bothersome little fellows. They dropped to the ground and ran to the opening of the burrow. When the mother went inside, they hurried after

her and scrambled upon her back again before she was ready to set out on another hunting trip.

After the children had changed their skins the second time, they began to be quarrelsome, perhaps because they were hungry and wanted something to eat. When the mother spider saw a red ant hurrying past the burrow, she jumped for it. The jar shook the youngest one from the edge of the crowd on her back. He picked himself up and crept near to watch what she was doing. She was drawing out cobweb threads from her spinning-tubes, and winding them around and around the ant. The ant kicked with its six legs and clashed its horny jaws, as it struggled to get free. This frightened the young spider so that he turned and scampered away as fast as he could go. But in a moment he stole cautiously back again. Some of his brothers and sisters trotted after him.

They waited till the ant was dead. As soon as the mother had crushed it tender in her jaws, she held it while her babies ate it. To be sure, one ant was not large enough to feed a hundred little spiders, so the old spider had to work hard to catch enough to feed her family. Once she captured a big fat beetle and then they all had a feast together.

III. How They All Ran Away From Home

The youngest baby tried to stay close by the mother spider much of the time. That was how it happened that

he was almost always near enough to get a bite when she caught anything. Naturally he grew faster than the others, because he was able to eat oftener. Very soon he was as big as any of his brothers, though he had hatched last of all.

By-and-by the mother seemed to get tired of feeding and carrying her children.

One morning she was so cross that she made every one scramble down from her back. When the youngest tried to climb up again, she reached for him with her forelegs and threw him several inches. She was careful not to throw him hard enough to hurt. But still, such treatment must have wounded his feelings a little. It made him wish to run away from home the first chance he could find.

He did not need to wait long, for even if the mother did have eight eyes she could not watch a hundred babies every minute. That very afternoon he crept from the burrow and ran to a stem of grass. First he touched the root with the spinning-tubes at the end of his body. Out of the tubes flowed a thread of cobweb silk. As he crawled up the grass, the thread lengthened behind him. When he had climbed a few inches, one of his brothers followed him, clinging to the first thread, and drawing another after him. Then came a dozen others, each one adding a new thread to the line that reached from the ground up along the stem.

When the leader reached the top of the grass blade, he walked around on it, still drawing out his silken thread.

This was lucky for him, because the wind was swaying the grasses so hard that it shook him off. Instead of dropping straight down, he swung at the end of his thread. He lowered himself slowly by spinning it out longer inch by inch.

He chanced to land near the home burrow and hurried inside just as his mother was spinning a door over the opening. She could feel that the night would be cold, and so she wanted to keep the children shut up safe within the warm hole. Doubtless she had seen the dozen runaways go scampering off toward the grass. The youngest squeezed under the edge of the new door and ran to join the others at the lower end. He was the only one of the wanderers who found his way back.

After that, whenever the mother spider opened the door on a sunny day, some of the children would run off and never come home again. Each one wanted to make a home of his own, and live by himself.

One sunshiny autumn morning the youngest spider started out alone without saying good-by to his mother or the half dozen little fellows who still followed her around. He trotted off past the clump of grasses and under a gooseberry bush. Just as he was crawling over a twig, he happened to look up. There close beside him he saw one of his sisters digging a burrow. She had that moment come out of her tiny hole, with a speck of earth in her jaws. Her brother ran nearer to see what she was doing. Instantly she

dropped the speck of earth, and sprang forward to chase him away. She did not wish to be bothered by any of the family now that she had her own home.

The visitor scampered on in a hurry. He did not see any use in trying to stay where he was not wanted, especially as his sister was bigger than he was. When he reached the next bush, he went exploring hither and thither till he found a spot of soft moist earth. Here he dug a burrow of his own. He dug it by biting out specks of soil and carrying them to one side in his jaws. He knew how to do it without being told. Although he was so young, he could do everything that his mother could.

Perhaps you would not find it very thrilling to live alone in a hole under a gooseberry bush for weeks and weeks. But this spider had some exciting adventure nearly every day. He spent his life in hunting or being hunted. One morning a robin pecked the hole open. If she had not had her bill full of earth when the spider scuttled out she would surely have snapped him up. He had but a moment to scurry under a clod.

Another morning, when he was wandering around an ant-hill, hunting for tiny red ants, he was almost caught by a lizard.

More than once he was chased all the way home to his hole by some big hungry old spider. Many a time he scuttled into hiding, every leg shaking with fright.

Now, would you believe it? Spiders are very good friends to the green growing things in a garden. They eat the tiny insects that suck the juices of plants. They catch little caterpillars that gnaw the tender leaves. They devour small beetles and bugs that nibble the roots. That is how they help the garden to grow. This is why you should be kind to spiders, for they rarely bite people. They do not crawl over the food in the pantry as flies do. They do not care to sting you as mosquitoes do. If you will look at them closely, you will see that some of them are beautiful, with glistening colors.

IV. How They Flew Without Wings

As the days became shorter and the nights cooler, our little spider stayed underground in his burrow more and more of the time. One afternoon in October he felt the sunshine warm above him and crept out in search of adventures. Perhaps he was tired of living in the same hole week after week. And anyway he was getting too big to slip inside easily.

He set forth on his travels without a look behind. If he had looked behind, he would have seen something to worry him. A slender wasp was peering about under the dead leaves that had fallen from the bushes. She was hunting for spiders. By the time she reached the empty little burrow and peered within, its lucky owner was halfway up the stalk of a hollyhock that grew beside the hedge.

Here and there, between a leaf and the stalk, he found a cobweb barring his path, and crept cautiously out around it. One of the webs was triangular. One was round as a wheel, and in the middle of it hung a big black and yellow spider with her feet resting on the silken lines. If he had stepped on one of them, she would have run toward him to see if anything good to eat was entangled in the sticky lines.

A few inches above this spider's home, one of her children was spinning a web about the size of a silver dollar. He had fastened three threads in the shape of a triangle between a leaf and the stalk. He was running busily round and round, drawing out new threads and weaving them in the form of an uneven spiral. Some time you ought to watch a spider spinning a web.

Our little fellow who was climbing up the hollyhock was not much interested in webs, as he liked better to live in a hole. He did not stop to look, but trotted to the tip of a leaf that touched the hedge. Over he jumped and hurried on till he was at the tiptop of the highest twig and could climb no farther. Then what do you imagine he did? He stiffened his legs and raised the end of his body where the spinning-tubes were. From the tubes came a ray of threads that floated out in the breeze. Longer and longer it blew up above him till it pulled harder than he could hold. All at once he loosened his eight claws and sprang into the air. Away he went sailing across the field with the lines of silk

streaming in the wind. He was flying upside-down, with his feet clinging to a tangle of delicate threads.

That was almost as much fun as having wings. The sun shone, and the breeze blew, and the air glistened with floating threads of young spiders out a-flying that autumn afternoon. There were all sorts of spiders that had come from all sorts of homes. Some lived in holes, some lived in webs, some lived in cracks of wood, some lived under stones, and some lived on trees or bushes, or in the grass. When our little wanderer went sailing over a fence, he was almost near enough to see dozens of others running and jumping in frolic at each other while they were getting ready to spin out their threads for flying.

Away and away, higher, higher, higher, above the fence, above the bushes, above the tops of the tallest trees, he sailed. But there were perils in the air as well as on the ground for adventurous little spiders. Once a bird darted toward him with such a rush of wind from her flapping wings that he was blown just beyond reach as she snapped at him.

Perhaps that narrow escape made him feel that he had been flying long enough, so he began to draw in the floating threads. With his jaws and palps and fore-feet he wound the silk into a flossy ball at his mouth. As the lines grew shorter, the wind could not carry him along so lightly as before. Slowly he dropped lower and lower till he swung

against the tip of an oak leaf, kicked his legs free from the tangled threads, and scampered down the trunk.

He found himself in a grove of trees far from the beautiful garden. Of course he did not know how far he had travelled, or where he was. All that he could see was a small space of rough gray bark with brown leaves lying around it. He slipped under a leaf and crawled beneath an acorn to rest till morning.

The night was so cold that frost gathered thick and white on the ground. Even in his snug corner the little spider felt chilled. He lay curled up in a tiny ball till the sun had melted the frost on the wet, glistening leaves. Then he crept out and caught a beetle for breakfast.

After that he was strong enough to dig another hole. This was to be his home where he would sleep all winter long. So he dug it deeper than his other burrow, and made a door of bits of twigs woven together with silk. After he had gone inside, he fastened the door down over the opening with threads. Now he was ready to curl down safe and warm in his house and sleep till April sunshine thawed the ground above and called him forth to go once more a-hunting.

This is the House the Ant Built

I. How the House was Begun

It was an exciting day for the little brown ants that lived in the meadow. Out of every doorway in the hill they had come swarming. Hither and thither scurried the small, wingless ones, now darting this way, now rushing that way, as they prodded, and pushed, and pinched the large, winged ones to make them hurry faster. Those without wings wanted the others to fly away and start homes for new families of ants.

The first winged ant that went running down from the round hillock scampered up a lily leaf as fast as she could move her six nimble legs. No wonder she was in haste. Every time she stopped for an instant, the little one behind her poked her with a hard tiny head or nipped her with a pair of horny jaws. Up she scurried to the tip of the leaf, and opened her gauzy wings that flashed in the light. She kept raising and lowering them uneasily, for she wished to fly, and yet she was almost afraid, for she had never flown before.

All her life till this summer day she had lived in the pleasant dark rooms of the nest under the hill, except when she was brought out with her winged brothers and sisters to play on a pebble or swing on a grass stem in the sunshine. On those other days the wingless ants had taken care of her and fed her and coaxed her back into the nest again. But now they were trying to drive her away. And

strange to say, she was eager to go! She longed to fly up, up, up into the warm bright air above the meadow.

On the edge of the leaf she hesitated, her wings quivering. Then came the nip, nip, from behind. She swayed to and fro, her feet unclasped their hold, and she soared slowly above the lily. She was flying! From other leaves and grasses near by flitted her brothers and sisters. Soon the air was alive with winged ants,—rising, falling, dancing in and out of the swarm. They drifted onward with the wind as they fluttered and whirled.

When the sun went down and the chill of twilight began to numb the restless tiny bodies, one by one they dropped to the ground. The one who had first climbed the lily leaf tried to creep under a twig to hide for the night, but her trailing gauzy wings caught on a splinter and jerked her backward. When she started to squeeze beneath a stone, they held her back again. Somehow she knew that she would never need them for flying any more. So she broke them off. She flapped them back and forth and pulled at them with her feet. She rubbed against pebbles and twisted suddenly this way and that till finally the frail wings snapped off and lay tattered and torn on the ground. Then she slipped beneath the stone and rested till morning.

Though she was tired from her flight, she did not sleep quietly. She lay on her side with her two big eyes and three little ones wide open, because, you see, she had no lids to

close over them. Once in a while she lifted first one foot, then the other. Perhaps if an ant can dream at all, she was dreaming of the busy days to come. Now and then her body twitched nervously, and her slender feelers quivered in her sleep.

In the early morning she began to awaken. She stretched out her head; next she lifted a leg and shook it. In a minute she scrambled up on all six legs and walked toward the light shining in under the edge of the stone. There she stopped to yawn and clean herself before beginning work. She licked her face and head with her tongue, as a cat does. She drew her legs between her jaws to wash them. She combed her feelers with her forefeet. Then she started out to find a good place to build her house.

Now, though she did not know it, she had chanced to drop to earth right in the middle of the beautiful garden. The stone under which she had been sleeping lay near the gravel path. She ran this way and that, touching with her sensitive feelers first one pebble and then another. The ground seemed too hard for digging easily. You see, she had no shovel or pickaxe to use; she had only her horny little jaws for biting up the specks of dirt, for carrying them away, for getting food, for fighting, and for whatever else she had to do.

After she had decided that she did not like to dig in the path, she hurried on to a bed of vegetables. But the soil

there had just been raked over and was too loose to suit her. It would have caved in if she had tried to make a tiny tunnel through it.

At last she found exactly the spot she wanted, close to the edge of the path. It was neither too hard nor too soft, neither too moist nor too dry. It was not too sandy, or too clayey, or too marshy.

Without pausing to rest and wish for somebody to help her, she started to work. She bit out a mouthful of earth and laid it down a little way off from the beginning of her house. Soon the soil was piled in a hillock of crumbly brown specks all around the hole. She carried each new mouthful up to the top and let it roll down the outside. So she kept on biting up bits of soil, carrying them up to the entrance and letting them roll away.

II. Taking Care of the Babies

When she had dug down far enough, she hollowed out a tiny room and laid an egg not nearly so big as the head of a pin. Then she was busier than ever. What with laying new eggs, carrying them up into the sunshine when the day was cold, or down into the shady nurseries when the air was too hot outside, what with cleaning the house and digging new rooms, she really did not have time to eat.

In two or three weeks, a baby ant was hatched from the first egg that she had laid. It looked almost like the egg itself, except that the baby's body had a small groove

around it, just below its head. It was like a soft white worm. The mother fed it with food from her own mouth.

Now she could hardly find a moment, even to sleep. When she was not feeding the baby, or brushing and washing it with her tongue, she was carrying the eggs from one room to another, or licking them to keep them from getting dry and hard. All day long and most of the night her six busy legs trotted up and down, to and fro, in and out, till they fairly ached from weariness. Whenever she had a spare minute she dug her house a bit larger and laid another egg. It takes a great deal of work to be the mother of a whole anthill.

By the time there were six little ones hatched, the eldest was ready to fall asleep and change to a grown-up ant. It must have been a relief to the mother when the baby stopped eating and began to spin a web over her own body. After she was covered all around in a safe warm shell of silk, she curled down quietly and slept for almost four weeks. While she slept, the tired little mother kept on working harder than ever. She would be glad enough to have a grown-up daughter to aid her by and by.

At last one day the mother noticed that the cocoon moved and almost turned over. Something was stirring inside. She came running swiftly to help the young ant crawl out. She unfolded the six legs which had been doubled up in the narrow cradle. She smoothed the threadlike feelers, placed some food in the hungry new

mouth, and licked the soft skin of the slender body. Then she must have told this eldest child of hers to hurry and take care of the other babies.

Yes, there were dozens of babies in the nest by this time. Some were fast asleep in their cocoons; others were getting ready to spin the webs around themselves; others were still soft squirming little worms. The young ant began at once to run hither and thither in her eagerness to help.

She was nervous at first. Once she dropped a baby when she tried to carry it from one room to another. To be sure, the child was not hurt because she had such a very short distance to fall from her sister's tiny jaws to the floor. Still, the young ant was not such a good nurse as the mother. Sometimes while she was licking her baby sisters, she made a mistake and gave a nip that caused them to wriggle and squirm. When she started to feed one, as her mother did, by patting it on each side of the face with her antennæ, and then laying its lips against hers to drink the sweet liquid from her mouth, it twisted away as if she had squeezed it too tight.

However she kept on trying, and by the time that two other sisters had been helped from their cocoons, she could take care of the babies very well. Indeed, the mother began to leave most of the work to her daughters now, while she spent all her time and strength in laying fresh eggs.

III. Feeding the Family

One morning the eldest sister set forth to hunt for food. This was not her first trip out-of-doors, for she had often carried eggs up to the warm air above. Now she was going alone on a journey, and perhaps she would never come back. The beautiful garden was to her a world of dangers. A bird might snap at her; a spider might spring upon her; or somebody's heavy foot might crush her flat.

She was not afraid, however, doubtless because she did not stop to think of what might happen. Away scurried the little brown ant down the little brown hill. She ran across the path, her head bent toward the ground, her feelers touching every pebble and twig within reach. Now she scrambled over a bit of gravel; now she squeezed beneath a stalk of grass; now she trotted around the edge of a monstrous chasm made by some human person's heel. Such a chasm may not seem monstrous to you; but then you must remember that you are much bigger than an ant.

On the other side of the path she hurried forward zigzagging this way and that through a wilderness of grasses that stretched around on every side for inches and inches. Indeed it was a forest as long as the path itself and as much as two feet wide. At its farther border the ant smelled something good to eat. She stood still for a moment, and twitched her feelers so that she could tell from which direction floated that delicious fragrance.

Ah, now she knew! Hurry-skurry, she scampered toward the stem of a lily plant. There in a small hollow at the root lay a tiny fly that had been drowned by a sudden shower while he lay asleep in the lily-cup above. His body had been washed down the stalk to the hollow. The ant sprang upon it and lifted it in her jaws.

Dear me! but it was heavy, and so much bigger than she was herself that she could hardly balance it even when she propped it with her forefeet. She dragged it toward home very slowly because it was so big and she was so little. She had not noticed before how rough the path was. Now the dead fly's wing caught on a grass blade and almost jerked her back in a somersault. Now it had to be pulled and hauled over a pebble. Now it needed to be lugged toilsomely all the way along one side of a fallen twig, around the end and up the other side.

The ant was tired out when she reached home at last. And then, after all that trouble, to find that the fly was too large to go into the nest! Perhaps if she had been a little girl, she would just have sat down and cried. But being an ant she trotted into the hole and called her sisters to help. She could tell them things by rubbing her feelers against theirs. Two of them followed her outside and gnawed off the fly's wings so that he could be dragged down into the dining-room.

The next day she started out to hunt for honey. At first she tried to get it from flowers. It seemed as if she was

always in a hurry; you could guess that from the zigzag, nervous way in which she ran hither and thither. It really was too bad that she wasted her time over the flowers. The first one she visited was a yellow snap-dragon. When she reached the tip of the stem, she found that the pretty petals covered the golden heart where the honey was hidden, and she was not strong enough to push in.

Then she trotted off to a verbena. When she began to climb up the stalk, she kept running against the sharp points of tiny hairs. Every time one tickled her eyes or brushed her feelers, she seized it in her jaws, because she thought it was something trying to fight her. This made her so cross that she turned and scrambled to the ground.

Next she began to creep up a milkweed, but her claws cut through the green stem and sticky white juice flowed out. She could hardly pull her claws free and struggle away. The dirt on the ground stuck to every one of her claws so that she had to stop and clean them. The last blossom that she visited was one with petals curving outward all around the heart. When she tried to climb over the slippery edge, she slid and tumbled off. After picking herself up, and shaking her legs to see if any were broken, she gave up seeking honey from flowers. It was better for the flowers to be visited by bees instead of ants, because a bee sucks honey from only one kind of plant at a time. If the flowers grew so that ants could run from one to another, the yellow pollen in their hearts would get all

mixed up, and that would be bad for the seeds. You will learn more about this when you study botany.

Now where do you think the little ant went to find honey to take home? First she climbed a tree to explore. Such a long way up, and the bark was so rough that she had to stop and rest several times. It was hard work to clamber up bumps as big as mountains to her, to go scrambling down into cracks like deep valleys, or to run zigzag along the edge of a tremendous precipice half an inch high. When she reached the first branch, she trotted out on it, twitching her feelers now to one side, now to the other.

In a few moments she saw a tiny green bug standing with its head bent as it sucked the juice of the tree. She hurried up behind it and waited till a drop of something like water oozed out at the end of the small green body. The ant put her mouth close down and swallowed the drop quickly. It tasted sweet as the honey from flowers. As soon as another drop appeared, she drank that too. Then she stroked the bug's back gently with her feelers till a third drop oozed forth. That was how she milked the little green cow.

There were other ant cows, or aphids, as their real name is, on the branch. The brown ant went from one to another till she was so full of honey-dew that she looked as round as a bubble. Then she trudged away down the trunk and back through the garden to the nest in the little

brown hill. One of her sisters ran to meet her. The honeybearer rose on her four hind legs with her front legs outstretched and her head lifted. The other stood up in the same position and pressed her jaws against her sister's till a droplet of honey flowed from one mouth to the other. Two or three others came to drink a drop or two. Then the honeybearer pushed past them and crept into the house to feed the babies and the mother ant in the same way.

IV. Happy Days at Home

So the late summer slipped by. There was always work for everybody to do. The mother ant kept laying eggs. The eggs kept hatching into soft white hungry babies. The babies ate and grew till they were ready to spin their own cradles and fall asleep in the wonderful sleep that changed them to nimble-footed workers. The busy young workers nursed the babies, fed the mother, took care of the eggs, dug the house larger, milked the cows, hunted for small tender caterpillars and dead flies, gathered seeds to store for the winter, and once in a while went out to fight the ants from another nest.

One day a little sister discovered a trail of molasses that the grocer's boy had spilled on his way to the back door of the house at the end of the garden. She hurried home to tell the others. Soon a long line of ants were coming and going, one behind the other. They followed always the same path, winding between the grass stems,

around the pebbles, across the walk and up the porch steps. The ants who were marching to get more molasses waved their feelers when they passed those returning with their burden of sweets. Though ever on the alert to spring upon a stranger and tear and bite and wrestle, they were kind and helpful and affectionate to all those belonging in their own nest.

They worked steadily all the morning and were still trudging back and forth in the afternoon. Then something disturbed them. Suddenly those who were crossing the path stopped, waved their feelers, broke from the line, ran uneasily this way and that, and finally scurried off in all directions. From around the lilac bush came marching an army of big red ants. They did not move in step side by side, but pushed on close together in a long narrow crowd of hundreds and hundreds. Forward they pressed without paying any attention to the frightened brown ants. They were on their way to a nest where some black ants lived. So on they journeyed over the path, across a flower bed, under the hedge and zigzag over a broad rock to the foot of a tree.

The black ants saw the red ants coming and began to run hither and thither. Some scampered away to hide in the grass or climb up weeds for safety. Others scuttled into the nest and tried to carry the eggs and babies with them as they fled to the deeper rooms underground. The big red ants rushed up the hill and dashed in at the doorways.

They went straight to the nurseries, but they did not kill the young ones.

When they came out, some were carrying eggs; others had the soft little wriggling wormlike babies in their jaws; others were holding the cocoons in which slept those who were changing. They were taking to their own home these children of the black ants so that they might have servants to work for them. When the captives grew up, they took care of the red ants' eggs, and nursed their babies, and kept the house clean.

The brown ants, however, who had been busy with the molasses, knew nothing of this dreadful robbery. They never stole other ants' babies. They preferred to do their own work and attend to their own children. This was all the better for them, because work made them stronger and healthier, and very likely happier too, than the lazy ants who kept slaves.

When the autumn days grew cooler the little brown ants seemed to become dull and drowsy. The mother ant laid fewer eggs. The nurses were less careful to carry the eggs from one room to another every day. The soft white squirming babies lay quiet, without eating, for hours at a time. The young ones, shut close in their cocoons, slept longer and longer. The workers who went out to find food for the nest moved more slowly and came trudging home sooner than they had done during the warm summer weather. The tiny green cows on the trees and plants were

nipped with frost and died. But some of their eggs had been taken away by the ants and hidden safe in the deep rooms underground, where the cold could not reach them.

Winter clouds sifted snow over the anthill, and icy winds blew through the bare garden. In their house with its winding galleries and wide halls the queen dozed beside a heap of her newest eggs. Now and then a nurse crawled slowly to the piles of seeds in the store-room, and took a listless nibble here and there. Then she crept back among the sleeping babies to watch for any who might wake up hungry for a moment.

When the spring sunshine thawed the frozen soil, the ant-hill began to stir with fresh life. The mother began to lay eggs faster. The babies began to squirm and wriggle with impatience to be fed oftener. The sleeping young ones began to kick in their cradles, eager to escape. The busy workers ran to and fro in the biggest kind of a hurry.

No wonder that they felt nervous with all the work to do! What with caring for the eggs, and watching the babies, and cleaning the house, and digging new rooms, and hunting for food, and tending the little green cows, they were almost worn out before darkness gave them a chance to rest. Indeed, at some specially busy times they worked late into the night.

This summer brought them an extra task. Among the young ants waking from their long sleep were a number of

brothers and sisters with wings. These did not help with the work of the home. They did not even take care of themselves, but were fed like babies. Once in a while they were coaxed to go outside and play in the fresh air. They crawled along a grass blade till it swayed up and down beneath their weight, while they clung to it as if swinging for fun. Sometimes they chased each other around a pebble, or stood on their hind legs and waved their feelers and clashed their horny jaws. Perhaps they felt that it was much pleasanter to be a winged ant than a busy little worker always in a hurry-scurry over something that had to be done.

But alas for their lazy days! One afternoon they were all driven from the nest, just as their mother had been pushed away from her first home the year before. The wingless ones nipped and prodded and poked them till they spread their filmy wings and flew up, up, up into the warm afternoon air. Swarms of winged ants from other nests joined them, and away they drifted, whirling and dancing with the breeze.

After the joyous flight was over, here and there they dropped to the ground. But only a few from the hundreds in the flashing swarm lived to start new nests the next morning. Many of them had been snapped up by birds and bats and dragon-flies as they danced in the twilight. Many had died of cold during the night or been gobbled by watchful spiders and solemn fat toads. Still, in spite of such perils, dozens and dozens of new little brown houses

began to be built along the road and in the meadows that late summer. And back in the old nest by the garden path the little brown ants worked as busily as ever all day long.

How Doth the Little Busy Bee

I. No Time to Play

The young bee was beginning to wake up from her long sleep. She stirred uneasily. Her four filmy wings that lay folded damp and soft at her sides quivered, and her six slender legs uncurled their tiny claws. She lifted her head and moved it to and fro. Close around her pressed the smooth walls of the waxen cell of honeycomb in which she was lying.

Two weeks earlier she had gone to sleep a fat little baby bee like a white worm, and now she was waking up a grown bee with wonderful big eyes for seeking gaily-colored blossoms, with a long tongue for sucking honey, with jointed feelers for touching and talking, with wings to bear her through the garden, and with legs that she could use for walking and clinging, for combing and brushing, and even, like baskets, for carrying the yellow pollen dust from the hearts of the flowers to the hive.

Very likely she was not in the least surprised at the change, for bees always change in that way. It would have been most remarkable indeed if she had stayed just the same from the first day to the last of her nap. But if it had been you, that of course would be different. Suppose you should go to sleep a soft white worm and wake up a gauzy-winged bee? Wouldn't that be surprising!

Well, the first thing that young bee did with the little jaws of her new head was to bite a hole through the waxen curtain that covered the outer end of the honeycomb cell. Then she poked her head through and looked around with her big eyes. It was dark there in the middle of the hive. Above and below her stretched a wall of honeycomb from ceiling to floor. Opposite her, so near that she could almost touch it with her feelers, another wall like that in which she had lived all her baby life reached also from ceiling to floor. No wonder it was dark in that narrow passage, especially as the one little door of the hive was so far away beyond the nursery honeycombs that she could catch only a glimpse of a faint ray of light stealing in from the sunshiny morning outside.

In the dusk around her something was moving. She could see dim forms of many bees crawling over the honeycomb. Two or three of them climbed up to her. One gnawed the hole bigger so that they could help her squeeze through to the outside. She clung there, weak and pale, digging her claws into the wax, while her nurses licked her with their tongues and brushed her with the brushes on their hind legs. Another brought a drop of honey and laid it in her mouth. As soon as she swallowed it, she began to feel stronger. It was her first taste of food since she had fallen asleep so many days before.

While she rested, waiting for her wings to dry and her legs to cease their trembling, the nurses pushed into her empty cell and cleaned away the bits of wax, the bee-

bread, and the silken threads which she had spun over the inside of the door. They were making it ready for another egg out of which would hatch a new baby. After they had finished this work, they went creeping onward to other cells where other babies were lying, some squirming hungrily, some curling down for a nap, some ready to bite their way out. The new little nurse crawled after them. She did not even think of stopping to play a little while she was young. She was eager to begin to help with the work of the hive.

Such a busy time as she had for the next week! There were hundreds and hundreds of babies, each in its own tiny cell. There were hundreds and hundreds of nurses, for every young bee went to work nursing as soon as she woke from her long sleep and found herself changed to a grown up bee. Nursing was the easiest work of all, and that was why the youngest ones did it till they were strong enough to go out to gather honey from the garden.

However even the easiest work in the hive was not much like play, though it was certainly interesting. Our little bee had not a minute to spare. Now she poked her head in at the open end of a cell to see if the egg there had hatched yet. If a new baby was lying curled down in the end of the waxen cave, she reached down to lay her mouth against its lips and feed it with food already digested in her own stomach. This special food is called bee-jelly, and is fed to every baby worker for the first two days of its life, and to a queen all her life.

Perhaps the next thing this nurse did was to climb to the honey-cells at the top of the hive to bring a drop of the sweet liquid to one of the older babies. Or it might be that her part was to visit the comb where the pollen dust was kept, and to carry a speck back to mix with honey to make bee-bread. Now she packed a bit of bee-bread down beside a big baby who was ready to go to sleep. Then she aided in closing the open end of that cell with a curtain of wax so that the sleeper would not be disturbed during the wonderful nap. Now she clung in front of the closed cell and beat her wings till she felt hot enough to melt. The warmth of her body, added to the warmth from the other small nurses who were dancing and fluttering beside her, heated the air near them. This heat made the baby asleep behind the curtain change faster than while it was cool. A few moments later she was hurrying with the others to help a newly awakened young bee out of the cell, to lick her furry coat, to brush her and comb her and lay a drop of honey on her tongue.

II. Off on Flashing Wings

And at last, after a busy week of this, how strange it was the first time she went flying! She did not go alone, for almost all the other nurses who were just her age started out the same day. Since the queen bee laid many dozens of eggs every day, of course dozens of babies hatched at about the same time and grew up together. Such a crowd

of them as went creeping over the nursery honeycombs toward the entrance that sunshiny summer morning!

They crawled out upon the platform in front of the door. Our little bee was afraid of the light at first. The two large black eyes on the sides of her head shone like jewels. These two remarkable eyes were really made up of six or seven thousand single eyes close together. In the middle of her forehead was a group of three simple eyes. No wonder the sunshine seemed dazzling to her after the dusky shadows of the windowless hive!

Perhaps she trembled for a moment and moved closer to her sisters. Surely the world outside the hive was very big and bright and terrible. Surely it would be safer to slip back again into the warm, dim, friendly darkness of the hive. It may be that she turned and lifted her wings to help her hurry faster. And then—and then—it was the queerest thing! Somehow the two upper wings hooked upon the two lower ones, and were held spread wide open. She flapped them once, twice, gave a little leap upward, and away she went sailing through the air.

The fresh air flowed into her body through the tiny breathing holes on each side. This made her feel light and clean and joyous, even though she could not quite get over her instinctive fear of being separated from her sisters in the crowded hive. After a few circling flights over the bushes near-by, she alighted on the platform and, unhooking her wings, folded them as before and crept

back to her work in the nursery honeycombs. It was not until a week later that she set forth on her first visit to gather honey from the flowers in the garden.

How sweet the air was that beautiful morning! Any bee could tell, just from smelling of it with her feelers, that flowers were unclosing gay petals from over their golden hearts everywhere in the garden. Our little bee crept out of the hive and paused on the platform. Did she know that she was going to get honey? Who had told her that she must seek it in a flower instead of in a waxen cell of honeycomb where she had always found it before? How did she know what a flower looked like? She had never yet seen one in bloom?

Perhaps she did not know where she was going or what she was seeking? All that she knew was that she wanted somehow to spread her wings and fly away from the hive. Many bees were humming about the platform. Some were starting out and others were returning. Almost before she could make up her mind to follow one or another she found herself flitting upward. A moment later she circled and darted back again in fright. What if she should lose her way in the wide sea of light and air that reached to the skies? Again and again she set forth, only to swoop quickly home after a short timid flight. At last she rose high, with her head turned toward the hive, and hovered there, looking around at the garden below her. She wanted to be sure to remember the path back. Then off on flashing wings she went to her new work.

III. Hurrah for the Honey!

This was different from pushing through the crowds in the dim shadowy hive. She went soaring, now up, now down, now in long dipping flight hither and thither! There was no danger here of bumps and bangs and bruises against other hairy little bodies crawling close together over the combs.

Across the lawn she flew toward the flower beds. A fragrance floating upward made her feelers quiver. Her shining eyes saw spots of bright color where the marigolds opened their yellow blossoms in the sunshine. Darting nearer she hovered above them, her wings buzzing against her body. Suddenly she dropped upon a blossom and thrust her tongue down into its golden heart. Her little black tongue went wriggling in and out of its tube as she lapped up the honey in the flower. She swallowed the sweet liquid into her tiny honey-sac, and then flitted to another blossom.

When her sac, which held as much as a small drop, was full, she rose high above the marigolds and flew straight to the hive. Bees always take the quickest way through the air when they are headed for home; and that is why people call the shortest straightest path to anything a bee-line.

When she reached the hive she crept inside and went to empty her honey into one of the clean new wax cells near the edge of the comb. This fresh sweet juice, or

nectar, is more watery than honey ought to be. So, while some of the bees keep bringing in nectar and pouring it into the cells, others work over it, fanning their wings to and fro just as the young nurses do to help warm the babies who are changing in their sleep. The warmed air blows over the nectar and dries up part of the water. Then the bees squeeze from their heads a few drops of something that keeps the honey from spoiling. After that they cover each full cell with a thin curtain of wax to keep it safe for the winter.

The next morning our little bee went out to gather pollen-dust for the nurses to mix with honey in making bee-bread for the babies. This time, instead of lapping up nectar, she tumbled about in the yellow center of a flower till the pollen grains stuck to the hairs on her legs and body. Then she rubbed the little stiff combs on her hind legs over her body and scraped off the pollen in two pasty balls. On the outside of each hind leg was a small hollow spot bordered with hairs. These were the baskets in which she carried the balls of pollen as she flew home. They were so heavy that they dragged her legs down. She had to flap her wings hard to travel with such a load.

When in the hive again, she crawled to a cell near the nursery, and stood with her hind legs in it. She pushed off the balls of pollen with her middle legs, and other bees smoothed it down while she hurried out again to get more. On each journey she visited only one sort of flowers, so that the pollen in her baskets was all of the same kind. This

was exactly what the flowers needed to help them to form good seeds, as you will learn when you study botany, but I cannot explain it to you now.

After the young bee had worked a few days at gathering honey and collecting pollen, she stayed in the hive one afternoon to make wax for new honeycombs. This task really was hardest of all, though it looked easy enough. She climbed to the ceiling and hung there by the claws of her front legs. Another bee crawled up and clung to her, and another caught hold of that one, and so on until there was a chain of bees hanging still in the dark. Others climbed up beside them and swung down other chains which tangled together in a mass of little warm bodies. The longer they hung there, the warmer they grew. Our bee felt drowsy and numb, waiting and waiting, almost asleep. Tiny claws of her sisters clutched her hair and her legs. She could hardly breathe in the close-packed crowd.

And slowly, slowly, while she clung there without moving, four specks of wax formed in the four tiny pockets on the under side of her body. It was almost as if she perspired wax instead of salty water, as you do.

Then, one by one, the bees crawled out of the mass and took the scales of wax from their pockets and chewed them soft. The first one stuck her bit of a lump to the roof. The next one added her speck and the next and the next did the same, till there was a little knob of wax hanging from above.

After that, another bee climbed up to it and scooped out a small hole on one side, while others scooped out a hole on the opposite side. The wax-makers kept bringing more wax and building it on to the comb; and the other workers kept digging new cells. At last a whole new comb hung there ready to be filled with honey.

IV. Moving Day

Meanwhile, back in the dark nursery, the big queen bee went creeping from empty cell to cell, and laying an egg in each one. A number of working bees followed her everywhere, feeding her on the purest honey, cleaning and brushing her, and watching her night and day. If anything should happen to the queen there would be no more eggs and no more babies to grow up and help with the work of the hive.

Now, of course, a queen bee cannot live forever, even if she may live four or five years. It was wise to have a young queen ready to take her place whenever she might die. Generally there was more than one little princess growing in the hive. It was the oddest thing! When the bees wanted to have a new princess, they simply made a special big cell for one of the ordinary eggs. The baby who hatched from it was fed on bee-jelly all her life, instead of partly on bee-bread. And wonderful to think! During her long sleep, instead of changing to a small worker with a tongue to suck honey from the flowers, with brushes on her feet, with pollen-baskets on her legs, and with wax-

pockets on her body, she waked up a big queen who could do nothing except lay eggs.

It chanced one day that a young princess was ready to gnaw her way out of her cell, while the old queen was still living. There is never room for two queens in one hive, so what do you suppose they did? The old queen flew away with thousands of the workers to begin a new home.

This was how it happened. The hive was getting more and more crowded every day as more young bees kept gnawing out of their cells. Our little bee could hardly push through her sisters who were creeping about the doorway. Her neck fairly ached from prodding those in front of her this way and that. While she was busy emptying her baskets of pollen, the hurrying nurses bumped into her. When she brought in honey, the lazy drone bees, who never worked, jostled against her in their greedy haste to steal a mouthful. If she was busy cleaning the floor or plastering up cracks with gum from certain plants, she had to step aside every moment to let one or another pass. Whenever her task was to help keep the air fresh by standing near the door and clutching the floor with her claws while she beat her wings to and fro, somebody was always banging into her. It seemed as if she really did not have room to turn around except when she could escape into the wide spaces of the garden.

One beautiful morning our little bee awoke as usual and crept toward the door in readiness to set forth to

gather honey. But those who generally guarded the entrance and greeted every passer with a wave of their feelers seemed to be excited over something. They were running to and fro nervously. Others were crawling in and out without bringing any burden from the flowers. Behind her in the hive thousands of bees began to suck honey from the open cells where it was stored. Each one took enough to last several days, for they would have no time to visit the garden when they were starting their new home.

After a while some of them spread their wings and began to fly round and round inside the hive. The queen rushed from the nursery and dashed hither and thither as if she were crazy. Finally she ran through the doorway and, lifting her wings, flew upward. Pouring out after her came the throng of her followers. They flew with her, circling and drawing closer and closer in a swarm of vibrating little bodies and glistening gauzy wings. When the queen alighted on a tree and held quiet, the others came to rest around her and hung there, clinging to one another in a living cluster.

Presently a few of the bees loosened their hold and started off to hunt for a hollow in a tree or wall where they could live, plastering up the cracks and hanging curtains of fresh honeycomb for a nursery and store rooms.

Meanwhile back in the old hive our little bee found herself amid those who had stayed behind. Then indeed she had to work harder than ever in her life. Though the

workers were so much fewer than before, there were just as many babies waiting to be fed, just as many greedy drones eager to steal honey. A new queen was almost ready to begin to lay eggs. And besides all that, more honey must be gathered and stored for the winter that was coming.

V. Waiting for Spring

As the days became cooler, the bees did not work so hard as during the summer weather. The queen laid fewer eggs. The babies slept more and ate less. There was no need to build new combs, for little honey could be found in the stray flowers that still bloomed in the garden. One morning, after a frosty night, our bee crawled slowly from the door and flew toward the marigold bed. The blossoms hung wilted and blackened on bent stems. After hovering over them a moment, she flitted back home.

There was plenty of room inside now, even more than at the time when so many of her sisters had swarmed away following the old queen. Since then the drones had been driven out of the hive, and had died of cold and hunger. The workers knew that they would need all the honey in the combs to keep them alive through the winter. They had none to spare for feeding greedy drones who had never helped gather a grain of pollen or drop of nectar all summer.

Finally winter came in earnest. An icy wind rattled the bare branches of the trees. Snow sifted down over the shrivelled plants in the garden. It covered the earthworm's burrow, and lay deep and soft above the spot where grasshopper eggs were buried. Mosquito wigglers hid in the mud at the bottom of the pond in the meadow. Here and there in the sheltered crotch of a limb, or rolled within a doubled-up leaf, the cocoons of different kinds of butterflies hung waiting for spring. In the house a few flies crept behind the pictures or slipped into a crack till the warm weather should make them feel like coming out to go again a-buzzing. Spiders slept in their holes or curled up in the middle of thick webs. The ants moved about dully in their underground houses. Within the hive the bees clung together in a great cluster around a comb full of honey.

Our little bee happened to be next to the honey. When she was hungry she sipped a drop and then passed on a mouthful or two to those behind her. From one to another the sweet food travelled till all were fed. When that comb was empty, they moved to the next, crawling over each other. Sometimes our bee was snug in the center, with the many wings around her slowly beating to and fro to keep the air warm. Sometimes she found herself swinging in the outermost row. When too chilly there, she pushed and scrambled farther into the close crowded mass.

Slowly the winter hours dragged on and on and on. Drowsy, barely stirring, half alive, the bees clung together,

waiting for spring to bring the flowers in the beautiful garden.

Stories of Insect Life

Our Insect Musicians

The tree-top concert troupe, of which Dame Nature is the manager, includes not only the birds, which are the celebrated singers, but a great orchestra of insects that do the instrumental parts. They are fitted out with the most ingenious little drums, violins, and castanets that you can imagine, and on these they play most skillfully, without ever taking lessons or spending time in practice.

In this country these insect musicians have a "season" of six or eight weeks during the long, hot days and still nights of mid-summer. Nature makes great preparations for their comfort and enjoyment. Their "green rooms" are every year freshly curtained and decorated and a continual feast is spread of the food most agreeable to their taste. "And which are the musical insects?" do you ask?

Well, in the first place, there are so many insects that have the power of producing sounds that it would make the list too long to mention every one. We will therefore include among our true musicians only those that have some especial apparatus for the purpose, and that make a business of playing at certain hours of the day or night.

This will leave out all the bees, wasps, and flies, most of the beetles and grasshoppers, and even the mosquito whose "song" so exasperatingly informs us of her blood-thirsty intentions before she has a chance to stab us with her tiny lancets.

All these insects produce their "hummings" and "buzzings" and "whirrings" by the mere act of flight, and, though they add a very fine tone to Nature's harmony, we will not here consider them as members of our "Band."

Among our greatest performers are the harvest flies, or cicadas, some of the true grasshoppers, and all of the katydids, black crickets, and tree crickets. It must be remembered that only the males are provided with instruments and are supposed to play for the purpose of calling up their mates. But as they continue their solos and choruses for hours and seem to pay no attention to the members of their family which may come to listen, we may conclude that they play for the pure enjoyment of it.

One or two of the lady katydids sometimes make a sharp chirping sound by a sudden jerk of the wings, but they are the exceptions to the rule.

It has always been a great puzzle to find out where the ears of insects were located, and so far this has been done only in the case of certain grasshoppers, which have earlike organs on the joint of the hind part of the body next to the thorax, and in the katydids and some of their relations, which have their ears on their front legs! Nothing that would seem to serve as organs of hearing has yet been found on the noisy harvest flies, nor on the squeaking beetles. It is, however, only reasonable to suppose that all insects, having an especial apparatus for

producing sounds, have also some means for hearing them.

Every one will agree that in the summer concerts the "leading role," as musical people would say, is taken by the harvest fly, or dog-day fly, or annual cicada. This insect is well known in almost all parts of the United States. It makes its appearance every summer. It is one of the largest American insects of its family, another being its singular cousin, the seventeen-year or thirteen-year cicada, commonly, but incorrectly, called a "locust."

There are two broods of the common harvest fly, one of which appears one year and the other the next, because it is said to be two years in getting its growth. This period is passed underground, feeding on the tender roots of trees and shrubs. When full-grown it tunnels its way upward toward the light and air, but stops just below the surface to change its form for one better suited to crawling on the ground and climbing trees. This is its pupa stage. It has now a hard, light brown shell with strong, spiny legs, large eyes, and wing pads. In this form it comes out of the ground and runs as fast as it can to the nearest tree, up which it scrambles to a height of several feet. Here it attaches itself firmly to the bark by its spiny legs and claws and is ready for its second change of form.

This takes place in a few hours. The pupa shell opens on the back, and the perfect fly draws itself out. It is very soft and pale in color at first and the wings are short and

limp. As soon as its body hardens a little it climbs up into the tree and hides among the leaves until its wings spread and stiffen and it is able to fly. The empty pupa shells are left clinging to the tree, and many of these are to be seen every summer in orchards and groves.

The perfect insect is more than two inches long and quite stout. The head is short and broad with a large round eye on each side. It has short, bristle-shaped antennæ and a sharp, strong beak doubled under its chin. The colors are black and green, and on the sides and underneath it has a chalky appearance.

The drums are on the under side, covered by little rounded flaps that are hinged to the body on one edge. Over the hollows are stretched convex pieces of membrane gathered into fine plaits. These form the drum heads and are played upon, not by sticks, but by strong muscles or cords underneath, which are loosened and tightened with great rapidity, producing a shrill rattling sound that begins rather slowly but gets louder and faster in its vibrations, until it is almost deafening when close at hand, and finally dies away in a slow, dragging "whirr," as though the performer were tired out. But after a minute's rest he begins again with great energy. These performances take place usually in the afternoon and are continued into the twilight hours, but during the night the insects rest or amuse themselves quietly.

The seventeen-year or thirteen-year cicadas appear in immense numbers at their appointed times, and the woods and orchards during these "locust years," as they are called, ring with the long-drawn-out *"Pha-a-a-a-rho,"* as the sound has been translated, by those who at first thought these insects to be the same as the "locusts" which plagued the wicked king of Egypt in early biblical times.

The Songs of the Katydids

The prettiest and most interesting of musical insects are the katydids and their near relatives. The true katydids live in trees or on tall shrubbery and are more frequently heard than seen. There is quite a family of them, each differing from the others in form and having its own peculiar tune.

They are very active and graceful insects, of a deep green color, and in the texture and veinings of the wings imitate the leaves among which they dwell. The head in several species is shaped and set on like that of a horse, and they have a most wise and dignified expression. They all have very long, thread-like antennæ, of which they take the utmost care. The legs are quite long, especially the hinder pair, and they are great jumpers. The musical apparatus is on the back, at the bases of the wings. It consists of two triangular, overlapping plates of strong, clear membrane, surrounded by a raised horny border with some cross ridges of the same substance. When the upper wings are partly lifted and slowly opened and closed, these ridges grate upon one another and produce the distinct rattling sounds by which these insects are known.

The "head of the family" is the broad-winged katydid—the only one whose upper wings entirely cover the under pair and the body. This hatches in the spring,

from eggs that had been crowded into the rough bark of trees, and grows for about two months before it gets its wings.

This is the species that, all through the summer nights, continues to tell us either that Katy "did" or that she "didn't," but never reveals to us who "Katy" was, or what remarkable thing she did that should be so continually asserted and contradicted. The poets, it is true, would have us believe that they know all about it, and have told the story in many ways in very musical verses, but we still have our doubts as to whether the katydids really favored them more than they have other people.

The next species to attract attention is the angular-winged katydid. This is a longer and more slender insect, which takes its name from the upper outline of its wings. It is the eggs of this species that are so often found bordering the margins of leaves or arranged, one overlapping the other in rows, on slender twigs and on strings and wires, sometimes even indoors. The note of this insect is simply a clear rattle, which has been compared to the sound made by drawing a stiff quill slowly across a coarse file, or to some sorts of baby's rattle boxes.

Another member of this tree-top family is the narrow-winged katydid—a pretty little creature, only about one-half the size of the two just described. Before this species gets its wings, it is frequently found on bushes and low

plants. This is accounted for by the fact that it hatches on the ground from eggs which its mother had the fall before pushed into the edges of oak and other thick leaves, between the upper and under skins. It is the most gaily dressed of all the young hoppers, having its velvety green coat ornamented with bands and dots of red and yellow. Its wings also, after it is grown, show some rainbow-like colors in certain lights.

The note of the male is a soft little call, like *zeep, zeep, zeep,* to which its mate responds with a cheerful "chirp," by suddenly extending her wings as if for flight.

Still another very noisy insect is the cone-head. It quite closely resembles the angular-winged species, except that it is more slender, with straight wings, and has the head pointed on top. It makes a long-continued, shrill whirring that when heard close at hand is almost ear-splitting.

These are the principal performers in the nightly concerts, but their music is accompanied by the chirpings of the black crickets, the soft murmurings of those shy and singular insects, the mole crickets, and by the high notes of the delicate little tree crickets.

Besides the "musicians" mentioned, there are a considerable number of their more or less distant cousins, that give very lively matinee performances during sunny afternoons in the fields and meadows.

Among these we find, in addition to several of the long-horned grasshoppers, which are smaller in size, but

otherwise much like those that live in trees, some short-horned grasshoppers, the true "locusts," that are most accomplished fiddlers. They sit upon tall grass stalks and play, first with one stout, roughened hind leg and then with the other, upon the ridged surface of the upper wings, exactly as a violinist draws his bow across the strings of his instrument. There are quite a number of these, but we cannot now describe each separately.

Any observing boy or girl can make their acquaintance, without an introduction, by visiting them in their homes and approaching them softly, so as not to interrupt their solos.

No insects afford more interesting subjects for study than these musical species.

The katydids, especially, are very friendly and confiding, and will sit upon one's finger while dressing their antennæ or polishing their feet and wings, and will even nibble a bit of bread or apple with great relish if it is offered to them. When confined in an insect cage of glass and wire cloth, they become perfectly tame, and if well supplied with fresh leaves for food, will go through all their performances with as much energy and pleasure as though they were free.

The Firefly

What a gay carnival season is the golden, glowing summer to the insect world! All day long butterflies flit from flower to flower, and bugs and beetles, in shining coats of mail, wander up and down the garden paths on their little errands, while the hum of bees and flies keeps up a soft accompaniment to the bird solos that ring out from the trees and hedges; and, turn which way we will, we find

There's never a leaf nor blade too mean
To be some happy creature's palace.

But if the sunshine brings out the more gaily dressed of these little beings, the purple twilight has also its no less interesting forms, and even during the starlit midnight hours throngs of insects, in white or somber colors, noiselessly pursue their pleasures and perform the work that Nature gives them to do.

Among the insects that come out of their hiding places only after the sun has set is one that everybody observes and admires. I mean the firefly.

With what pleasure we follow its brilliant, intermittent sparkle over the lawn and among the shrubbery! The dusky scene becomes fairly illuminated on warm evenings in July and August with these innumerable little lights, ever vanishing and reappearing; sometimes a single

gleam, and then a great many flashes at once, as if the insects had agreed on forming a miniature constellation.

Fireflies are really not flies at all, but soft-shelled beetles; that is, the wing covers, instead of being hard, like metal or shell, are more like thin leather and can be bent without breaking, and they are not folded so closely around the body as in many species. There are several kinds of "lightning beetles" in different parts of the country, but the one which gives the brightest flash is found in the Middle and Southern states.

Seen by daylight it is rather a common-looking insect, from one-half to three-fifths of an inch long, and of a flat oblong shape. The wing covers are a dull black, with a narrow border of pale yellow. The head, with its large eyes, cannot be seen from above, as the shield-shaped top of the first joint of the thorax sets out over it like the brim of a hat, and only the notched antennas, or feelers, appear. This little shield is of a dull yellow color, with a black spot in the center and one of bright rose red on each side. The hind body, on the under side, is dark brown, except the two end joints, which are of a clear sulphur yellow; and it is from these that the strange, brilliant gleam is given out. The material for this light, like that sometimes seen on decaying wood, is supposed to be phosphorescent, and the flash seems to be produced by the influence of the nervous system acting upon the cells of the luminous portion of the body.

Under the wing cases which have been described are folded the large transparent wings by which it flies, though there is also a slight motion of the wing covers which are held straight out from the body. The flight is very graceful, a sort of slow swimming through the air, and though the motion is very rapid, no fluttering can be distinguished.

Almost every one knows the insect in its firefly form, but the two earlier stages, that of larva and pupa, are but rarely seen. The grub, or larva, lives in the soil and feeds on earthworms and soft-bodied insects. It is not yet known exactly how long this growing period lasts, but probably several months, as most burrowing beetle larvæ grow rather slowly.

When it has reached full size it is a smooth, distinctly jointed worm, about one and one-eighth inches long, showing thirteen rings, or joints, beside the head. On the top of each joint is a polished horny brown plate, marked with three white lines. The sides are pink or red, and the under surface cream color with brown markings. Each of the three joints behind the head is provided with a pair of jointed legs, but, unlike the larvæ of butterflies and moths, it has no prolegs under the middle of the body, and only one very curious one at the tail. This proleg, or appendage, can be drawn into the body or thrust out at will, and not only assists the insect in moving about, but is used like a brush to clean the head and other parts of the body after feeding. Dr. C. V. Riley, who was the first to study its habits, says: "It is quite amusing to watch one of these

larvæ as it deftly curls its body and stretches this fan-like organ over its head and literally washes itself."

This larva is quite luminous, a sort of glowworm, and after dark may often be found by this character when the soil in which it hides is stirred.

When it is full-grown it forms a hard, earthen wall all around itself, and in this it changes to a pupa. The latter is not very different in appearance from the larva, except that the upper part is thicker and the wing cases show plainly. It also glows with a faint, steady light. In about ten days it slips off its pupal shell and breaks out of its little earthen house and comes to the surface of the ground a perfect beetle, very soft and limp at first, but soon hardening and ready to join the other sparklers on lawn or meadow.

A Queer Little Nursery

A lady who was sewing one warm day by an open window was surprised by a visitor whom she did not remember ever to have seen before. The stranger came in quite familiarly, softly humming a tune, and dropped down upon the window sill to rest. She did not answer the lady's greeting in words, but made many odd little bows and curtsies, as she looked around with her large eyes and seemed to take a very careful survey of the room and its furniture. She had a neat, slim figure and was dressed in glossy black, trimmed with pale yellow, and wore a gauze scarf. The spools of thread on the window sill soon excited her curiosity, and presently, to the lady's astonishment, she walked, head-foremost, into a "No. 40 Coats"!

"Why, it must have been a fairy!" you will say. And so it was, indeed. Not exactly the sort of fairy that we read of in Grimm's *Tales,* which would look like a boy or girl seen through the wrong end of a telescope—but a real fairy, one of the millions of little people who live in our fields and woods and gardens without paying us a cent of rent, and carry on the most wonderful business, almost under our eyes, of which we know nothing at all. But to make the matter plain, this singular-acting visitor was a little mason wasp, who was looking about for some convenient place in which to build her nursery. The inside of the spool seemed to be the very spot for which she was searching, and after buzzing about for a few minutes, she backed out

and darted swiftly away through the air. In less than five minutes she returned with a lump of damp clay, about the size of a sweet pea, tucked under her chin.

This she carried down into the spool and stayed there some time pressing it into place, after which she came out and flew away, to return very soon with more clay. This she did three or four times. After the fourth flight she was gone for a much longer time, and when she again appeared was carrying, with some difficulty, a green measuring worm, nearly an inch long. She seemed very tired and, still holding the worm, sat for a short time on the end of the spool to rest. Then taking a good hold of it with her jaws and allowing it to slide under her body, she dragged it into the spool and seemed to take great pains to coil it up and press it together, so that it should not occupy much space. When it was adjusted to suit her she came up and flew away, returning soon with another worm of the same kind, and went through the same motions in packing it away. The third time she brought another sort of larva, and the fourth time still another. As she returned with this, the lady, who was watching her with great interest, made a slight motion, which frightened the wasp, and she dropped her burden before reaching the spool. For a moment she seemed very much bewildered, turning round and round and buzzing noisily, but instead of picking up the worm, flew off for another.

While she was gone the wounded larva was examined with a lens, and the places where the wasp had stung it

could be plainly seen. These stings were not severe enough to kill it, but rendered it almost motionless and helpless to escape. It was taken up and placed upon the edge of the spool, but when the wasp came with still another larva, she took no notice of it and pushed it off in making her way into the hole. She remained hidden for a long time and, after her next flight, came back with more wet clay; so the lady knew that one little cell was finished and stored with food for the wasp baby, and that the egg was laid from which the baby would hatch.

As soon as the first cell had been closed up another was begun, and for an hour and a half the industrious little mother continued to carry clay and small, smooth caterpillars until three cells had been made and supplied, and the spindle hole in one spool was full and all nicely plastered over the top.

Several times during the process, either from weariness or because she had been startled, she dropped her insect or bit of clay, and never once would she pick them up, but always started immediately for another load.

When the first spool was finished she began without delay in another; but by the time the first cell in this was closed up, it was so late that she went away to rest for the night. The window was carefully closed and the spools of thread that had been made use of were left standing, and other empty spools were looked up and placed beside them.

Soon after the window was opened the next morning, the wasp appeared, to see if everything was as she left it, and seemed well satisfied with the state of affairs. The cell building went on until by the afternoon of the third day she had filled nine spools, the smallest with two, others with three, and the largest with four cells. When this was done she flew away, to return no more.

The spools were all firmly masoned to the window sill, and scattered about among them were many pellets of clay and paralyzed larvæ that had been accidentally dropped. One of the last-filled spools was examined and found to contain three cells, separated by plates of fine mortar which was almost as hard as cement. The side walls were not plastered. When the spool was loosened from the window sill the contents of the lower cell fell out. They consisted of six larvæ, "geometers" and "apple worms," the former more than an inch long, and the latter making up in plumpness what they lacked in length. It did not seem probable that a single wasp baby could require so much food, but no doubt the little mother knew.

The small, oval, white egg from which this baby was to hatch was attached to the side of the cell by a short hair-like stalk. It was no easy matter to pack these limp but living larvæ back into the cell, but they were crowded in as well as possible and held there by a little plug. Two days later, they were again turned out, and there was the tiny wasp larva with its head buried in one of the apple worms. It was spindle-shaped and of a glossy, greenish-white

color. In a week it had eaten all its provisions and seemed to be full-grown.

It was now more than half an inch long and quite thick through the middle of the body. Soon after, it was found in the pupa form, very soft and cream white, but showing the wings and legs and mouth parts of the perfect insect. In less than a week it came out a full-fledged wasp, like its mother. Some reader may wonder how the wasps in the lowest cells, which would be the older, could get out without hurting the younger ones above them. But it was found that they all got their wings about the same time, and those in the upper cells came out first, followed very soon by those next below them. In less than two weeks every spool was empty again, and the insects came no more to the window sill that summer.

This wasp is quite troublesome at times when it clogs up the keyholes of doors and furniture with clay and worms, and it also stings quite severely, if accidentally squeezed or roughly treated; but for all that it makes a most interesting subject for study, and will build its nest in any little tube, like a pencil case or penholder, that may be provided for it.

There are two or three broods during the summer, and where they are abundant there is no doubt that these little wasps destroy a great many leaf and fruit-eating caterpillars and should therefore be regarded as among our insect friends.

An Insect Mother and Her Brood

There is an oddly shaped little leaf-hopper often seen in summer on sunflowers and other plants of the same family. It will be easily recognized from the picture, but is only one-fifth of an inch long. In color it varies from light brown and yellow to a very dark brown with scarcely any spots or shadings.

Late in the summer each mother insect prepares a place for her eggs by gnawing off the outer skin of one of the large veins on the underside of a leaf. Then she pushes from twenty to thirty tiny eggs into the soft tissue of the leaf and stations herself over or beside them until they hatch. When, in about a week, the young hoppers come out, they stay close together near where they were hatched and stick their little, sharp beaks almost side by side into the leaf to pump up the sap on which they subsist. The mother, unlike most parent insects, does not fly off and leave them to their fate, but hovers over them much as a hen guards her brood of chickens. It is even quite difficult to frighten her away, and if driven to another part of the leaf or to a neighboring leaf, she will run about in all directions until she comes across her own little flock, beside which she will again take her place.

The young hoppers do not look much like their mother, having soft, fuzzy bodies, large in front and tapering to a point behind. They are green in color, with

brownish-red heads and collars, and a broad band of the same color across the middle of the back. They change their skins every few days and move from place to place on the leaf in search of the most juicy spots, the mother always going with them. Occasionally, when they are nearly grown, the family separates into two or three groups, some of them often removing to another leaf. This separation is, perhaps, that they may not attract too much attention by their numbers and also that they may be sure of a better supply of sap. The mother insect stays with one or the other of these companies until they are all fully grown and appear with wings and wing covers like her own, after which she can no longer be distinguished from them.

In all stages of their life these insects are very sociable and feed and move about over the leaves in companies. It is but rarely that we find one by itself.

Although they can fly with ease and jump great distances, besides being able to run quite rapidly, these little *Entilias*, as they are called, are not great travelers, and when not disturbed spend their lives not far from the spot where they were hatched.

A lady who gave some time to observing the habits of these insects in her garden says that they are great favorites with some kinds of ants, which herd them and attend them in the same way that they do the aphides. She even saw the ants assisting them to get off their outgrown

skins and driving them into clusters when they seemed disposed to wander.

It is supposed that the ants get from them some sort of agreeable fluid in return for their attentions similar to that obtained from the honey tubes of aphides, which are often called the "ants' cows."

Perhaps the leaf-hoppers do not care for the presence of the ants, as they always seem more restless and scattered about on leaves where the ants have found them, in spite of the efforts of the latter to keep them together.

The Life History of a Ladybird Beetle

During summer one may often find on trees and other plants infested by plant lice the pretty little beetles commonly known as "ladybirds" or "ladybugs." These insects form one of the most interesting families of their class. They are nearly all of neat and handsome appearance, having rounded or oval forms and bright, attractive colors.

There are many different species in the lady-beetle family, but with few exceptions they resemble each other in life history and habits. They are all quite small, with the wing covers hard and shining. Both thorax and wing covers are either of black or dark colors ornamented with red spots, or of light colors with many or few black spots or markings. They are very tame and friendly, but, it is said, will always fly off in a hurry when children say:

Ladybird, Ladybird, hie away home,
Your house is on fire, your children will burn!

These poor ladybird children! fire is the least of the dangers to which they are subject. The very people who regard their parents with so much favor will often destroy these young ones by the dozen, under the mistaken idea that they are killing some very injurious species.

Do you wonder how this happens? The explanation is found in the fact that the young do not bear the slightest resemblance to their parents, being tadpole-shaped, with

hungry-looking jaws and awkward legs, and are clumsy in their movements. They are also commonly found in the company of insects that are doing serious injury to valuable plants. Often the insects that are doing the damage are entirely overlooked, and the ladybird young, which were engaged in eating up the destructive species as fast as they can, are killed instead of the sap-suckers. It seems a great pity that this should be so, and the only way to prevent the destruction of these little friends is to become acquainted with their appearance and habits and to introduce them to as many people as possible, telling the latter what good service they do, and urging them to be careful not to injure them.

The small yellowish eggs of the ladybird beetles are deposited on the twigs or leaves of trees, shrubs, and other plants. These eggs are very similar to the eggs of the common potato beetle. In a short time they hatch into little larvæ, which are rather long, active creatures of various colors. They have six well-developed legs and are generally covered with bristly hairs.

These ladybird larvæ feed upon the plant lice, devouring them greedily. As the larvæ grow, they shed their skins occasionally. In a few weeks they become full-grown, so far as this part of their life is concerned. They are now ready to enter upon the next stage of their existence. To do this, each larva attaches the hind part of its body to a leaf, the bark of a tree, or some similar object,

and soon sheds its skin. On the completion of this process of moulting, the insect assumes a peculiar appearance.

The insect remains in this motionless pupa state a week or ten days. Then it emerges as an adult beetle, similar to the one which laid the eggs a few weeks before. These beetles also feed upon aphides, although less eagerly than do the larvæ. Sometimes they do not hesitate to eat the eggs of other ladybird beetles. A few years ago, in an apple orchard in southern Illinois, I saw some of them thus engaged in eating the eggs of their fellows. But as a rule these beetles are friendly to man, preying upon insects destructive to his crops.

The Usefulness of Ladybirds

While the ladybird larvæ often kill young caterpillars and eat the eggs and young of potato beetles, they are most likely to be found among the colonies of little plant lice or aphides that are such a nuisance and injury on our fruit trees and flowering plants. Often in a few weeks, sometimes aided by a few other larvæ of similar habits, these useful insects will entirely clear a garden of aphid pests.

Some species feed upon scale insects or bark lice and are of the greatest importance in keeping them in check. A few years ago a very destructive scale insect appeared in the orange groves of California. The owners feared that they would lose all their trees and were very much discouraged. They consulted Dr. C. V. Riley, who was then United States Entomologist, and he undertook to discover a remedy for the trouble. He first found out, by means of much writing and looking up of papers, that the insect called the "cottony cushion scale" had come to California on trees imported from Australia. He next learned that in that country the scale did very little damage, so he concluded that in its native land it must be kept in check by some natural enemy. Acting on this supposition he sent a young man to Australia to examine into the matter, who soon found that it was the larvæ of two or three ladybird beetles that kept the scale from multiplying. The difficulty was to bring them alive to this

country, as the danger was that they would starve or become diseased on the long voyage. However, after a few unsuccessful attempts, a small number reached California alive and were placed on some scaly orange wood where they began at once to eat up the bark lice. They were carefully guarded and seemed to do well in their new home. As soon as enough of them had been bred they were distributed to all parts of the state where they were needed, and very soon the cottony scale began to diminish in numbers and the orange growers grew hopeful. In the course of two or three years the crops of fruit again became enormous and brought great wealth to the state, and all through the agency of a tiny red-and-black beetle and its greedy larvæ.

In some parts of the United States where hop-growing is an important industry, the ladybird larvæ are greatly prized because of their aid in keeping in check the aphides that are so destructive to the hop plant.

A few years ago the grain aphis did much damage to wheat and oats in many of the states in the Ohio and Mississippi valleys. Great numbers of ladybird beetles and their larvæ appeared in the infested fields, and, aided somewhat by certain parasitic insects, soon exterminated the aphides.

I am sorry to say that there are a few "black sheep," even in this useful flock, who do not confine their diet to injurious insects, but have, themselves, taken to vegetable

food. These are rather large-sized beetles of a yellow color, spotted with black. Their larvæ are somewhat shorter than those of the cannibal species, black, and have several fringed lobes on each side of the body. One of these infests cucumber and melon vines in the Northeastern states, and one is very destructive to beans in the Southwest, eating holes in both leaves and pods, sometimes doing much damage. As a rule, however, the ladybird beetles deserve all the favor and protection they receive, and their young, which really do us the most service, should be recognized by every one, and care taken to preserve them from injury.

The Tomato Worms

Late in summer and early in autumn one can generally find on tomato vines in the garden, portions of the plants on which the foliage has been partially eaten off, so that the branch looks bare beside its full-leaved neighbors. In such cases a little search will nearly always lead to the discovery that the author of the mischief is a large, light-green worm, with several oblique, whitish stripes along the sides of the body, and a peculiar spine projecting from its posterior end. This is the insect commonly called the tomato worm, or tomato caterpillar.

If one of these caterpillars be put into a covered jar or box having several inches of damp earth in the bottom, it can easily be fed fresh tomato leaves every day or two, and kept until it is full-grown, when it will be about three inches long. It will then stop eating and burrow down into the soil. Were it out of doors it would go down a considerable distance and at the bottom of its hole enlarge the opening sufficiently to form an earthen cell. It then casts off its caterpillar skin and becomes a pupa, or chrysalis. It is now very different. The legs have disappeared. On one end is a long and slender tongue case, suggestive of a jug handle. The color is chestnut brown.

The insect remains in this quiet pupal condition until early the following summer. Then the pupa wriggles its

way upward to the surface of the soil; the brown case splits open, and there emerges an insect with crumpled wings, that soon expand, so that the creature becomes the beautiful "hawk moth". The ground color of the body and wings is gray and there are various dots and stripes of different shades. On each side of the abdomen—the hind part of the body—there are five orange-colored roundish spots. The eyes are round and prominent; over them project two large *antennæ*, or feelers, with feather-like processes on the front edge. But perhaps the most curious part of the insect is the long, coiled tongue at the mouth. This is usually coiled up tight, but it can be uncoiled readily. It is then seen to consist of a slender sucking tube three or four inches long.

This moth, with others of its kind, remains quiet in some sheltered nook during the day, but at dusk it starts out on a rapid flight in search of flowers from which to suck up nectar—the honey-like liquid found in many blossoms. Large, light-colored flowers, like the white lilies, are most easily seen during the evening. For this reason they are most likely to be selected by the hawk moths, but honeysuckles and many other blossoms are also visited by the insects.

These hawk moths have also another object in view during their nocturnal flights. If you watch the tomato plants in a garden at dusk during the summer, you are likely to see one or more of these moths flying rapidly from plant to plant, stopping at each one a moment. In this

way they deposit eggs upon the leaves. In a few days the eggs hatch into little green caterpillars, that feed upon the green portions of the leaves about them. A week or so after hatching, they have increased in size to such an extent that they are too large for the skins with which they were born. Instead of this skin enlarging with the individual, as it does in the higher animals, in these caterpillars a new skin is formed beneath the old one; the latter splits open along the back near the head, and the caterpillar crawls out, clothed in a new suit. This moulting process is repeated several times during the next few weeks, in which the caterpillars rapidly develop until they become full-grown. Then they go into the earth to change to the pupa, or chrysalis stage, in which condition in northern regions they remain through the winter.

These hawk moths are so called because of a resemblance in their swift flight to the motions of a hawk. They are also often called the sphinx moths. If looked at through a lens, one sees that their wings are covered with minute scales, so that the moth belongs to the great order of scale-winged insects—the Lepidoptera, in which are included the butterflies and moths.

Late in the summer you may often find tomato worms as well as other sphinx caterpillars, which are more or less covered with such small white oval objects as are shown in the accompanying picture. Perhaps if you did not know the story of the caterpillar's life you might think these things were the eggs. But of course you know they cannot

be the eggs, for these are laid by the moth upon the leaves of the food plant.

These little silken objects have an interesting history, however, and a very unpleasant one so far as the caterpillar is concerned. Some weeks before, a little black fly lit upon the back of the caterpillar, and laid inside his skin many tiny eggs. In a short time each egg hatched into a little grub, that absorbed the body juices of the caterpillar. These *parasites* continued to grow at the expense of their unwilling *host*, the caterpillar, for some time before they became of full size. Finally they were ready for the next change; they burrowed through the skin of the caterpillar, and each parasite larva spun about itself a silken cocoon, inside of which it soon changed to a pupa.

So each white object is a cocoon and contains a pupa. About two weeks from the time the cocoons are made, the pupæ change to flies, each of which gnaws off the end of its cocoon and comes out into the world.

The poor caterpillar lingers for some time in a half-dead condition before it finally dies, without completing the later stages of its growth.

The Preying Mantis

"Oh, what an ugly, wicked-looking bug!" some Northern child may exclaim as he looks at this picture. "See, how strange its head is and what big round eyes it has, and how funnily it holds up its front legs! I'm glad it doesn't live in our part of the country. I would just as soon come across a rattlesnake."

But the Southern boy would say: "Why, these don't do any harm. *We* are not a bit afraid of them. We call them 'devil horses' and 'rear horses' and often drive them about with strings tied around their long necks. I tell you, it is great fun to see them fight, and they are quicker than lightning in catching flies."

Many other names besides those mentioned are given to these singular insects in different parts of this country and Europe. The English call them "camel crickets," on account of their long necks, and also "intelligence bugs" and "diviners," from their wise and threatening expression, and "praying nuns," from the apparently devotional way in which they hold up their front legs. The best writers on insects agree in calling them mantes (singular, mantis).

It is not wonderful that their weird look and unusual habits should have caused people formerly to regard them with superstition; and many, not only among the foolish and ignorant, but of those who were quite well educated,

believed that these insects had a knowledge of future events, and it was the custom of those who were about to start on a journey or engage in some new enterprise to consult one of these insects; they thought they could tell by the motions of the mantis whether or not they would be safe and prosperous.

There is a story of a pious monk of olden times who, seeing a mantis moving slowly forward with its fore legs raised, thought it must be engaged in prayer and ordered it to sing aloud, whereupon, as the story goes, the insect immediately chanted a hymn.

Another old author writes: "So divine a creature is this esteemed that if a childe aske the way to such a place, she will stretch out one of her feet to show him the right way and seldom or never misse." The Hottentots are said to go still further and to worship a certain kind of mantis as a god and to look upon any one upon whom one of these insects may alight as a saint.

In this country, people are more apt to imagine that their motions predict famine, death, and other calamities, and nobody is very anxious to be made a saint by having a mantis suddenly drop down upon him.

The species of mantis are most numerous in tropical countries, where their forms imitate leaves, buds, and stems so exactly, even to spots of mildew and torn edges, that when they are sitting still it is impossible to tell them

from certain parts of the tree or shrub on which they are resting.

There is only one common species in the United States. It is not so odd and leaf-like in its form as some of its more southern relatives; but its color and shape, as it rests among the branches of bushes and grapevines, make it very difficult to discover. The body is long and somewhat flattened, and the first joint of the thorax is smooth and stick-like and has the appearance of a very long, slim neck. The head is in the shape of a triangle, with a large round eye at each upper angle and the small, but strong, sharp jaws at the lower, the mouth feelers resembling a drooping moustache. The greatest peculiarity of this insect may be mentioned here, which is one not found in any other American species—the power of twisting its head in any direction.

The front legs, which are never used in walking, seem to have one more joint than those of other insects. The thighs and shanks are very stout and are set on the inner edges with sharp teeth and spines, for holding and crushing the insects on which the mantis feeds. The second and third pairs of legs are rather slender and weak, and the insect is but a slow and unsteady walker. When fullgrown the males have two pairs of strong, brown, membranous wings, with which they can fly long distances, but the females, which are much stouter and usually of a pale green color, have wings that only partly cover the hind body and can scarcely fly at all.

The mantes are among the lions and tigers of the insect world and are even more cruel than these, as they will kill and eat each other with as much relish as they do other insects, and they will not touch any food unless they can catch it alive. Strictly speaking, they do not hunt their prey, but have a way of holding themselves perfectly motionless among the leaves and twigs of plants, so that they cannot be distinguished from them, until some insect that suits their taste crawls or flutters by, when they make a sudden dash with their spiky front legs and rarely fail to catch even the most agile fly or leaf -hopper.

They are so fierce and cruel from the moment of hatching that as fast as they come out of their shells they hurry away in different directions to escape being fallen upon and eaten by each other. As they grow older they become still more savage, especially the females, which often, after playing awhile with their mates, will suddenly spring upon them and tear them in pieces. In their relations to man, however, they are entirely beneficial, as they kill a great number of the pests of the vineyard and orchard and, bloodthirsty as they are, seldom attempt to bite, and would not be able to puncture the human skin should they try to do so.

Late in summer the eggs are laid in a compact mass covered with a tough sort of silk, which protects them from the weather. These egg masses, which are attached to twigs of trees, posts, and vines, are often noticed during winter and always excite the curiosity of those who see

them for the first time. They are of a dull-brown color, rather more than an inch long, and one-third of an inch thick and wide. The eggs are in rows, so placed that their edges form a sort of braided pattern on top of the mass. The latter is not so broad, but otherwise they resemble the familiar fossil called a "trilobite."

They should never be destroyed, as is sometimes done by those who imagine that they are some hurtful thing. On the contrary, it is a good plan to collect them from wild lands and place them where the mantes, when they hatch, can help to protect orchards and gardens from the bugs, flies, and caterpillars that are so destructive. This has often been done with great advantage by observing gardeners, and is only one of many instances in which man, with a knowledge of insect habits, has been able to make such unlovely qualities as cruelty and voracity serve good purposes under his direction.

The Tent Caterpillars and Their Nests

Of course every child who has taken a walk in the country in spring has seen the caterpillars' nests in the apple and wild cherry trees. No doubt you thought they were not very pretty, and perhaps you shuddered when thinking of the "horrid worms" you knew were in them.

But if you could sit on a big apple limb some day and watch one of the nests close at hand, I think you would find much to interest you. In the morning, some time after sunrise, you would see the "horrid worms" come out of the doors of the tent and march along—mostly in Indian file—in search of breakfast. When they come to a fork in the branch some will go to the right and some to the left, but each will finally stop when it finds a leaf to its liking. It will then feed upon the leaf, biting it on the edges with its good-sized jaws, and often leaving only the midrib to show that a leaf was there.

After breakfasting an hour or two, most of the caterpillars are likely to march back to the tent and crawl in through the half-closed doors, where they range themselves side by side, much as sardines are packed in a box. By thus seeking shelter during the middle of the day, they hide away from the birds and from some little flies that are always looking for caterpillars to lay their eggs in them. But I will tell you later why the flies do this.

Towards the middle of the afternoon the procession of the caterpillars may again be seen going forth to war upon the unresisting leaves. As in the morning, they scatter here and there over the twigs, each choosing a leaf for its victim and devouring it piecemeal until hunger is satisfied. Then homeward they go, and through the cold, damp night they keep each other warm beneath the silken folds of the tent.

If you look carefully at the surface of the limb on which the procession has been marching you will see many whitish silken threads. One of these threads is spun by each of the caterpillars as it marches along. The thread comes from the mouth in the form of a liquid, secreted by certain peculiar glands, which on exposure to the air hardens into a silken thread. Probably the caterpillar is guided back to its tent by the thread which it spun on the outward journey.

During cold and wet weather the caterpillars remain within the shelter of the tent, sallying forth again when the spring sun shows his genial face.

About the first of June the caterpillars become full-grown, as far as this part of their life is concerned. They can eat no more leaves, and appear to be seized with a desire to wander away from home. Down the tree they crawl and out into a strange new world—a jungle of weeds and grass—they go, seeking here and there the friendly shelter of a stone or board or fence. When such shelter is

found, the caterpillar halts for rest. Soon it begins weaving about itself a silken shroud, the glands in the mouth which furnish the thread to guide it homeward from its feeding grounds again doing duty for the shroud. Before long the caterpillar is hidden within the white silken woof. It next ejects from its body a yellow fluid which runs among the silken meshes and gives the cocoon—for so the shroud is called—a yellow color.

The body of the caterpillar now becomes shorter and thicker. Before long the skin on the front part of its back splits open and the caterpillar wriggles violently until the skin is finally crowded off to the hinder end, and there lies within the cocoon only a brown chrysalis.

The change from the active caterpillar to the quiet chrysalis is a strange *transformation*. The chrysalis takes no food, and its only movement is a feeble wriggle. The insect remains in this condition for nearly two weeks. Then another change takes place: the skin of the chrysalis splits apart and there comes forth a queer-looking moth that pushes its way through the meshes of the cocoon. When ite wings are finally spread out and dried it resembles Fig. 5, if it happens to be a female moth. If it is a male moth it is somewhat smaller. The color in both is reddish brown.

Thus the caterpillar has reached the highest stage of its existence. Within a few weeks the "horrid worm" has become a handsome moth.

The Moth and Its Eggs

If you could become a fairy small enough to ride upon the back of one of the larger of these reddish-brown moths, you would have an interesting experience. During the day the moth would hide with you in almost any quiet shelter she could find, but at night she would fly abroad with many other moths of the same and other kinds. She might be attracted by the light shining through somebody's window, and bump your fairy nose against the pane. But more likely she would ask you to rest upon an apple twig while she busied herself in laying her eggs. She fastens these upon the twig in clusters of two hundred or more, setting them on end side by side upon the bark. When the laying of a cluster is finished the moth covers the eggs with a glue-like substance, which hardens into a shiny varnish that keeps out the moisture.

After the eggs are laid the fairy will do well to find another moth to carry its tiny self, for this moth will soon die, her purpose in life being accomplished when the eggs were laid.

These eggs fastened upon the twigs of apple and wild cherry trees during July do not hatch until the following spring. The marvelous change within the shell by which the egg develops into a tiny caterpillar takes place, however, before winter begins. If you could carefully open one of the little cylinder-like eggshells during cold weather

you would find the fully formed caterpillar within. It is such a condition as would occur if a hen's egg developed into a chick which remained alive inside the shell for several months before pecking its way out.

When the long months of waiting through the cold winter are passed, the spring sunshine wakens the caterpillars to life. Then they gnaw through the thin eggshells and crawl out to find themselves in a strange new world. Beside them are the buds bursting into leaf, and, led by that strange knowledge which we call instinct, the band of little caterpillars crawls down the twig to the nearest fork in the branches. Here they spin a silken web which is the beginning of the tent or "nest." They stay in it at night and at other times when not feeding upon the leaves.

About a week after the caterpillars have hatched, their bodies have so increased in size that they must provide themselves with a skin larger than the one with which they were born; for insects do not grow as the higher animals do. With the latter the skin grows along with the body, but with the former it does not stretch and cannot increase in size. So some day the colony of caterpillars remains at home beneath the silken folds of the tent. The skin of each splits open along the back, and the caterpillar crawls out of the old skin clothed in a new one that had been formed beneath the other.

When the caterpillars become used to the new clothes thus so kindly provided by Mother Nature, they sally forth

again in search of food. This skin-shedding process is called *moulting*. It is repeated several times during the lives of the caterpillars, which become full-grown in about six weeks when they are nearly two inches long. The body is hairy and has a distinct white stripe along the middle of the back, on each side of which are short yellow lines. The sides are partially covered with paler lines, spotted and streaked with blue. The lower surface of the body is black.

You can easily watch the growth of these caterpillars by placing two or three of them in a glass-covered box, having a little sand or earth in the bottom. Feed them every day with apple or wild cherry leaves freshly dipped in water.

In feeding, the tent caterpillars devour the substance of the leaf, often taking all but the midrib, but more commonly leaving parts of the leaf along the midrib. If many caterpillars are on the tree, its leaves will be entirely eaten off.

The Tent Caterpillar Parasite

In many of the nests of the tent caterpillars you can find peculiarly shrunken caterpillar skins. The under side is generally split open and shows part of a silken cocoon.

These are the remains of caterpillars which have been killed by parasites. Weeks before, when the caterpillars were rather small, an egg was deposited in each by a four-winged fly. The egg hatched into a tiny maggot, which grew by absorbing the juices of the caterpillar's body.

In two or three weeks the maggot became so large that the caterpillar was killed and nothing was left of it but the skin with the parasite on the inside. The latter then spun a silken cocoon, within which it changed to a pupa.

A short time afterwards another change takes place and from the pupa there emerges a fly similar to the one which laid the egg in the young caterpillar. This fly is called an ichneumon fly.

The tent caterpillars have many enemies besides these ichneumon flies. While their hairy skins protect them from the attacks of many birds, there are some, like the Blue Jay and the Cuckoos, which devour them eagerly. In one case a Cuckoo was seen to eat twenty-seven caterpillars, one after the other, at one time, all taken from a single nest.

The Common Potato Beetle

Nearly every child who has seen potatoes growing in fields or gardens has seen the brown striped beetles, so commonly called "potato bugs". Those who have lived upon farms will know that these beetles may be found in the potato field soon after the plants come up, eating the tender leaves, and laying upon the under surfaces of the latter masses of orange-colored eggs. These eggs are sometimes deposited also upon the leaves of grasses, smartweed, or other plants in the field. A week or more later they hatch into little grubs that feed upon the leaves, gradually increasing in size and occasionally moulting or shedding their skins. In a few weeks they finish their larval growth; they then descend to the ground, where just beneath the soil surface or under rubbish above it they change to pupæ, emerging as perfect beetles about ten days later. The number of broods varies with the latitude, there being from two to four each season.

This insect was originally a native of the Rocky Mountain region, where it fed upon a wild plant related to the cultivated potato. When the garden patches of the settlers extended to its habitat, so that there were potatoes growing at short distances apart throughout the region between the Rocky Mountains and the Atlantic Ocean, these beetles began feeding upon the new food plant and rapidly spread eastward, until within a few yeara from the time they started they had reached the eastern states.

Then they were carried to various European countries by means of steamboats and sailing vessels.

These potato beetles have a few enemies to contend against. Their eggs are greedily devoured by ladybird beetles and their larvæ, and the other stages are eaten by the Rose-breasted Grosbeak and perhaps a few other birds.

Cecil's Book of Insects

About Ants

Branch—*Articulata*—Consisting of rings, or joints.

Class—*Insects*—Having bodies divided into two or three distinct parts.

Order—*Hymenoptera*—Having membranous wings.

Family—*Formicaria*—Ant family.

Do you ever find yourself, some dreamy summer day, with nothing to do? The hot, dense rays of the July sun scorch the dry grass, glow in the burning sand, and almost hiss in the water of the idle stream. The birds hide in the dense thickets, the cattle pant in the shade, and the very dog wishes he could take his jacket off. The strawberry leaves crisp in the heat, and rest upon the ground; the corn curls its green blades, and turns blue; the portulaccas shut their cups; the pansies hang their heads; even the giant sunflower droops his broad leaves, and the cabbages perspire. It is too warm to work, or to read, or to play. The boy has exhausted all his own plans for fun, and in despair asks his mother, "What shall I do?"

I'll tell you what to do. Find an ant-hill in some shady place, where the sun will not burn your back, lie down upon your face, and watch it. You have passed such a thousand times, without knowing what curious things could be seen there. The little fellows worked all the morning, and brought up out of that hole in the middle, all the grains of sand that you see piled around in a tiny,

circular fortress. One by one they brought them out and laid them in their places. Now they are thoroughly warmed by the sun, and they are carrying them back again, into the rooms which they have excavated below. If there is a flat stone near, turn it over, and you will quite likely find a much busier crowd. A large chamber, with many winding passages running hither and thither, and connecting with each other, and with other passages underneath, has been made, like the public square and the thronged streets of an old fashioned city. It is not like the exact, right-angled, stiff, modern town, but the lanes turn in and out, and yet go on with persevering directness towards some particular spot which was not down in the original plan, although a point of much consequence. Scattered all along the thoroughfares of this stone-canopied town, and quite plenty in the grand square, are many long, round, white somethings, a little like grains of wheat. People have mistaken these things for the food of the ants, and so have written,

"The little ant, for one poor grain,
Doth tug, and toil, and strive."

But the ants lay up no food. They need none; for as soon as the hard frosts of autumn chill them, they lie down to sleep till the spring wakes them again. If they did lay up food, it would not be grain, for the ant can no more eat grain than a man can eat gold, and the ant is not so big a fool as to hoard what he can not use.

Others have thought that these little white sacks are the eggs of the ants; but eggs do not grow, and surely ants can not lay eggs that are larger than themselves. Whatever they are, the ants evidently think them very valuable. Away they go, over the clumps of earth, and through the tiny streets, as if to see what has happened, and estimate the damage. They don't quite understand it, but they are agreed that one thing is to be done forthwith—these precious little sacks must be carried in, out of danger. So each grasps the nearest, and drags it away to the hole in the centre, the gateway of the inner town, where you see the throng coming out. The sack is larger than the ant, but he seizes it resolutely, and raises it over his head. Away he creeps, but it strikes that block of sand at the street corner, and he can not lift it over. He lays it down and pulls the end of it round; that obstacle is past, but another is beyond. A second worker comes, and the two, by pulling at one end and lifting at the other, have brought it to the gate. Surely they can not get it through that narrow and crooked passage. One has gone below, and the sack shuts him from sight. The other tugs and pulls. It will not move. Yes, it does; see that end rise in the air; now it sinks in the hole; now it is out of sight. But here comes another, and another. All are hurrying to the numerous stairways to the city below, and in a short time all will have vanished.

These sacks contain the young ants. The eggs were laid by the queen, and hatched by the warmth of the hot grains of sand. The grubs were fed, and grew, and finally

shut themselves up in the sacks, as the caterpillar spins a cocoon, or the beetle-grub sheds his coat and becomes a chrysalis. Then the ants take great care of these sacks. They are very precious to them because they contain their children. If the air is damp and cold, or the rain falls, they carry them down into the lower rooms, and keep them warm. If the sun is warm and bright, they are brought where the warmth may be felt, without making them too dry. If they happen to be exposed, we have seen how they are hurried to a place of safety. If you should carefully dig down into the earth, you would find the underground city very extensive, the long, winding galleries lying tier after tier beneath each other, and leading to large apartments, where the ants and their children find room.

Three kinds of ants come out of these cocoon-sacks. There are males, which have four wings; females, which are much larger, and have two wings; and a third kind, called workers, or nurse-ants, which have no wings. After midsummer the several kinds may often be seen very busy about an ant hill, the winged ants trying to get away, and the workers bringing them back as often as they can find them. The males seem to be worthless fellows, and soon disappear. They have no sting to protect themselves with, and no jaws to help them get a living.

Some of the females are caught by the workers, and taken back to the nest. Others wander away with a few followers and found new colonies, while others stray away by themselves, going out into the wide world alone. When

one alights, she examines the new land which she has discovered, to see if it is fit for a home. If she is satisfied, she turns back her head, bites off her wings at the shoulders, and settles down for life. Her wings carried her from her mother's house to her new home, and henceforth her journeying is ended. Then she begins to hollow out a chamber for herself. Even if she has workers with her, she continues to toil until she has laid eggs; then she is recognized and honored as a queen. If alone, she has to continue her toil until the young from her own eggs make a colony about her. The grubs, when hatched, are fed by the nurse-ants, or by the mother, with food prepared in the stomach, and the solitary insect has much to do, to find food for herself and her hungry family.

Ants eat various substances, particularly such as are juicy, or contain sugar. They kill and eat weaker insects, and they are very fond of ripe, sweet fruit. One may be sure they will always choose the best. If the pioneers can not eat the whole of some plunder which they have found, they carry away what they can, and then bring back an army to carry off the rest. They are very fond of a substance called honeydew. Ants are often seen running up and down the trunks of trees, even when there is no fruit on the tree to tempt them. As the trees which they visit are often sickly, they are supposed to do some injury. They are not at all to blame, but are only going to their farms to look after their cattle. The leaves and tender twigs of these trees will be found to be covered with small, pale-

green insects, called *Aphides*, or Plant-lice. They are often very closely packed upon the leaf or stem, and they do harm by sucking up the juices of the growing plant. The ant comes up the tree to his dairy farm, and strokes one of the green lice with his feeler; the louse gives out a single drop of clear liquid, which the ant drinks. Then he goes to the next, and so on, milking his cows, or gathering honey-dew. When he has enough, he goes back to his work, digging, building, or feeding the young ants.

The working ant does a great deal of work in a day. M. Huber, a French naturalist, gives an account of a single day's work of one ant. The insect first dug in the earth a groove or road, about a quarter of an inch deep and four inches long. The dirt which he took out, he kneaded into pellets, and placed on each side of his road, to make a wall. When this road was finished, very smooth and straight, he found that another was wanted, and he made that in the same manner, and about the same size. A man, to have done as much in proportion to his size, must have dug two ditches, each four and a half feet deep, and seventy-two feet long; he must have made the clay into bricks, and laid them up in walls on each side of the ditches, two to three feet high and fifteen inches thick. He must have gone over it all and made it straight and smooth; and must have made it alone, in ground full of logs and stones.

The Brown Ants, *F. brunnea*, are both miners and builders. They work either at night or in damp weather, because the sunshine dries their mortar too fast. They

build a house of many stories, sometimes twenty or thirty. Each story is about a fifth of an inch high, supported by many partitions and pillars. In wet weather they take the family into the upper rooms; in dry weather they occupy the middle or the lower floors. While building, they work the damp clay in their jaws until the pellets are compact, and will adhere firmly; then they press them tightly against the tops of the partitions which they have made. As fast as one row of bricks has dried, another row is added; thus they will lay a perfectly smooth and strong ceiling two inches in diameter. When these walls are finished, the rain and sun seem only to make them harder. If a stick or straw is in their way, they at once make a beam or a post of it. If a post, they cover it with mortar until it is thick and strong enough for their work. If a beam, they build their ceiling against and around it. If a room is too large, they build partitions, and divide it into smaller rooms of suitable size.

Other Ants are carpenters. They often remove so much of a log of wood as to leave it a mere honey-comb, pierced through and through in every direction with their passages. The walls between are often as thin as paper, and yet are never broken through except where one passage crosses another. They can not know how to cut so near another passage by sight, for all is done in the dark; they can not plan or measure, as a reasoning being would do; and yet they do their work with greater delicacy and accuracy than the man who reasons and measures. For

some unexplained cause, the wood through which they cut is all colored black, as if the fire had passed through it.

When these black carpenters get into a dwelling, they cause a deal of trouble. They make themselves at home in the very woodwork of the house. They gnaw a way into any wooden box which they wish to explore, and will find the least crevice into the sugar-box or cake-jar. The prudent housewife puts her pot of sweetmeats in a pan of water, but if the ants know what the jar contains, they will find a way to it, even if they crawl upon the shelf above, and drop down upon it. The family may be almost exterminated, and yet, if two or three be left, with all the resources of the nest at their command, in a little time the plagues are as thick as ever. Moreover, they bite.

Some tribes of Ants are very warlike, and they make war to capture the workers of other tribes, and obtain slaves for their own communities. It is said that the kidnappers are always pale or red Ants, and that the captured slaves are black. When the red Ants are about to make a foray, they send scouts to explore the ground, who afterwards return and report their success. They then march forth in regular armies. The assailed town pours out its inhabitants, and the fight begins. Head to head, foot to foot, jaw to jaw, the sable warriors defend their homes and their children, but in vain. The victory is always with the invaders. They do not drive out their conquered foes, but they break into their homes and carry away the cocoons of the workers. The red ants return in perfect order to their

own city, bearing with them their living burdens. They treat the plundered young with the same care they give their own, and the ants produced from the stolen cocoons seem to work with abundant energy and good will. The inhabitants of the besieged city, knowing what result will follow the fight, often carry away many of their young. They take them to the tops of the grass stems, and hide them amid the foliage of other plants. When the raid is over, they bring them back to the nest again. Several kinds of ants practice this kind of warfare, and the results are too well attested by careful observers to admit of doubt.

Although there are many kinds, and countless numbers of Ants in the cooler countries of the temperate zone, they are far surpassed in number, in size, and in venomous power, by those found in the hot lands of the torrid zone. Here all kinds of reptile and of insect life seem to be extravagantly developed, and the ants are often so numerous and so powerful as to drive away every other living thing.

The Saüba or Coushie Ant, *Œcodoma cephalotes*, lives in South America. It is often called the Parasol Ant. Large columns may be seen marching along, each carrying in its jaws, and over its head, a round piece of leaf, about the size of a dime. Many suppose that this is actually carried to keep off the heat of the sun; but the fact is that they use the leaves to thatch the roofs of their houses, and to keep the loose earth from falling in. They choose the leaves of cultivated trees, as the orange and the coffee. When they

attack a tree, they strip it of foliage so entirely, that it often dies. Then they march away with their plunder, and fling it on the ground, at the nest. Another party of workers take up the pieces, and put them upon the roof, covering them with dirt. These domed houses are wonderfully large, measuring sometimes two feet in height, and forty feet in diameter. Their underground cities are on even a larger scale. The smoke of burning sulphur blown into one opening has been found to come out at another, more than two hundred feet away.

There are three kinds of these ants: the winged, the large headed—sometimes called soldiers, and the workers. The large headed are also of two sorts: one kind has a smooth helmet, covered with horny substance, which one can almost see through, and the other wears a dark helmet, covered with hairs. The business of these large-heads is not very well understood. The smooth helmets seem to do nothing but walk about. They do not fight; they do not work; they do not appear to overlook those which do work. The hairy-helmets are not known to do any more. If the top of one of the mounds be taken off, a circular well will be found in the centre, into which a stick three or four feet long may be thrust, without touching bottom. Presently some of these hairy-headed fellows, each wearing one eye in the middle of its forehead, like a fabled Cyclops, will come slowly up the smooth sides of the well, to see what is wanted. But they are not very pugnacious, and may easily be caught by the fingers.

The winged ants are the perfect males and females. They come out a little after midsummer, that is in February. The females have bodies about as large as hornets, and spread their wings nearly two inches. The males are much smaller. Although hosts pour out of the nests, few remain after a day, for the birds and insect eating animals have devoured most of them. Those which escape found new colonies in spite of all the dangers which threaten to destroy them; even the art of man can not conquer them.

Among the South American Ants are several species which are classed together, and called Foraging Ants. They belong to the genus *Eciton*. They have been confounded with the Saüba Ants, just described, but their habits are quite different. The real Foraging Ant, *E. drepanephora*, is very annoying, and very useful. These insects go out from their cities in immense armies, not very broad, but often a hundred yards long. Officers march beside the column, very busy keeping their own portion of the line in order. There is an officer to about twenty privates; their white heads nodding up and down make them quite conspicuous. The pittas, or ant thrushes, always accompany these armies, picking up the Ants for their own food; but still the band goes marching on. The people know that the Ants are on the war path, and make every preparation for their reception.

In those countries, insects of every kind get into the houses, and multiply to an extent which almost drives the

inhabitants from their homes. By day they are a trouble, and by night a pest. They bite, and suck, and scratch, and sting. They crawl over the food; they hide in the bed; they fly into the lamp, and then whirl on the table; they creep into the ink; they emit horrible smells. There are centipedes which sting, and scorpions which sting. There are cockroaches of powerful size and smell, and of insatiable appetite. As for snakes and lizards, and other creeping things, they are too common to be noticed. It is of no use to fight. Your enemies are legions of numbers innumerable. But when the Foraging Ants come, the case is altered, for nothing can stand their attack. When the pittas come about, the people open every box and drawer in the house, so as to allow the ants to explore every crevice, and then they vacate the premises.

"Presently a few scouts, which form the vanguard of the grand army, approach, and seem to inspect the house, to see if it is worthy of a visit. The long column then pours in and disperses over the dwelling. They enter every crevice, and speedily haul out any unfortunate creature which is hidden therein. Great cockroaches are dragged unwillingly away, being pulled in front by four or five ants, and pushed from behind by as many more. The rats and mice speedily succumb to the onslaught of their myriad foes, the snakes and the lizards fare no better, and even the formidable weapons of the centipedes and scorpions are overcome.

"In a wonderfully short time the Foraging Ants have done their work, the turmoil gradually ceases, the scattered parties again form into line, and the army moves out of the house, carrying its spoils in triumph. When the inhabitants return, they find every intruder gone, and to their great comfort may move about without treading on some unfortunate creature, or put on their shoes without knocking them on the floor to shake out a scorpion or a centipede."

But those who are accustomed to the country are careful to keep out of the way. If a man should happen to cross the column, the ants at once dash at him, climb up his legs, and bite with their powerful and poisonous jaws. His only safety is in running away until the main army is too far off to renew the attack, and then destroying those which he has brought with him. This is not easy, for the Ants have long, hooked jaws, and bite so fiercely that they may be pulled away piecemeal, leaving the jaws in the wound to be picked out separately.

Another species, *E. prædator*, marches in broad, solid mass. It is a little creature, like our common red ant, but much brighter colored, making the trunk of a tree upon which many climb look as if smeared with a blood-red liquid.

This little red ant is exceedingly venomous: its bite brings a quenchless, burning sensation, whence the Brazilians call it "fire ant." The South American Indians

require their young men to undergo the ordeal of the Tocandeiros, or fire-ants, before they can be known as warriors, or recognized as braves. A pair of mittens are made of the bark of the palm tree, long enough to cover the arms above the elbows, and are filled with the Tocandeiros. The candidate for warlike honor must put his hands into these bags of living fire, and wear them while he makes the round of the village, and dances a jig at every pause. During this march he must wear a smiling face, and chant a kind of song so loud as to be heard above all the noise his companions may make upon rude horns and drums. He must not, by word, action, or look, show any sign of the torture which he endures; if he should, he will be the ridicule of his tribe, and even the maidens will refuse to know him. When the round of the village is complete, he must pause before the chief with swifter dance, and louder chant, until he falls from exhaustion, and the burning gauntlets are removed. Then he has won his right to carry a spear with his tribe.

A species, *E. legionis*, attacks the nests of some of the large burrowing ants. They arrange themselves for this purpose into two bands; one set dig into the ground and take out pellets of earth, while the others receive the pellets and carry them away. They will thus sink a hole ten or twelve inches, and always succeed in opening the nest. The materials they pull to pieces and carry home, as well as the inmates. The community is in wonderful discipline. Each ant knows his place, and attends to his business.

The species *E. erratica*, is blind. The eyes of the other varieties are very small, but in the Blind Ant they are absolutely wanting, not showing even a trace. They have, however, some means of knowing light from darkness, for they are very uneasy when brought into the light.

They are wonderful builders, constructing long galleries through which they travel. If a gallery be broken into, the soldiers are seen slowly coming out, and opening their large jaws as if they would bite something. If not disturbed, they retire into the gallery, and soon the workers come and repair the breach. These galleries are built upon the surface of the earth, and do not penetrate the soil.

Some Ants make their nests in trees, hanging them from the boughs, like the wasps. One of these carries its abdomen in the air, hanging over its back, and has acquired the uncouth name *Crematogaster*, or "hanging-belly." Another is called by travelers the Green Ant, *Œcophylla virescens*. The name signifies a house and a leaf, and is given because it makes its hanging nest of dried leaves. When disturbed, the Ants come pattering down upon the man below like rain-drops, seeking for spots which they can wound, and having a special faculty for finding their way down the neck.

A tribe of Ants somewhat similar to the *Ecitons* of South America, is found in Africa, and is called Bashi Kouay, or Driver Ant, *Anomma areens*. It is the dread of all

animals, from the leopard to the smallest insect. It marches through the forest in lines about two inches broad, and of incredible length. One writer asserts that he has seen a column of these insects continue passing a single point, at good speed, for twelve hours. Officers march along the line and maintain order. If the advance guard come to an open place, not shaded by trees, they build a covered way, or tunnel, of dirt moistened with their saliva. If there are sticks and leaves on the ground, they fill up only the spaces which are exposed, for the direct rays of the sun kill them very quickly. If a stream crosses their path, they make a bridge of themselves, over which the whole pass. First a single Ant swings himself from the branch of a tree which overhangs the water. Then another crawls over him, and hangs from his feet. Others follow until a living chain is formed which reaches to the water, and rests upon it. Then the wind or the current wafts the free end of the chain about until it touches the opposite shore, and the crossing is complete. If one chain bridge is insufficient, others are made alongside. It is asserted that the bridge is even made tubular, and that the army marches through it.

When the Ants get hungry, the long line stops marching by the flank, as soldiers would say, that is, following each other in line, and moves like an army in line of battle, devouring every thing in its way. The black men run for their lives. In a very short time a mouse, a dog, a leopard, or even a deer, is overrun, killed, eaten, and only

the bones are left. When they enter a house, they clear it of every living thing. If a fowl is the victim, they dig out the feathers by the roots, and then pull the flesh to pieces, fastening their strong pincers into it, and never failing to bring away the piece.

A white hunter killed an antelope, and brought it to a native village. In the night he felt himself terribly bitten, and roused his attendants. The whole village was attacked by a column of the Bashi Kouay, which was attracted by the smell of the meat. The natives protected themselves by making circles of fire and standing inside. Before morning the insects had eaten every thing they could get, and had traveled on.

During the abundant tropical rains the Drivers run together and form themselves into balls, varying in size, but usually about as large as those used in the game of ball. These balls of ants float upon the water until the land appears again, and the insects can go about their business. The natives try to destroy them by making fires over and about their nests. This does not accomplish much, for the cunning ants escape before the heat becomes too great, and will be found hanging in festoons upon the neighboring trees, and crossing from one to another by their chain bridges.

These ants are black, with a tinge of red. They have enormous heads, equaling about one third of their entire length. The jaws are sharply curved, and cross each other

when closed, so that if the ant has fixed itself, its hold can not be loosened unless the jaws are opened. It has no appearance of external eyes.

Dr. Lincecum has observed an Ant in Texas, which has been called the Agricultural Ant, *Atta malefaciens*. When this species has fixed its home in good dry ground, it bores a central hole, about which it raises the surface perhaps six inches, making a low mound, which gently slopes to the outer edge. If the spot be wet, the mound is raised higher, and is even fifteen or twenty inches high. The space about the mound is carefully cleaned and smoothed like a pavement. Nothing is allowed to grow in this circle, two or three feet from the centre, except a single species of grass. This grass the ants tend with the greatest care, cutting away the weeds within and about it. It thrives under their culture, and bears a crop of seed which resembles, under the microscope, miniature rice. When ripe, it is carefully harvested, and carried into the cells, where it is cleaned of the chaff, and packed away. If the grain gets moist in damp weather, it is taken out and dried on the first fair day, and the sound kernels are carried back again; those which have sprouted are thrown away. Since men have made farms in that country, and the cattle have eaten down the ant-rice, thus spoiling their crop, the ants have either abandoned the pastures, or those communities have perished. They may be found in places where the cattle can not get at their crop of grain.

Dr. Lincecum is confident, after twelve years' observation, that these ants plant the grain, take care of it, harvest it, and keep seed for another sowing. Each year the crop of ant-rice is found growing about their cities, and not a blade of any other green thing can be found within twelve inches of this grain.

About Bees

Articulata—Insecta.

Order—*Hymenoptera*—Membrane-winged.

Family—*Apidæ*—Bee family.

On the summer days, among the white clover heads, we find a bright, busy, buzzing Bee. He runs quickly over the round white bouquet, and thrusts his long tongue deep into every floweret. He tastes of each, and then, with cheery hum, visits another and another flower. In a little time he has gathered his sweet freight. He rises in the air, circles about for an instant, and then dashes away in the straightest of bee-lines to his home. Another is searching the larkspur. A third is working at the snapdragon, the "frogs-mouth" of the children. Now he kicks against the lower lip of the gay corolla. It opens, and in he goes, while the door shuts after him. Presently it opens again, the Bee creeps out, goes to another, and vanishes in that. A fourth is making the round of the cucumber vines. Down he goes into the golden cup, round the sculptured pillar at the bottom, and out again, dusty with yellow pollen. He descends into a second cup, and as he rubs his way round that column, carved with a different device, he leaves a little of the golden dust to give vitality to the tiny cucumber at the base of the flower. If there were no Bees, the cucumbers and squashes would not grow.

Hear the gentle hum among the pale, graceful clusters of locust blossoms, which burden the air with their oppressive sweetness. The buckwheat field resounds with the busy murmur. They visit the honeysuckles and the morning-glories, the clematis and the violets, the lilies, the pea-blossoms, the scarlet-runners, and all the multitude of flowers that provide honey in their fragrant cups.

Before that fellow which explored the cucumber blossoms went home, he rested on a twig and scraped himself all over with his feet. He cleaned off every particle of the yellow pollen which had gathered upon his velvet coat, and put his jacket in the nicest order. Little dandy, is he? Not at all. He is only neat; and besides, the dust was partly what he came for. He kneaded it together, rolled it up carefully in a ball, and tucked it away in his trousers pocket. Not just that, either, but in a hollow inside his thigh, made on purpose for that kind of load, and lined with bristly hairs to keep the little yellow packet from falling out. One may often be seen with his two thighs loaded down, while he is still gathering his supply of honey.

Behind the house, under a little shed in the thicket of locusts and cinnamon roses, is the Bee's home. When his ancestors took care of themselves, they made their comb and stored their honey in the hollow of some old tree; they ate it themselves, unless the bears climbed the tree and took a share. Kow the careful farmer provides a snug, clean box for each swarm, and pays himself from their stores.

You may stand near and watch them, if you will be quiet, and have not made yourself offensive to the Bees with some strong perfume. Their sense of smell is very acute, and many perfumes make them very cross. If you find that one begins to circle round your head with a sharp, rasping buzz, quite unlike the genial hum of those which are coming and going, and particularly if you find that two or three join in the song, and fly in the same curve, you had better go without ceremony. In an instant more you may expect them to dash in your face and sting you, and that a score of angry bees will follow their example. But you may usually approach without fear, and will find a busy community—"busy as bees."

A hive of Bees contains a queen, a few hundred drones, and may have 15,000 or 20,000 workers. The workers are those we have seen gathering honey and pollen. They are about half an inch long, nearly black, and are armed with a straight sting. The drones are about five-eighths of an inch long, and are thicker and clumsier than the workers. They have no sting. The queen is more than three-fourths of an inch long, slender and graceful; she has a curved sting.

When a swarm of Bees are newly settled in a hive, their first business is to commence building. A part clean out the hive, while most go to the fields for honey and pollen. This latter they work into a substance called propolis, with which they glue the wax to the roof of the hive, and stop up all crevices which might admit cold, or insects. The wax is produced by the Bees themselves. Those which return

from the fields hang themselves from the top of the hive in bunches, festoons, ropes, and other fantastic forms, and remain quiet for about twenty-four hours. During this time the wax exudes between the rings of the bodies of the Bees, eight little scales coming out on each side. One leaves the festoon, goes to the top of the hive, and drives away the others from the spot where it would begin. It then takes from itself one of the scales of wax, chews it to make it pliable, and sticks it against the roof of the hive. When it has thus used all its wax, another takes the place, and lays more wax. While one works in one direction, another works in the opposite direction. Soon a thin partition begins to hang down, which will separate the ends of the two rows of cells that meet in the middle of the comb. When the two Bees working opposite to each other leave room between them, a third begins to cut out a hollow in one side of the partition, and presently two others begin to hollow on the opposite side. As fast as the wax layers extend the partition and make room, the sculpturers dig out the hollows on the sides. If the reader will press a slip of paper between the tips of two fingers of one hand and three fingers of the other, the paper will take the shape which the wax partition has when the sculpturers have followed the wax layers. The hollows made by the ends of the fingers will represent the bottoms of the cells on either side of the partition. Now lay a number of marbles of the same size upon a table. They will lie most closely if one be put down first, and six more

placed around it; when these are placed, the others will readily find their places. If the marbles were pressed into the surface of a sheet of wax, they would show the arrangement of several cells against one side of the central partition; the spaces between the marbles would show where the partitions between cells are made. But these spaces are triangular, and if filled up with wax, would waste wax and space, both which are very precious to the builders. So they cut out all that can be spared from the little three cornered places, and make the three partitions meet between three cells which join each other. Thus the six sided, or hexagonal shape of the cells is arranged.

Now there is room for more Bees to work. Some lengthen and widen the middle partition; some hollow out the cell bottoms; some lay wax for the sides of the cells, building directly out from the central wall; some smooth the interior of the cells. The same Bees do not lay the wax and smooth it too. When the work on one comb is fairly begun, the proper distance is measured, and another is laid out on either side of the first; then two more still farther away, and so on until the ceiling is covered. In a little time all the workers find plenty to do, and they work with such diligence that a moderate swarm will build four thousand cells in a day.

When the cells are made, and even before they are finished, the queen comes to lay the eggs. She first puts her head in the cell, as if to see that it is properly made, then she turns about and places an egg at the farther end. She

supplies thirty or forty cells on one side of the comb, and then passes to the opposite side, where she lays as many more. In this way the grubs in the same body of comb are hatched at the same time, and the bees come out together. While the queen is laying, the workers treat her with the greatest attention. They caress her; they feed her from their own mouths; if danger threatens, they cover her with their bodies, piling up two or three inches thick. If they are pushed aside, and the queen is taken out, they seem greatly alarmed for her safety, but do not sting. Their whole anxiety is for the welfare of their beloved mistress.

The egg hangs upon the upper angle of the cell for three days. Then it bursts, and a lively little worm falls from it. At once the workers begin to look after the baby-bee. They feed it with liquid food, prepared in their own stomachs from farina, or pollen, with honey, and perhaps water. At first the liquid is quite insipid, but afterwards contains more honey. The grub eats voraciously, and the Bees bring all it can eat. They watch the brood with tender care. If a comb containing it be placed in an empty hive, they will continue to take care of it without regard to other duties. By thus removing a body of comb containing one or two queen cells, a portion of a swarm may be transferred to a new hive, without the usual process of swarming.

About five days after the egg is hatched the grub stops eating. It has nearly filled the cell, and has curled itself into a ring. Then the Bees seal it up in its cell with a cover of

wax, and leave it, while it spins a silken shroud like a silkworm. This takes a day and a half; in three days more it has changed into a pupa, or chrysalis. First it straightens itself. Then the parts of the perfect Bee begin to form under the clear, white skin. The head, the eyes, the antennæ, the wings, the feet, the rings of back and abdomen, may all be seen under the silken garment which seems to be laid in shining folds about its head, and gathered up about its feet. It looks like the living mummy of a Bee. The skin changes from white and clear, to black and opaque; the parts become more distinct. On the twenty-first day from the laying of the egg, the perfect insect throws off the black mummy wrapper, eats through the silken shroud and the wax coffin-lid, and comes forth. In half an hour she is free from the cell; she dries her wings, and on the same day goes out into the world to sip honey and gather farina with her elder sisters. As soon as the young Bee has left the cell, the workers clean it out and put it in order for another egg, or for the storage of farina or honey. A large portion of the cells are used for this purpose, the food being intended for a supply at the season when flowers are not in bloom.

The care taken of the egg and grub of the worker, though very great, can not compare with that given to the young which are to become queens. The workers act as if the fate of their nation depended upon the young creature. They feed it with a richer, more pungent, and more acid jelly, and supply more of this royal food than can be eaten.

After the cell is closed up, the grub spins a cocoon, but does not complete it. This omission is often fatal to itself, but necessary to the quiet of the hive, for the queen first hatched often stings to death her rivals which have-not yet appeared. If the cocoon were complete, she might not be able to pierce it, or her sting might be entangled in the silk, which would destroy her own life. The queen ceases to be a chrysalis on the sixteenth day, but she is not allowed to leave the cell until a suitable time comes. If she were to come forth while the weather was such that a swarm could not fly, there would be two queens in the same hive, and that could not be permitted. A contest would ensue, and the older and stronger would kill the younger. So the workers keep the young queen prisoner, but give her plenty to eat.

Mean while the old queen becomes agitated and impatient. She has stopped laying eggs, and runs distractedly here and there over the comb. The workers share in her excitement, and gather about her. They fly wildly about the hive, but do not go away for food. Suddenly the confused noise within ceases. In a second some workers come forth, and then the whole swarm, led by the mother queen, streams out and fills the air with a dark cloud. They hover for an instant about their old home, and then settle in a compact mass, like a ball, or bunch of grapes, upon a bush, or branch of a tree. If undisturbed they will soon fly again, and on swift wings vanish to some distant place, and probably be lost. While

the swarm is quiet, they may be gathered in a bag or shaken into a hive. If the box be sweet and clean, and particularly if a little honey or wax has been rubbed in it, the Bees will almost always adopt it as their new home.

When swarming they are said to be perfectly harmless. Jardine says: "They are so intent on the acquisition of a new abode, and so anxious about the safety of their mother and queen, that what on ordinary occasions would draw forth many a vengeful weapon, now passes utterly unheeded by them; and the cultivator may lift them in handfuls, like so much grain, without in the least suffering for his boldness."

The young queens are left in the hive. After the departure of the old queen, the young one is allowed to come out of her cell. She at once goes to the other royal cells, and tries to kill the queens enclosed in them. Sometimes she succeeds, but the workers often crowd round her and hold her back. Excited by this treatment she sometimes leaves the hive, taking a quantity of workers with her, and so forms a second swarm. This may be repeated from a large hive until three or four swarms have left. It would seem that the hive must become quite deserted from such drafts upon it, but this is not the case. The many Bees which are in the field when the swarm leaves return to their old home, and there is a multitude of young Bees in the comb, which shortly come forth and supply the place of those which left.

It sometimes happens that a queen dies, and that too at a time when there are no queen grubs in the cells. Perhaps the queen has been taken away in order to see what the Bees would do. For about twelve hours every thing goes on as usual; the workers do not seem to know their loss. Then the community is in great distress. All labor is suspended. They rush in crowds to the door as if to leave the hive. They gather in groups as if consulting together. Then they seek the comb where worker grubs are hatched, and open three cells into one, making a royal cell. The one grub which is left in the cell is fed with royal jelly, and treated in every way like a queen grub. The same thing is done in three or four places, to make the result secure. The change of food, and the increased size of the cell, work a change in the larva, or produce a more complete development, and in due time it comes forth a perfect queen. It is known to be a fact that the Bees can produce a new queen for themselves if they have a comb containing grubs not more than three days old.

When a second queen is placed in a hive which has already a recognized queen, the Bees gather round the new comer, and though they do no violence, in a few hours she is either starved or suffocated. If the two queens meet, a battle follows, and one is slain. Sometimes both perish. If the Bees have lost their queen, and have discovered their loss, a new queen will be at once recognized; before the proper time has passed, they treat the new queen as if the old one were yet with them.

There is another Bee in the hive, of which little has been said. This is the drone, or male Bee. He is known by his larger size, his heavy flight, and his loud humming or droning sound. He takes no part in the work of the hive, nor does he go to the field to gather honey. His life is short. About the first of August, when the supply of honey begins to fail, the Bees seem to discover that the drones are of no use in their community, and that they can not afford to support them in idleness. The drones appear to know their danger, and cluster together in a corner. By and by the storm bursts. They are driven to the bottom of the hive, and out of doors. They have their wings bitten off. They drag two or three of their enemies with them, but their strength will not save them. They are unarmed, and the workers wear sharp, poisoned stings. Those which escape the massacre fall a prey to birds or toads, or perish with cold and hunger. So bitter is the fury of the workers, that they tear open the cells which would produce drones, kill the young, and drag the lifeless bodies out of the hive.

In all the work of the Bees, they take much pains to keep the hive uniformly warm. In cold weather the heat comes from the clusters of their bodies, and is considerably more than that of a well warmed house. In summer the hive is cooled by ventilation. A certain number of workers may always be found in hot weather, vibrating their wings on the alighting board before the door of the hive. Inside, a still larger number is employed in the same way. They stand on the floor of the hive in

lines, which separate to allow the workers to pass, and extend to the spaces between the combs. The beating of their wings forces a constant current of fresh air into the hive. This is one cause of the hum which constantly resounds from a hive where the bees are at work.

The honey may be taken from the hive, after the Bees have been removed by driving, or by suffocation, or it may be procured in extra boxes. Formerly, a dense smoke was made, the hive placed over it, and the Bees destroyed. Or the hive may be turned up, and an empty one placed over it; a few smart taps on the lower hive will drive the Bees into the upper one. But the best plan is to have the hives made in two stories, and to put suitable boxes into the upper story, communicating with the lower by holes through the ceiling. The Bees fill the boxes with comb and honey, and then they may be removed and others put in the place.

Bees are kept in most countries, but the varieties differ considerably. Fifteen or twenty kinds of hive Bees are named.

In Africa, in Australia, and in America, they are often found wild. Bee hunters sometimes derive considerable profit from the honey which they find in the hollow trunks of decayed trees. The hunter catches a Bee which is about ready to go home, marks it with a little red paint, or sticks a bit of white down to it, and then watches its flight. He goes a little distance, and takes another, which he treats in

the same way. By observing several, he traces their lines to the tree, cuts it down, and obtains the honey. The wild Bees of America were not originally natives. They were brought from Europe by the English, and a swarm was carried over the Alleghany mountains in 1670 by a hurricane. The Indians call them "English Flies," and they say that the Indian and the buffalo flee before the Bees. Longfellow's Indian says of the Bees and the white clover:

"Wheresoe'er they move, before them
Swarms the stinging fly, the Ahmo,
Swarms the Bee, the honey-maker;
Wheresoe'er they tread, beneath them
Springs a flower unknown among us,
Springs the White Man's Foot in blossom."

"Wise in their government, diligent and active in their employments, devoted to their young and to their queen, the Bees read a lecture to mankind that exemplifies their oriental name, Deburah, *she that speaketh*."

The great family of Bees may be divided into two classes: those which live in communities, and are called Social Bees, and those which living and working alone, are called Solitary Bees. The varieties of both classes are very numerous. More than two hundred and fifty species are known in Great Britain alone. The most noted of the social Bees are the common Hive or Honey Bees, which have already been described. Another kind, familiar to all my readers, is the Humble Bee. In New England these Bees are known to boys as Bumble Bees, or Bum-bees. In

different parts of Old England they are called Foggies, Dumbledores, or Hummel-bees. Let us observe the annual circuit of a family of these Bees.

In autumn the workers, the males, and all the old females, die. The young females find some sheltered place, in moss, dead leaves, or decayed wood of an old tree, where they may pass the winter. As the cold begins they become torpid, and so they remain until the bright sun and balmy air of spring wake them from their long sleep, and call them again among the flowers. At once they separate, and each, widow though she be, makes a home and founds a colony of her own. She finds a spot which suits her, and begins to dig a path in the ground. She picks out the grains of dirt with her strong jaws, passes them from one pair of legs to the next, under herself, and finally kicks them as far behind her as she can. When her passage is deep enough, a few inches or even some feet long, she ends it in a rounded cavern, which she lines with soft leaves. Sometimes she borrows the burrow of the field mouse, and quite often the field mouse comes and reclaims his own. Indeed, he is not careful to prove ownership, particularly if the chamber is well filled with honey and young brood.

When the room is done, she builds brood-cells, taking the wax from herself, like the hive Bees. Her comb is not built in the marvelously regular style of the hive Bees. She makes an egg-shaped cell of dirty wax, shaped like an earthen jar. This she places on its end, mouth upwards.

Then she sets another beside it, and so gathers an irregular mass of cells, some standing on the ground, some fastened to the walls of others. Some are filled with honey; others receive eggs. If more than one tier of cells is found, the second and third will be placed above the first, and will be supported by waxen pillars. Besides these cells, others are built by themselves about the room. These are filled with honey. The honey jars are never sealed up, for they are not filled for winter supply, but for daily use.

In about fifteen days from the laying of eggs, the labors of the mother Bee, who has hitherto toiled alone, are rewarded by the appearance of workers. The young Bees make more comb, and fill the cells with honey and farina. They line the roof and walls of the nest with a coating of wax, to keep the earth in place, and to prevent the rain from soaking through. When the new cells are ready, the mother lays a new supply of eggs. She must protect the new laid eggs from the workers, who would eat them if not driven away. At times she gets angry at some who persist in their efforts to get the eggs, and chases them out of the nest; but her wrath has defeated her prudence—the others take advantage of her absence, and steal her treasure.

If she can guard the eggs for a few hours, the danger ceases. In four or five days they are hatched, and as soon as the grubs are grown, each spins a cocoon for himself. Several eggs are placed in one cell. As the grubs grow, the cell becomes too small, and the pressure tears it open. The

Bees patch up the rent. Presently it tears again, and again it is patched. Thus in a little time it becomes four or five times as large as it was at first. The patch work is not fitted neatly, like the wax work of the honey Bees, and produces the rough, clumsy cells found in these nests. The males are more useful than the drones in the Bee hive; for though they do not gather food, they provide their share of wax. The other Bees do not kill them in autumn, but all perish together when the frosts come.

These underground cities frequently contain quite a dense population. In one nest were counted 157 males, 56 females, and 180 workers, making a total census of 343. These numbers seem small compared with the 20,000 to 40,000 honey Bees in a hive, but if we remember that the Humble Bees are much the largest, that the comb is large and very irregular, we find that so many require a large space; and we must not forget that they usually dig the place for themselves in the earth.

Their honey is very sweet, but is apt to give headache. The wax is not clear like ordinary beeswax, and will not melt as well. Each species makes a cell peculiar to itself, either in position or shape.

Huber, while studying the habits of these Bees, placed several under a glass, with a piece of brood-comb. He took away all their wax and honey and gave them farina only. The comb did not rest fairly on the table, and when the bees climbed upon it, to make it warm enough to hatch

the eggs, it rocked to and fro. This motion annoyed them very much, but they had no wax, and could not make props to keep the comb in place. A few of the Bees then rested the hooks of their hind feet upon the comb, and braced the middle and fore feet upon the table. In this way they propped the mass on every side, and kept it steady. They remained in this position until relieved by others, taking turns together for two or three days. Then Huber gave them some wax, which they at once wrought into pillars, beneath the comb. But in a few days the wax became dry and gave way, and the Bees had to support the comb as before.

One variety of Humble Bee does not dig a chamber in the ground, but fills up a crevice in a heap of stones, and for this has been called the Lapidary Bee, *Bombus lapidarius.*

Another is the Carder Bee, *B. muscorum*. This Bee makes a nest in some hollow upon the surface of the ground. It consists of a roof of moss, lined and bound together with moss. It has an entrance at the bottom, which is also covered with an arch, and the whole affair is shaped not unlike the huts which the Esquimaux build of snow. The manner in which the Carder Bees prepare the moss for their nest is quite curious. When several have found a supply which suits them, they form a line from the nest to the moss. The foremost Bee takes a bunch of moss and combs it with her jaws and fore feet until the fibres all lie straight in a bundle beneath her. She then pushes it

behind her, and at once proceeds to make another bundle. A second Bee takes the first bundle, combs it again, and kicks it back to a third, and so it is passed on from one to another, along the whole line to the last Bee, which puts it in its place on the roof of the house. This domed roof is made from four to six inches high.

Certain kinds of Bees have been called False Humble Bees, or Cuckoo Bees, *Apathus*. They are like the true Humble Bees in size and shape, but they lack the brush-lined cavities in the thighs for carrying pollen. These Bees do not build any house, do not make cells, or store honey, or care for their young. They are rovers, who take care of number one, and lay their eggs in the nests of other Bees. The larvæ which hatch from these eggs are stronger than the rightful occupants of the cells, and eat up all the food. So the hard working Humble Bee has built her cell for an intruder, and continues to care for it as if it were the true heir, which it has starved out. Such things do not happen among mankind alone.

Among the solitary Bees several trades are represented. Their labors all tend to the same result—shelter and food for their young, while some work in wood like carpenters; others, like masons, build houses of mortar; others excavate the ground as miners; others find cavities, which they line with leaves, like upholsterers.

The Carpenter Bee begins her work in early spring. She chooses a bit of wood which suits her, usually the dead

branch of a tree, or a weather beaten board, and in this she bores a hole about an inch and a half long and large enough to turn round in, which usually opens upon the under side of the branch or board, so that the rain may not come in. After boring directly in as far as she chooses, she turns and works several inches along the grain of the wood. All her chips she takes out and stores carefully in some place where they will not be blown away by the wind.

When she has bored as deep as she chooses, she begins to fill up the hole again. She puts a little heap of pollen in the bottom, and lays an egg. Then she goes to her store of chips and gets material for a floor above the egg. She fastens the chips in a ring about the wall, with glue from her mouth. Within this ring she makes a second, then a third, until the partition is complete. On this floor she places another pile of pollen, and an egg; and thus she continues until the hole is full. When the egg hatches, the grub finds a supply of food; in a few days it has grown to its full size, and changes to a chrysalis, placing its head downwards. In this way the perfect Bee, as it gnaws its way out of the wood, is prevented from interfering with its younger brothers and sisters which are not yet quite ready to meet the responsibilities of society. English writers describe the Carpenter Bees as living in South America and Africa; they may be found in various parts of the United States.

A variety of wood-boring Bee chooses the stem of the willow tree for its home. When its tunnel is finished, it flies away to a rose bush, alights upon a leaf, and cuts out a round piece, about as large as a half dime. Many persons seeing the round spaces left, charge the mischief to the caterpillars. The Bee stands upon the piece which she cuts off, and as it falls she flies back to her nest with it in her jaws. She bends it into a cup shape, and stuffs it down to the very bottom of the hole. When the cell is suitably lined, she puts in some pollen and an egg, and covers it with another bit of leaf, which is the floor of a second cell. When the leaves are dry and stiff, they are so compact that the whole may be taken out together, and then separated into sections, like a row of thimbles thrust into each other. One variety of the Upholsterer Bee uses the scarlet leaves of the poppy for the silken lining of its cradle.

When a boy, the writer was somewhat frightened by a bee which came into his bedroom. The alarm was soon changed to curiosity, when the Bee was seen to examine an old inkstand, which had several holes in it for holding pens. The Bee would enter one of these holes, remain an instant, fly away out of the window, and presently come back to the same place again. So she buzzed about all that day and the next, and by the end of the second day she had filled up all the holes in the inkstand, and plastered them over neatly with mortar. She explored the central place, where the ink should be placed, but although it was dry, it did not suit her, and she departed. The holes were found

to be divided into cells by partitions of mortar, and in each cell was a grub which would have become a Bee.

Other Mason Bees build a mass of cells, placed side by side, in a lump, which they stick against the side of a wall, or in a corner. They love to work in the dark attic of a house. where they are undisturbed, finding entrance through some crevice or knot-hole.

They frequently fill the hollow stems of old raspberry vines, and the smaller kinds fill straws or nail holes. In fact, they occupy all sorts of odd and queer places, even filling up the scrolls of a snail shell.

There is no better sport for a boy than the watching of one of the working insects in a quiet afternoon among the summer holidays. Unlike the birds, they do not mind the presence of a visitor, and go right on with their work. An ant hill, a Bee hive, a solitary Bee, a spider spinning his web, or a hornet building his paper mansion on the other side of the window pane, will pay for many an hour's silent observation. And the quiet boy, with watchful eyes, will find many chances of seeing them, which he least expected.

About Spiders

Articulata.—Insecta.

Order—*Arachnidæ*. Spider-family.

Curious and beautiful forms are found in every department of the insect world. In all its infinite variety there are none which do not pay for careful, watchful study. We have described two great tribes of workers. Each is busy, one not more than the other. "Go to the ant, thou sluggard," says the wise man, "consider her ways and be wise."

So doth the little busy bee
Improve each shining hour;
And gathers honey all the day,
From every opening flower.

We come now to the family of spiders. They are workers, too, in their way, but their labors are devised only to carry on their great business of preying upon other insects. They are carnivorous insects; made to live upon flesh, just as the animals of the cat tribe live upon other animals, and as the hawks prey upon other birds. They serve a very important purpose in the insect world, for they help to keep other tribes, which would increase too rapidly, in their proper proportion.

Many people have a natural dislike to a Spider. They are known to bite, that is, to sting—flies, at least—and there is a kind of fear that they may sting men or children.

They seem to be very crafty, and then they run so fast, and in such unexpected ways, that young ladies think it quite proper to scream, or run, if a Spider happens to come her way. Then the housekeepers hate them because they spin webs in the corners; the webs gather dust, and the room is untidy. The offending webs are swept down, but the Spiders are diligent, and in a few hours replace the webs. So the housewives search diligently, and without mercy put the persevering insects to death. It may be that perseverance, as an abstract quality, is not as valuable as some people think. Perseverance in a good cause, to attain a desirable object, is very commendable, but perseverance in an evil way only makes the evil worse. We are apt to think that ways which are not in harmony with our ways are wrong, and so the housewife very much dislikes the perseverance of the Spider.

Goldsmith writes of a Spider which he watched. It was three days making its web; then another Spider came, and in the battle which the two had for the web they nearly ruined it. Three days more were spent in repairing damages. When the web was complete again, a wasp was caught in it, and as the Spider did not dare engage so powerful an enemy, it cut the bands and let the wasp go. But the web was so torn that the insect thought it easier to make a new one, than to repair the old. This new web Goldsmith destroyed, and the Spider made another. Again he destroyed the work, but the poor creature could spin no more. It had spun four entire webs, besides

making repairs enough to complete another, and had worked nearly fifteen days. Its only resource for a living was to drive another Spider from its web, and take possession.

In shape and structure the Spiders are all similar, but unlike most other insects. A wasp, a bee, or an ant, has three distinct parts—a head, a body or thorax, and a belly or abdomen; and these three parts are connected by slender cords or tubes. The Spider's head and body seem to have been soldered into one piece, as if a man's head were set firmly upon his shoulders. Naturalists call this the *cephalothorax*, or head-chest. Its body, as well as the eight legs which are joined to it, is covered with plate armor of strong scales. The fore part has two branches, which might be called arms, each furnished at the end with a curved sting, shaped like the claw of a cat. Each claw has a tiny opening near the point, through which poison passes into the wound which it gives. When a fly is caught in its toils, the Spider runs to it, and strikes with these arms, inflicting wounds with its poisoned dagger-claws. In different parts of the head the Spider has several eyes, generally eight, but sometimes only six, and these eyes are arranged differently in different species. The number seems to make up for their want of motion.

The hind part of the Spider is covered with fine supple skin, and clothed with hair. Near the end are four, five, or six, little swollen spots or spinners. Each of these has a multitude of little tubes, so many that the microscope has

shown a thousand in a space no bigger than a pin's point. Out of these tubes comes the material of the Spider's web. At a little distance, the threads from all these tubes of one spinner join, and then the strands from all the spinners are joined together. Thus the thin spider-line which one can barely see, as it glitters with moisture in the sunshine, and in many positions can not see at all, is made of four or six strands, each strand composed of more than a thousand threadlets. This wonderful cable is strong enough to support the Spider herself. She often stops spinning in mid-air, turns back and climbs up the same cord to the place whence she let herself fall.

The spinning of the Garden Spider is probably not more curious than that of any other, but it is rather more easily observed. Sometimes one begins her web on the outside of a window, and is easily watched from within. She begins by pressing the spinners against the wood of the window frame; a little of the gum exudes, and fastens one end of the line. She runs along, giving out line as she goes, until she finds a good place to fasten at, where she presses herself against the wall, making the other end secure. She first stretches a few lines about the Space which the web is to fill, forming a triangle, or a four-sided figure. She then draws a line across the middle of this space. All these lines she makes very strong, doubling some of them several times. If any of them seems to become slack, she fastens a line near one end, and pulls it aside, until the main line is taut. Now she goes to the

middle of the cross line, fastens a line there, and then runs back to the margin and fastens it an inch or so from the end of the cross line. She goes to the middle, and stretches another line in another direction, and then another, as if she were putting iu the spokes of a wheel. While doing this she does not put in the rays or spokes on one side first, but draws her lines in opposite directions, keeping the strains all the time even. When she is about the first part of the work, running the marginal lines, and placing the first few spokes, she works slowly, stopping now and then to plan; but as the web progresses, she seems to have solved her problem to her satisfaction, and hurries on the work.

Presently the rays are all set. Then she goes to the centre, and lays down a spiral line, fastening it to every spoke, and drawing it round and round, at even distances, in ever widening circles, until she comes to the outside. The main lines and rays are made stout and firm. The spiral lines are very elastic, and may be drawn far out of place without breaking. The garden Spider finishes her web in a few hours. She works as well by night as by day; in the dark as in the light.

When her web is done, she hangs herself in the middle of it, with her head downwards, waiting until some insect becomes entangled in her snare. When she feels the web move, she rushes to the spot. If the game be small, she thrusts in her dagger, and kills it at once. If it be large, and there is danger that its struggles will tear the web, she at once winds it round and round with cords, which she spins

as she goes. She ties it, wing and foot, until its struggles can do no harm; then she gives the fatal blow, and eats the victim at her leisure. If the insect is so large that she can not manage it, she cuts away the threads as quick as possible, and lets it go, before it has torn her web in pieces.

A writer for the "Atlantic Monthly," a surgeon in the United States Army, gives an interesting account of the spinning of a kind of Spider, *Nephila plumipes*, which he found on one of the sea islands near Charleston. These Spiders were quite large. The females were from an inch to an inch and a quarter long; the males were only about one fourth of an inch long, and about one hundred and twenty would have weighed as much as one of their buxom wives. Accident showed him that he could reel the silk from the living Spider. He therefore gathered as many as he could find, and brought them north to experiment with. When ready to spin, he fastened each in a little frame of cardboard, which would hold the insect without hurting it. Then he reeled the silk upon a suitable reel. From one he wound about one thousand yards, and from another over *two miles* of silk. A single thread sustained a weight of fifty-four grains.

The silk from the same Spider was of different colors and qualities. At the same instant he wound from one insect one thread golden yellow, and another bright silver white. If the two ran together, they made one light yellow thread. The white silk, when dry, was firm and unyielding, suitable for the rays of a Spider's web. The yellow was very

elastic, like that used for the spiral rings which bind the rays together. There was also a pale blue silk which seemed to be used to tie up an insect after it was caught in the web. Enough silk was reeled to be woven in a loom, upon a warp of black silk, so as to make a bit of ribbon two inches wide, showing that it was real silk.

The House Spider usually puts her web in some corner. She runs out as far as she intends to spread the web, fastens a thread to the wood, then goes back to the corner and out on the other side, until she comes opposite the place where she first made the thread fast, and there fixes the other end. Then she places a second and a third thread beside the first, for these make the foundation of her whole work. From these she draws other lines to the angle, and then she works back and forth over the whole, until the piece of gauze is done. She then stretches a great number of threads from side to side above her web, crossing them every way. These lines are arranged not unlike the tackling of a ship, and often reach two or three feet high. The flies passing through the space become entangled, fall upon the web below, and are caught. Besides all this, she makes a round funnel, for a hiding place, below the web, in the corner, or behind some piece of furniture. Here she waits and watches, out of sight. If the least touch disturbs the web, she feels it, for the rays from every part pass down into this funnel, and she rushes forth to learn the cause.

A Spider of Jamaica is called the Trap-door Spider. This insect digs a burrow in the ground, and lines it first with coarse, rough web, which seems more like the paper of the wasp's nest than the silk of the Spider. The inner lining is smooth and soft, and may be drawn out of the other, without injuring either. The tube is placed where the surface of the ground is a little sloping, and the mouth is covered with a door, made like the lining of the tube. This door is fastened by a hinge at the upper edge, in such a position that it falls into place by its own weight. The outside is covered with earth, which perfectly conceals the nest. A stranger may well be startled at seeing a hole open in the ground at his feet, and a large Spider peep out to observe what is going on. One of these Spiders dug its tube in cultivated ground. After it was made, the earth was heaped over it about three inches; the Spider finished out its tube, and made a second door at the new surface.

This Spider is about an inch and a half long. It leaves its burrow at night and hunts for its prey. If anyone attempts to raise the trap, it hooks its hind legs into the door, and its fore legs into the side of the tube, and holds on with all its might. It will suffer its nest to be dug out of the ground and carried away without leaving it; in this way they have been caught and put where they could be watched. Other species which make their home thus are found in Australia and elsewhere.

In Surinam, and on the Amazon river, Spiders are found of the genus *Mygale*, which destroy birds. When this

was first reported, it was not believed, but the Spiders have been caught in the very act. When we consider the size which they attain, the wonder ceases. One is described as two inches in length of body, and more than seven inches in expanse of legs. It was covered with coarse red and gray hairs. Some of these huge Spiders make a dense web; one digs a burrow two feet deep, and lines it with silk. When the children catch one of these fellows, they tie a string about its waist, and lead it along like a dog. The Mygale sheds its hairs easily and they pierce the skin of one who handles it, causing painful irritation.

The name Tarantula is given to several large Spiders that live in the ground and hunt for prey. The Italians have a belief that one kind will cause a disease which can be cured only by dancing a long while to peculiar music. The sting really makes but a slight wound.

One member of this family lives in the water. Still it lives by breathing air, and therefore it takes a supply along with it down under the water into its nest. Like all the other Spiders, this makes its nest of silk; it is generally about as large as an acorn, egg-shaped, and open below. This cell is filled with air; and if the Spider be kept in a glass vessel, it may be seen in its cell, resting in Spider fashion, with its head downward. Where the air came from was, for a long time, the question. Some thought it was the oxygen which was formed by the water plants.

A few years since, Mr. Bell saw some of these Spiders spin their webs, and fill them with air. When one had made her web, she went to the surface, grasped a bubble of air, descended quickly to her nest, and thrust the air in. Then she came up for more, and after twelve or fourteen journeys she had laid in her supply. When enough had been collected, the Spider crept in and settled herself to rest in her transparent cell.

"The manner in which the animal possesses itself of the bubble is very curious. It ascends to the surface slowly, assisted by a thread attached to a leaf below and to one at the surface. As soon as it comes near the surface, it turns the extremity of the abdomen upwards, and exposes a portion of the body to the air for an instant, then with a jerk it snatches, as it were, a bubble of air, which is attached not only to the hairs which cover the abdomen, but is held on by the two hinder legs, which are crossed at an acute angle near the extremity, this crossing of the legs taking place the instant the bubble is seized. The little creature then descends more rapidly and regains its cell, always by the same route, turns the abdomen within it, and leaves the bubble."

The whaler Spiders feed on the insects which swarm in the water, eating their prey in their homes.

Another aquatic Spider builds a raft. It gathers together a mass of dry leaves and similar things which will float, and fastens it with silk threads. On this raft it sits,

floating wherever the winds and waters carry it. When the water insects come to the top, it seizes them before they can escape. Others fly over the surface for their prey, and fall into the jaws of this Spider-wolf. It is quite large, and very beautifully colored and marked.

At certain seasons of the year, large quantities of gossamer threads are seen floating in the air. They fall upon the grass and streak it with fine lines. They gather on the trees. The steamboat, plowing up the long lanes of water through forest and prairie, gathers streamers and pennons of gossamer on every pole, and the rough helmsman frets as the films catch upon his eyebrows, and dim his sight. All this is made by Spiders. They climb to the tops of trees, and pushing the gossamer out at their spinners, let it float upon the air until its buoyancy is enough to carry them away. Balloonists have found these Spiders floating in the air above their cars.

Says Gilbert White: "Every day, in fine autumnal weather, do I see these Spiders shooting out their web and mounting aloft. They will go off from your finger if you will take them into your hand; last summer one alighted on my book, as I was reading in the parlor, and running to the top of the page and shooting out a web, took a departure from thence. But what I most wondered at was, that it went off with considerable swiftness, in a place where no air was stirring; and I am sure I did not assist it with my breath; so that these little crawlers seem to have,

while mounting, some locomotive power, without the use of wings, and move faster in the air than the air itself."

There are spiders which lie concealed in a rolled up leaf, and seize any insect which comes in the way. Others lurk in the cup of a flower, and eat the fly that comes for honey. Some hunting Spiders leap upon their prey like tigers, and have a way of jumping sideways. They steal upon their game as a cat steals upon a bird. If the fly moves, the Spider moves too—backwards, forwards, or sideways—until the two seem to be moved by one unseen spirit. If the fly takes wing and alights behind the Spider, it turns about with the swiftness of thought, too quick for the eye to follow. When its movements have brought it within reach of its victim, its leap is sudden and deadly as lightning.

The Spider is very watchful over its young. Most species do not lay eggs until two years old. Then the female prepares a cocoon of silk, very thick and strong, in which she places from fifty to a hundred salmon-colored eggs. This sack is often made of two dish-shaped pieces, fastened together at the edges. Sometimes it is hidden in the crevice of a wall, or under the edge of a loose board. In this case it is securely fastened by a net-work thrown over and about it. It is often carried about by the mother, attached beneath the abdomen, or held in the jaws as a cat carries her kitten.

If any attempt is made to carry away this treasure, which the mother always watches over, she resists it to the utmost. When taken from her, she becomes listless, as if stupefied; if restored, she seizes it eagerly, and runs away with it to a safer place. When the young are hatched they remain in the cocoon until, at the proper time, the mother bites it open and sets them free. Even then they do not leave her, but remain, like a brood of chickens, under her care. She often takes them upon her back; she provides food for them, and leads them about until they have age and strength to shift for themselves.

The gentleman who obtained the silk spinners from Charleston harbor, procured a large number of these egg sacks, and in a short time had a brood of about *two hundred thousand.* One bright June day he left them on a tray in the sun, and on his return found his brood—baked. A supply of Spiders, which he kept in little paper boxes, furnished a fresh harvest of eggs, from which about seven thousand were hatched. They appeared in about a month after the eggs were laid. For a long time they seemed to eat nothing; then they shed their skins, and began to grow. As they grew, their numbers diminished, and it began to be evident that they were eating each other. Shut up in the sacks they had nothing else to eat, and the weaker ones were a prey to the stronger. They were then placed in inverted glass jars, with wet sponges in the mouths, and were fed with flies, bugs, and afterwards with such flesh as bits of chicken's liver. Some of the first family brought

north seemed to go into a decline and die, for no cause which their keeper could understand. He tried various expedients with them, but nothing did any good. At last he thought of giving them water, although he had never known that Spiders drank water. A drop was given on the tip of a camel's hair pencil, and was eagerly seized. All the Spiders drank, some taking several drops. Besides water to drink they required some moisture in the air. They became quite tame; would eat and drink from a bit of stick, or a pin, and when stroked gently, would raise up the back like a cat, or put up a foot to push away the finger.

As was said before, the Spider is a type of industry and perseverance, no less than the ant or the bee. The Scottish farmers love to tell that King Robert Bruce once learned a lesson of endurance from a Spider. While wandering on the wild hills of Arran, he passed a night within a poor, deserted cottage. He threw himself down upon a heap of straw, and lay, with his hands under his head, unable to sleep, but gazing up at the rafters of the hut, festooned with cobwebs. From long and dreamy thoughts about his hopeless condition, and the many evils which he had met, he was roused to notice the efforts of a poor Spider, which had begun its work with the first gray light of morning. The insect was trying to swing by its thread from one rafter to another, but it constantly failed, each time swinging back to the point from which it sprang. Twelve times the little creature made the attempt, and twelve times it failed. Without delay it tried again, and the rafter

was gained. "I accept the lesson," said Bruce, springing to his feet; "I shall again venture my life to win the battle for my country." And the victory was won.

About Dragon-flies

Articulata.—Insecta.

Order—*Neuroptera.* Net-winged.

Family—*Libellulidæ.*

A long, slender insect, with large head, swollen on either side by a huge eye, flying with four broad, gauzy wings, is a frequent mid-summer visitor. He and his mates range up and down in the air, pausing here a moment, then darting away in the most unexpected manner. He comes into the house with a great buzz, and makes vain attempts to fly back to free air through the window pane. He seems to have no particular business, except flying about, buzzing, and bumping his head. The children call him a Darning-needle, because his body is straight and slender; and as its long and flexible tail twists about more than seems pleasant, they are afraid of it; they believe it can sting, and some call it a Horse-stinger. But the creature has no sting, and can do no harm to man, or beast. In the insect world he well deserves his name, Dragon-fly, for he devours multitudes of other insects. When dancing in the sunshine, or in the twilight shadows, he is busy catching gnats, or sweeping up other minute specks which fly in the air. He is not content, even, with such small game, but is the eagle among insects, pouncing upon unwary butterflies, which he drags to some bush to devour at his leisure.

The water is his birth-place. The eggs, like a bunch of grapes, sink to the bottom and hatch out six-footed larvæ, with dusky brown skins. Like many other grubs, when these youngsters grow too large for their clothes, they split them open, throw them away, and soon appear in a new and larger suit. When full grown, a pair of scales appears on the back, which is a mere suggestion of wings. The head is then armed with a long, jointed trunk, fitted at the end with a pair of strong hooks. While at rest, this trunk lies folded over the face, like a mask; if any prey parses by, the trunk leaps forth, and the hooks grapple the unwary victim.

The Dragon-fly lives as larva and pupa, two years. When ready to come out into the world, it climbs to the top of some water plant, into the sunshine. The eyes show when the change is coming. Instead of dark, dull places where eyes might be, they become clear and bright, and the real eye shines through the mask. If one can be found at this crisis, and fastened where the change can be seen, it will yield much amusement.

First a rent comes in the skin along the back, to the face; here another rent opens crosswise, over the eyes. Now that he has burst his case, he carefully picks out his legs, and then hangs his head down, motionless, as if dead. He has only hung his moist legs out to dry. Presently he lifts himself again, grasps the case with his feet, and slowly draws out his long tail, and wet, sodden wings. But the tail has not its full length, and the wings are folded. He rests

awhile; the tail expands, the wings unfold, and as they harden, glisten like sheets of mica. While in this wet condition, the Dragon-fly is careful not to touch them, even with its body; for a wrong twist now would make a deformity for ever. The change may be passed in a quarter of an hour, or may take several hours, according to the clearness of the air. When the wings are fully spread and hardened, and the bright colors of the mailed body are fully set, he leaves his twig and begins his long journey through the air. Like a newly commissioned Alabama, armed and supplied for a long cruise upon the high seas, he sets forth, a piratical rover, to capture, plunder, and destroy.

While living in the water, this creature has a way of moving about peculiar to itself. If seen at the bottom of clear water, it seems to move merely because it wills to move, with nothing like walking or swimming—it goes. But if a few grains of sand be near, they seem to will to go backward, at the same time. Put one of the larvæ into water colored with milk or indigo, and then suddenly change him into clear water, and the motion will be explained. He will be seen to spirt a stream of colored fluid into the clear water, and it will be found that he has in his abdomen a set of force pumps. These fill slowly from the fluid in which the larva floats, and then drive out the water backwards, while the same force which ejects the water, pushes the insect forwards. Some English ship-builders propose to drive steamships by this plan, which it may be

they borrowed from this very insect. They take water through the bottom of the ship, and then drive it out astern by powerful steam pumps. In this way they expect to force the vessel rapidly through the water.

We have mentioned the large globes of eyes on either side of the Dragon-fly's head. Under a small lens these eyes seem to be covered with fine net-work. A magnifier of larger power shows that the surface is composed of regular, six-sided faces, so that it resembles a minute crystal honey comb. Farther examination shows that each eye contains more than 12,000 of these lenses, and that what we call the eye is only a bundle of eyes.

Opticians grind a multitude of flat faces on a rounded bit of glass, which they set in a tube. Any thing seen through this tube seems multiplied as many times as there are faces on the glass; the image is very pretty, but very much confused. We need not suppose, however, that the Dragon-fly is puzzled by his compound eye, or that he sees more than one image. Although we have two eyes, we do not see double. The nerves which carry word to the brain that the eyes see something, meet just behind the eyes, and perhaps, for this reason, report but one object. If two eyes thus unite their results, so that we do not see double, in the same way 25,000 eyes in one head may combine all their results. The fact that we see so many images in the multiplying glass will not trouble us if we remember that our own eye is behind the glass, instead of a bundle of

nerves, and there is no way of gathering all the images into one.

There are many species of Dragon-flies, strong of wing, and beautifully colored with bright blue, green, scarlet, glossy black, or transparent white. The body is often of one hue, while the wings are barred or spotted with others. Often the male and female of the same species are variously marked. These bright colors always vanish when the animal dies; in a few days the most brilliant specimens will have faded to a blackish brown. The only way to preserve them is to remove the interior substance, and fill the space with paint of the proper color, and this method does not repay the time and labor spent.

One tribe belonging to this family are called Scorpion-flies. The rings near the end of the tail are quite slender, and move easily in any direction. The last ring is stout and thick, and bears a strong pair of forceps. When the fly is at rest, the tail is curved over its back like that of a puppy, but when alarmed it flourishes the tail in a very alarming style, the forceps snapping as if something serious would happen if there were a chance.

Some other members of the order *Neuroptera*, or nerve-winged insects, are worthy of notice.

The large, prominent eyes of the Lace-wings, or Golden-eyes, glow with changeful flames of gold and ruby, as if on fire. These insects are small, but their brilliancy and their broad wings make them quite conspicuous. The

larva of the lace-wing is very voracious. It is particularly fond of the plant lice, and therefore is quite useful. A single one will clear a densely crowded twig in a short time. It will, however, turn and eat the eggs in which its brothers are ready to hatch, if it can reach them. To prevent this, the instinct of the mother makes her spin a slender thread, like a bit of bristle, about a third of an inch long; the lower end of this thread she glues fast to a twig, and on the upper end she leaves an egg about the size and shape of the letter "o". So she places a dozen in a group, which is easily mistaken for a patch of moss. For a long time these were really supposed to be a variety of moss, nobody suspecting that they were the eggs of an insect. When the first hatches, he falls down upon the twig. He reaches up to breakfast on another egg, but he can not climb the slender waving stalk, so he creeps away, and finds his meal elsewhere.

A somewhat celebrated insect of this family is the Ant-lion. In its perfect state it much resembles the Dragon-fly, but the wings are broader and softer. It is most remarkable when a larva. Then it resembles a flattened maggot, with long legs and large jaws; but the legs are of little use for walking, as it moves mostly by means of its abdomen. It is very slow, and yet very voracious, living on insects much quicker than itself, which it catches alive. As it can not take them in open chase, it sets an ambush by digging a pit, and lying concealed at the bottom. In this work it begins at the outside. It presses its body down into the sand, and then

backs round in a circle, plowing the earth and throwing it outward. So it goes round and round, drawing one furrow after another until it comes to the middle. This plowing is repeated several times, as long as it will turn the earth outward. Then it begins to dig. It goes to the middle, and flings the sand out with its head, and smoothes the sides of the pit, down to the centre, into a regular funnel. If it finds small stones, it jerks them, one by one, over the wall. If too large for that, it takes them on its back and carries them up the slope, and tumbles them over the edge. Sometimes, after toilsomely tugging until a stone is nearly at the top, the pebble topples off and rolls to the bottom again, plowing a furrow as it goes down. The Ant-lion tries again, pushing the load up the same furrow; he works on until the stone is removed, or until repeated failure satisfies him that he is not equal to the task. Then he leaves the unfinished pit, and digs another.

When finished, the pit is about two inches deep, and three inches in diameter. The Ant-lion lies at the bottom, only his jaws being in sight. When an ant, journeying that way, looks over the edge, the loose sand under its feet begins to slide, and lets it down into the pit. It struggles to regain the top, but that only hastens its fall, and down it goes into the jaws of the hungry monster which waits for it at the bottom. If the ant succeeds in climbing up, and is likely to get out of danger, the Ant-lion shovels sand upon its head, and flings it after the escaping insect. Overwhelmed by this storm the ant is borne to the

bottom. When the juices are sucked out of him, the empty skin is tossed over the mound, and the pit is put in order for the next unfortunate.

Thus the Ant-lion lives for about two years. Then it wraps itself in a covering made of sand glued together, and bound by a kind of silk which it spins. In about three weeks it emerges in its perfect form.

Another of the *Neuroptera* is the May-fly, or Ephemera. The early days of summer bring vast swarms of them, which vanish as suddenly as they come; often a single day is sufficient for the entire round of their perfect life. Hence the name Ephemera—"(lasting) for a day." It is, however, a mistake to suppose that a day is enough for the entire life of the insect from the egg to the grave. On the contrary, two years are passed in the water before the winged form is assumed. Like other creatures that flit a few brief days about watering places—although it does not carry a Saratoga trunk full of finery—it can not do without a change of dress. So, after dancing its set in one costume, it retires to its chamber—a twig—kicks off its garment, and appears in another, bright and new, with larger wings, broader plumes, and longer train.

In both dresses, the May-fly is very eagerly taken by fish, and adroit anglers use them, or imitate them, when they would bring wary old trout from their deepest hiding places. Very much alike—Newport belles, and Newport May -flies!

Termites

The remarkable insects known as Termites, or White Ants, though commonly called ants, are not classed with that order, but among the *Neuroptera*, on account of the structure of their wings in their perfect stage. Like the ants, the Termites live in societies, which become immensely large. They build for themselves huge cities, great mounds, conical like sugar-loaves, sometimes twenty feet high, and more than a hundred feet in circuit. They make these of clay, and so solid and strong, that the wild cattle climb on them without breaking through. Within they are full of chambers and passages. There are apartments for the king and queen; nurseries for the young; garrisons of soldiers; dwellings for workmen, and storehouses for food. These edifices are said to surpass the dwellings of ants, bees, and beavers, as much as the architecture of Europeans excels the rude huts of Indians or Bushmen. Some species build in the ground, partly beneath and partly above the surface; others build on branches of trees, and often at a great height.

One of the best known species is the *Termes bellicosus* of Africa. In Senegal, and parts of Central Africa, their numerous clusters of hills resemble the huts in the native villages. The first hill which they make, in beginning a settlement, rises above the ground perhaps a foot. While this grows larger and higher, others spring up at a little distance, and still others, until a circle of small hills surrounds the larger one in the centre. These all keep on

growing; presently they join each other, and the middle cone includes or covers up the outer ones. Mean while the inside works which were first made, are pulled down, and the materials are used for building the outer cones. They have no precise form, the only cure being to make them firm and strong. Until they are six or eight feet high they are quite bare, but after that they increase more slowly, and grass often grows upon them. In the hot season, when the grass becomes dry, the whole resembles a large haystack.

The royal apartment, as the most important room of the house, is placed in the centre. It is shaped like half of an egg, cut lengthwise, and is at first about an inch long; it is afterwards enlarged to suit the increased size of the queen, until it is six or eight inches long, or even more. The openings through the walls and roof of this room are large enough to admit the workers which are in attendance, but the royal occupants can never pass out; they are life-long prisoners. A set of chambers about the royal cell contains the soldiers who protect, and the workers who serve the regal prisoners. These rooms are connected together; they extend a foot or two all round the central apartment. They are surrounded by the nurseries and the storehouses. The latter are built of clay, and filled with gums and similar vegetable substances. The walls and partitions of the nurseries are made of woody fibre, cemented together by the saliva of the insect. When the nest is small, they are near the royal chamber. As the

family grows, and the attendants of the queen become more numerous, the nurseries are moved farther away. They are enclosed in clay chambers, like the granaries, and the wooden partitions and linings would seem to prevent too sudden changes of temperature.

A large arched open space, two or three feet high, is left under the central dome, with arched passages on every side, which allow the warm air to circulate freely, and keep the nurseries at a proper degree of heat. The shell which forms the great dome is traversed by large round or oval passages, several inches wide. These ascend spirally, quite to the top, opening into each other, and into the central dome at proper distances. Other passages of less size connect the larger ones, and others still lead far away under ground. Even if all the Termites within a hundred yards of a house were destroyed, those which live farther away would extend their galleries to the house, eat up the merchandise in it, and destroy every thing. If they can not go under ground in the way they wish, they make pipes along the surface, of the same material as their nest; they often carry these covered ways above ground over the deeper paths, and make frequent communications between them, so that they can escape by one, if they are attacked in the other.

Each village of Termites has a king and queen, an army of soldiers, and a population of laborers. There are about a hundred workers to one soldier; they are about a quarter of an inch long, very busy and very swift. The soldiers are

half an inch long, and as large as fifteen of the workers. The winged or perfect insects are nearly an inch long, and their wings spread above two inches and a half. They are equal in bulk to two soldiers. The young Termites come out of the nest just after the first shower has opened the rainy season. The immense swarms fill the air as with dense white snow flakes. Every living thing seems to be their enemy. The ants fall upon them and eat them; birds come in flocks and pick them up; reptiles and ant-eaters devour them, and the black men gather them as the greatest delicacy. Not one pair in a hundred thousand escapes alive, but that pair will, by and by, produce a hundred thousand a day.

While the winged insects are flying, and being eaten, the workers are running about on the ground searching for them. If a pair is found, they are at once chosen king and queen, and their new subjects proceed to build them a house. They are shut up in a little clay chamber, with only one small entrance, too small to allow them to pass out. Presently the female begins to enlarge in a wonderful manner; and the house has to be enlarged to correspond. In time, it is thought about two years, she is about three-fourths of an inch wide and three inches long—specimens have been found of twice that length. Her body is now oblong, banded at intervals of half an inch with dark muscles. The transparent skin is of a fine cream color, through which the intestines, and the motion of the fluids, may be clearly seen. When she has reached this size, she

produces about eighty thousand eggs a day. The attendant workers carry these away to the nurseries, where they are hatched, and the young provided with every thing needed, until they are old enough to shift for themselves.

When a person enters a piece of ground which is marked by many of the covered ways of these insects, he hears an alarm given by distinct hisses. After that he may search the paths for Termites in vain; they have escaped by the underground lines. The tunnels are made large enough for passing and repassing without trouble. They serve as shelter from light and air, and particularly from the attacks of other ants. When driven from these defences the ants pounce upon them, and carry them to their own nests to feed their young ones. If the defence is broken, the workers at once set about repairing it, and even if three or four yards is destroyed, the place will be rebuilt before the next morning. If the gallery is often destroyed, it will be given up and another made, unless it leads to some favorite plunder. The main roads are made deep under ground, going under the very foundations of houses and stores, and come up under the floors, or through the posts on which the building rests. While some are boring the posts through and through, and taking out all their fibres, others climb the outside and enter the roof. If they find thatch, which they seem to like very well, they bring up clay and make covered ways in and through the roof as long as it will stand. Thus they carry away, bit by bit, every sill, and post, and beam, floor, ceiling, and

partition. The outside seems firm and sound, but the whole will crumble at a touch. Sometimes they seem to know that a post sustains weight, and then they fill up the cavities which they make with clay, packing it in more solidly than man could. The posts are found filled with material as hard and compact as many kinds of building stone. They will eat the very mat on which a man sleeps. They carry away all the wood of his strong box, leaving a shell as thin as paper. They devour his books, his records, his correspondence. If a piece of furniture be left too long in one place, nothing will remain but the surface. A man may be rich to-day, and poor to-morrow from their ravages.

It is a difficult task to destroy them. Any thing which is washed with corrosive sublimate they respect, but this can not be applied to many things. If the house is broken into, the soldiers come to the breach to defend it. They may be destroyed, but they are not those which do the mischief. The workers are left, and the business of the village goes on just as before. The only plan which is at all sure is to continue pulling down the nest until the chamber of the queen is found, and she is destroyed. Then the others seem to be bewildered, lose courage, and finally abandon the nest.

About the year 1780, some bales of goods, brought from St. Domingo, were stored in La Rochelle, and in other French seaports, and thus the Termites were introduced. At La Rochelle they took possession of the

arsenal, and of the prefect's house, invading rooms, offices, court, and garden. A stake driven, or a plank left, in the garden, was destroyed forthwith. One fine morning the records of the office were found ruined, though not the least trace of damage was seen on the outside. The Termites had mined the wood work, pierced the cardboard, and eaten up parchments and papers, but had always scrupulously respected the upper leaf, and the edges of all the leaves. By chance a clerk raised one of the leaves which hid this ruin, and discovered the injury.

About Wasps

Articulata—Insecta.

Order—*Hymenoptera.* Membrane-winged

Family—*Vespidæ*. Wasp-like.

Wasps attract attention, for two reasons. They have sharp, venomous stings, which they are ready to use on small provocation, and so make us afraid of them; and they build for themselves curious homes, which are well worth our study. Those that we are most familiar with, build with mud, or paper.

The paper makers usually choose some sheltered place, under a fence rail, in a bush, in a hollow tree, or under the projecting eaves of a house. As in the case of the humble bees, the mother of the family, single handed and alone, lays the foundation of the house, and makes preparation for rearing a family. She and a few like herself are the sole survivors of the thronged cities of last year. All the others perished at the coming of the frost which chilled her blood within her and kept her torpid till the warm south winds of spring awoke her from her long sleep.

When quite a little boy, the writer used to go away alone into a closet, to learn his lesson. The blinds at the only window in the room were always closed, giving barely light enough to read, when sitting on a stool beneath it. One spring day a Wasp came between the blind and the

glass, and after much buzzing and much walking about, began to build. She first laid down, beneath the under edge of the upper sash, a patch of paper about a third of an inch in diameter; then, standing on this, she raised cup-shaped edges all about her, increasing outward and downward, like the cup of an acorn, and then drawing together a little, until a little house was made just about the size and shape of a white oak acorn, except that she left a hole in the bottom where she might go in and out.

Then she began again at the top, and laid another cover of paper over the first, just as far away as the length of her legs made it easy for her to work. Now it was clear that she made the first shell as a frame or a scaffold on which she might stand to make the second. She would fly away, and after a few minutes come back, with nothing that could be seen, either in her feet or in her jaws. But she at once set to laying her paper-stuff, which came out of her mouth, upon the edge of the work she had made before. As she laid the material she walked backward, building and walking, until she had laid a patch a little more than an eighth of an inch wide and half or three-quarters of an inch long. When laid, the pulp looked like wet brown paper, which soon dried to an ashen gray, and still resembled coarse paper. As she laid the material, she occasionally went over it again, putting a little more here and there, in the thin places; generally the work was well done the first time.

So the work went on. The second paper shell was about as large as a pigeon's egg; then a third was made as large as a hen's egg; then another still larger. After a time the wasp seemed to go inside to get her material, and it appeared that she was taking down the first house, and putting the paper upon the outside. If so, she did not bring out pieces and patch them together as a carpenter, saving of work, would do, but she chewed the paper up, and made fresh pulp of it, just as the first was made. Of course the boy did not open the window, for he was too curious to see the work go on, and then he was afraid of the sting. How large the nest grew he never learned, for he soon after left the school, and saw no more of it. The Algebra and Latin which he learned that term were soon forgotten—he was really too young to study either, then—but he has not forgotten how the Wasp made her nest.

But he now knows pretty nearly what the Wasp did after his oversight of her ceased. She made the nest about as large as a goose egg, hanging with the broad end up, and with a hole as large as one's little finger at the bottom. She took out of the inside all but two or three thicknesses, and then she built paper combs in the vacancy. These paper combs were not made like the combs of the honey bees, standing upon edge, with the cells opening in the sides, but were hung to the top, with the cells opening downward. She made first a stout post or rope of paper, hanging from the centre of the room. To the end of this

rope she fastened a floor, which she spread out flat and level until it nearly reached the sides of the room. Underneath this floor, which might quite as well be called a roof, or a ceiling, she made a number of cells, and laid an egg in each. It is not quite settled whether she builds the cells first, and then lays the roof over them, or whether she makes the roof first, and then places the cells under it; probably the two parts are made nearly at the same time.

As soon as the first eggs are hatched, the cares of the mother Wasp increase, for now she has a hungry family to feed. She must supply their wants, enlarge their cells, make more cells, lay more eggs, make additions to the house, and all together. Was ever poor human mother, left to bring up a family alone, more driven with work? In due time the older grubs are full grown, stop eating, and spin a silken cover over their cells. After a short season, having passed from grubs to pupæ, and then to perfect Wasps, they come forth. They take the heavy work upon themselves, and the toil goes merrily on. Day by day their numbers increase, and soon the mother Wasp has nothing to do but lay eggs in the cells which her children have made.

When the first tier of cells is full, another is made below it. Several pendant cords similar to the first, are fastened to various points of the tier above. Cells are hung upon them as before, and continually increased in number, until the several parts unite to form a second complete tier. The mouths are placed downwards, and the

roof serves as a floor on which the Wasps walk when taking care of the young brood. As among the humble-bees, the first Wasps that come out are workers. The males and females are not seen until autumn. A large nest may contain seven or eight thousand cells, and each cell is occupied, on the average, by three tenants in succession. All the young grubs have to be fed; not with honey, as young bees are fed, but with animal food, usually flies. We can easily see that a good sized Wasp's nest, or vespiary, may be quite a serviceable thing about the house, if, in the end, the Wasps do not become the greater nuisance.

Mr. Wood says he has seen pigs, covered with flies, lying in the warm sunshine, and the Wasps pouncing upon them and carrying them off. It was a curious sight to watch the total indifference of the pigs, the busy clustering of the flies, which actually blackened the hide in some places, and then to see the Wasp just clear the wall, dart into the dark mass, and retreat again with a fly in its fatal grasp. On the average, one Wasp came every ten seconds, so that the pig-sty must have been a valuable store house for them.

The Wasps are hearty eaters, as well as their grubs. They prey upon other insects, sugar, meat, honey, and fruit. Indeed, they are particularly fond of ripe fruit, and always select the finest specimens, just when they are in their best condition, gnawing holes in them, and spoiling them for the table. Still it may be a question whether the good they do in destroying flies and young caterpillars does not more than pay for all the fruit they eat.

The nests of the paper-making Wasps usually vary from six to twelve inches in diameter. They sometimes become very much larger. A nest is preserved in a museum in Oxford, England, which fills a glass case four feet high, by two feet in width. It is turnip shaped, with a large knob at the top by which it hangs. This nest, when found, was about five inches in diameter. It was taken into a house, and hung near a window which gave the builders free passage to the open air. There was no danger in this, as the common Wasp has a much better temper than the hive bee, and is by no means as capricious in the use of his sting. Their captor was disposed to give them every means of living, and supplied them daily with sugar and beer. They consumed daily a pound of sugar and a pint of beer. With plenty to eat they increased rapidly, and the nest grew as fast. In the chamber above, two other nests had been placed, and as those workmen were not fed, when they found that their kinsmen below were faring so sumptuously every day, they deserted their own houses, and joined the colony on the ground floor.

The Chartergus Wasp of Ceylon, another paper maker, uses its nest as a permanent home, the same family living in it from year to year. This home is enlarged in a way which keeps its shape, and allows farther increase without trouble. The walls are shaped like the sides of a cow bell. The tiers of cells extend from side to side, like the regular floors of a house. When the house is full, another set of cells is built beneath the lowest floor, the wall is

lengthened down as far, and a new floor is made to shut up the bottom; so that the new house is the old one with a new story under. In fact, probably all the Wasps learned to build by reading Gulliver's Travels. The bells of this Wasp are usually about a foot long; one is described which was six feet long, and of corresponding width.

A South American Wasp has been called *Myrapetra*. It builds a nest of a dark, blackish brown substance, like *papier mâché*. The outside of the nest is thickly studded with projecting spikes or thorns. Their exact use is not known; some have thought that they are to protect the nest from wild beasts; others suggest that they are meant to conceal the entrances. The tiers of cells are not flat, but shaped like inverted bowls; the dishes grow broader and flatter towards the bottom of the nest.

The other branch of the Wasp family includes the Mud-diggers, or Dirt-daubers. Up in the attic of any old house in our country, east or west, the children will often find, stuck on the walls and rafters, lumps of mud of various sizes and shapes. Some are as thick as one's finger, others as large as one's fist. If one of these shapeless lumps be opened carefully, it will be found to be a mass of cells, each lined with a thin coat of brittle, shelly substance. The builders of these cells are commonly called mud Wasps. When one of these masons has chosen a place, and has begun to work, she brings in her jaws a lump of soft mud. It is not certain where she got it—whether she gathered some dust and moistened it with the liquid of her mouth,

or, as some think, she gathered it where the earth is softened by the wash of the sink. At any rate, she has kneaded it perfectly, and she spreads it as easily as the mason lays his mortar.

Mr. Gosse watched a Dauber, and tells some curious things about her. The first cell was nearly done; the Wasp had just closed the mouth. While gone for more, a pin was thrust through the mud into the cell. When the Wasp came, she laid her mortar over the hole, spreading it very skillfully and evenly. When gone again, the pin made another hole, which she closed up; and so for several times. Finally Madam Wasp got angry and began to buzz about, trying to catch the house-flies which were near. She seemed quite certain that they had done the mischief, and waited after she had laid more mortar, as if expecting to "catch them at it." Then Mr. Gosse broke off a large piece of the side and bottom, showing the grubs, and the small spiders which she had tucked in for her children's food. This breach she repaired as quickly as possible, in two or three loads, laying the mud all round the hole, and closing up at the middle.

Presently she began to build another cell, and again she found trouble. A tin-tack was placed in the mud, just where she would lay the next load. When she came back, she seemed quite "bothered;" she ran back and forth over the cells for some time, with the mud in her jaws, at a loss what to do. A hole she could stop up, but here was something in the way. If she should lay the mortar in its

place, the tack would be more firmly fixed. If she should place it elsewhere, it would be wasted, or might do harm; if she would try to remove the evil, she must lay down her burden. At length she seized the tin-tack in her jaws and pulled it out, dropping the mud as she did it. Next time she went away, a bit of worsted was pressed into the mud, which made still more serious trouble, as the bit which she could seize would yield without coming away. Still, by taking hold of the different parts, one after another, and tugging at them a long time, and by walking round and round with it in her mouth, she at length pulled it out.

The Dauber Wasp builds the walls of the cell, and lays an egg. Then she finds some spiders of a beautiful green species, and puts them in, bringing them very carefully in her jaws and feet. These she walls up with the egg, and the grub, when hatched, eats up the soft parts of the abdomen.

When autumn comes, the Wasps seek for hiding places in the crevices of houses, where they may pass the torpid months. Sometimes they crawl away where their presence is not desired—into clothing, and between sheets. An acquaintance had a beautiful black pointer dog, named Don. Don had a great dislike for black Wasps, and when they began to creep about, looking for their hiding places, he killed very many of them. He would draw back his lips from his teeth, so that they might not sting him, and then snap them in his teeth, throwing them quickly on the floor. If the Wasp writhed or crawled, another and

another snap was sure to follow, until the crushed insect showed no more signs of life.

A large and fierce variety of Wasps is called the Hornet. Its sting is very venomous, and its temper none of the best. It will follow a person, single handed, with great perseverance, when its wrath has been provoked.

Another very tetchy and hot tempered little thing, is a smaller variety, known to school boys as Yellow Wasps. They are usually quiet enough when undisturbed, but woe to the foolish boy who throws a stone, or thrusts a stick into their paper house. The angry swarm issues forth; they buzz about the ruined nest for a moment, and then, discovering the author of the mischief, they fly in solid column to avenge the wrong. If the unlucky urchin has not speedily taken himself far away, he will have good cause to repent an injury to a quiet and unoffending, if not inoffensive, community. These fellows do not give any warning, like the honey bee, but true as an arrow to the mark, they go straight at you, and ear, eye, cheek, lip—the part hit, suffers. The best course for the boy is to pocket the affront, and put some aqua ammonia, also called spirits of hartshorn, on the wound. Better still, let the Wasps alone in the outset. If it is necessary to remove them, put a wisp of straw on the end of a pole, and burn them out at nightfall. If it is desired to remove a nest with the inhabitants, for study, the Wasps may be quieted with chloroform, applied at the bottom of the nest, by a bunch of cotton.

About Locusts

Articulata—Insecta.

Order—*Orthoptera.* Straight-winged.

Family—*Locustidæ.* Locust-like.

Locusts and Grasshoppers belong to the same order, and few but naturalists know the differences between them, or are able to distinguish the species of either. They have the same general shape—a long body, stiff, folded, fan-like wings, under straight, hard wing-covers, a head not unlike that of a horse, and long legs, the last pair having long and very strong thighs, with which they leap very far. The Arabs say that the Locust was made of scraps of all animals. That it has the head of the horse, the horns of the stag, the eye of the elephant, the neck of the ox, the breast of the lion, the body of the scorpion, the hip of the camel, the legs of the stork, the wings of the eagle, and the tail of the dragon. The wings of some are spotted, and the spots have been supposed to foretell future events.

Locusts have been counted among the most fearful plagues which have ever punished a nation. In Eastern lands they have appeared in astonishing numbers; their swarms have darkened the sun; they have eaten every green thing, leaving the land behind them black as if burned with fire. They are not even content with that which is green, but devour every thing which can be

devoured—linen, woolen, silk, leather, the very varnish of the furniture.

In 1748 the locusts appeared early in June in Hungary, on the Danube. In July they were terribly destructive throughout Poland, and at the middle of August they appeared in clouds in London. In one night they ate the grass and the foliage of trees about Vienna, making the forests bare as brooms. In Poland they covered the country for miles, and were heaped up a foot thick; when they alighted they covered the ground like falling snow. At Warsaw soldiers were sent out against them with cannon. The firing of great guns scattered them and drove them away. In Italy the government offered rewards for them, and 12,000 sackfuls were gathered, cast into pits, and covered with quicklime.

The prophet Joel gives a description of their coming, both sublime and accurate: "A day of darkness and of gloominess, a day of clouds and of thick darkness, as the morning opened on the mountains; a great people and a strong. A fire devoureth before them, and behind them a flame burneth. The land is as a garden of Eden before them, and behind them a desolate wilderness; yea, and nothing shall escape them. The appearance of them is as the appearance of horses, and as horsemen shall they run. Like the noise of chariots on the tops of mountains so shall they leap; like the noise of a flame of fire that devoureth the stubble, as a strong people set in battle array. They shall run like mighty men; they shall climb the wall like

men of war. And they shall march every one his ways, and they shall not break his ranks; neither shall one thrust another. They shall walk every one in his path, and when they fall upon the sword they shall not be wounded. They shall run to and fro in the city. They shall run upon the wall. They shall climb up upon the houses. They shall enter in at the windows like a thief. The earth shall quake before them; the heaven shall tremble; the sun and moon shall be dark, and the stars shall withdraw their shining."

The prophet also mentions the usual way in which the locusts are destroyed: "I will remove far off" from you the northern army, and will drive him into a land barren and desolate, with his face toward the east sea, and his hinder part towards the utmost sea, and his stink shall come up because he hath done great things." This prophecy may refer to the coming of an army of human beings, but the description literally applies to the march of these insects as described by historians. Mr. Barron says that in 1784, and in 1797, two thousand miles in South Africa were covered with Locusts, which, being borne into the sea by a northwest wind, formed, for fifty miles along the shore, a bank three or four feet high; and when the wind was in the opposite point, the horrible odor from them was perceptible a hundred and fifty miles away.

Most scourges bring in their train benefits which fully repay, if they do not many fold surpass, the injury inflicted. The prairies rejoice in a greener verdure after the fire has consumed the withered grass. So a land which has been

choked with rank shrubs and withered bitter grasses, after it has been swept by the Locusts, soon wears a more beautiful dress, with new herbs, superb lilies, fresh annual grasses, and young and juicy shrubs, which afford sweet pasture for wild cattle and game.

Locusts are eaten by all sorts of quadrupeds, by many birds, large and small, and even by man. In the countries which they ravage, the people have nothing else left to eat, and learning from necessity, they continue to eat Locusts from choice. The Arabs boil them and dry them in the sun. Others soak them in oil. In other places they are gathered in heaps and salted. The wings are taken off, and the bodies eaten as meat, or they are dried, ground, and made into bread. They have even been exported, and armies have been relieved by them. The African Bushman delights in a swarm of Locusts, as his choicest game, furnishing plenty of food without having to work for it. He makes large fires, and the Locusts, flying through the flame, have their wings scorched, fall into the fire, are roasted and eaten. Those that remain are ground between stones, and kept for another meal. Europeans dislike them, but the fault is probably in the cooking; Dr. Livingstone thinks them very good eating when well prepared. Honey is eaten with them, when it can be had, as it assists digestion.

Does this remind us of John the Baptist, whose "meat was locusts and wild honey." It has been questioned whether the quails which the strong east wind blew

together for the Israelites in the desert, were not truly Locusts; there is doubt whether the word translated quail had ever that meaning. The Jews ate Locusts, and distinguished between such as were clean or unclean.

The young Locusts do not pass through the several changes which most insects undergo. The bee, for example, is first a grub, then a chrysalis, then a perfect, winged bee. The Locust comes from the egg a Locust, but wants wings, which come gradually. The eggs are laid in the ground. The female pierces the ground with a long, two bladed, hollow instrument. When it is forced into the soil, the blades open a little, and press the earth aside, while a dozen eggs are passed into the cavity then formed. The contrivance is not unlike a corn-planter, which makes a hole, drops the corn, and covers it, all at once. The Locust goes about thus, planting her eggs, until she has deposited several hundred. They remain during the winter, and until the warm sun next summer hatches them, bringing out little creatures as large as gnats. These stay a while in the nest, and in the ground near by, and then come forth, hopping about without wings. As they grow they shed their skins, each time appearing in a new, larger, and more perfect dress. By the third or fourth change, wings begin to appear, and by the sixth they are full fledged. The common Grasshoppers make their entire growth in one season, but the terrible migratory Locust, which has been mentioned above, is said to live in the ground two years, and come forth in the third.

It is often a matter of surprise that insects like the Locusts, the chinch-bugs, and others, should not be observed for many years, and then should appear in swarms of such immense numbers, and do such terrible mischief. Many attempt to account for this by supposing that the ground has some hidden power of spontaneous production, which is thus fitfully exerted. It is probably the fact that these insects never entirely disappear; that no season passes without producing enough to keep up the succession. They are exceedingly productive, so that a few may be the parents of a multitude. But the dangers which surround the eggs and the young, eaten as they are by every kind of bird and insect, and destroyed by myriads by unseasonable cold and rain, sweep them away, and leave only a remnant for seed. If only one in a thousand escapes, that one will reproduce a thousand. Thus if two favorable seasons follow in succession, the scourge appears, and the crops suffer.

In the south of Europe rewards are regularly paid for the collection of Locusts and of Locusts' eggs. The city of Marseilles expended 20,000 francs for that purpose, in one year. A franc is paid for about two pounds and a quarter of eggs. In Italy large quantities have been gathered and thrown into the streams. There is a slight difference in the piercer of the Locust and of the Grasshopper, but the method of placing the eggs in the ground is essentially the same.

One of the most noted among the Grasshoppers is the Katy-did. This insect is of a pale green color; its head seems to have been squarely chopped off; its wing-covers are rounded, and enclose the wings and body like the sides of a pea-pod. It lives in the branches of trees, and does not lay its eggs in the ground, but deposits them upon the twigs and branches in regular rows. The song of the Katy-did is one of the cheerful sounds of autumn, save that from constant repetition it becomes tiresome. It is not truly a song, for it is not made by the mouth.

"The musical organs of the male consist of a pair of taborets. They are formed by a thin, transparent membrane stretched in a strong, half-oval frame in the triangular overlapping part of each wing cover. During the day they are silent, but at night the males begin the joyous call by which they enliven their silent mates. This proceeds from the rubbing of the taboret frames against each other when the wing covers are opened and shut; and the notes are repeated for hours together. The sound may be heard in the stillness of the night to the distance of a quarter of a mile. At the approach of twilight the Katy-did mounts to the upper branches of the tree in which he lives, and, as soon as the evening shades prevail, begins his noisy babble, while rival notes issue from the neighboring trees, and the groves resound with the calls 'Katy-did-she-did, she didn't, she-did,' the livelong night."

He put his acorn helmet on;
It was plumed of the silk of the thistle-down;

The corslet plate that guarded his breast,
Was once the wild bee's golden vest;
His cloak, of a thousand mingled dyes,
Was formed of the wings of butterflies;
His shield was the shell of a lady-bug queen,
Studs of gold on a ground of green;
And the quivering lance which he brandished bright,
Was the sting of a wasp he had slain in fight.
Swift he bestrode his fire-fly steed;
He bared his blade of the bent-grass blue;
He drove his spurs of the cockle seed,
And away like a glance of thought he flew.

The moth-fly, as he shot in air,
Crept under the leaf, and hid her there;
The katy-did forgot its lay;
The prowling gnat fled fast away;
The fell mosquito checked his drone,
And folded his wings till the fay was gone;
And the wily beetle dropped his head,
And fell on the ground as if he were dead.

They watched till they saw him mount the roof
That canopies the world around;
Then glad they left their covert lair,
And freaked about in the midnight air.

The Culprit Fay.

About Mosquitoes

Articulata—Insecta.

Order—*Diptera.* Two-winged.

Family—*Culicidæ*. *Culex*, A gnat.

The Mosquito is a nuisance. He sings and then he bites; and his singing is usually notice that he intends to bite. He comes in the night, when the faint and sultry air persuades the sleeper to throw off the protecting cover, and sleep flies before him. If one seeks a shelter from the glaring sun, under the shade by the brook-side, myriads of these gauze-winged musicians warn him away from their realm. The wild forest is full of them. The heavy timber, from June to September, is utterly uninhabitable, unless constant war is made against the Mosquitoes. Every bit of standing water, and every purling rill, teems with them. The trees and bushes every where shelter them. Shake a bough, and a swarm rises from it; land from a boat, and a cloud tender a too cordial reception. They gather like hungry politicians about the dispenser of official favors.

Nothing but thick leather and woolen will protect your ancles or your wrists. You can save your face in only one way. Wear a soft hat that you can sleep in; get a yard of black lace, sew the ends together, and draw round the crown of your hat one end of the bag which you make, while you gather the other end under your chin. The brim of the hat will keep the veil from the face, and the

disappointed Mosquitoes will rave in vain against the outside. In a few moments one becomes so accustomed to the veil that it does not interfere with sight, although it is in the way in eating and drinking. It is no exaggeration to say, that in the dense forest, in June, the Mosquitoes have gathered upon the back of a man sitting down to rest, so thickly as to hide the color of his coat, whether light or dark, with the brown of their wings.

The Rev. Walter Colton tells how the miners in California made culprits disclose the truth by means of Mosquitoes. A rogue had stolen a bag of gold and hid it. Neither persuasions or threats could make him tell where it was concealed. He was sentenced to receive a hundred lashes, but was told that he would be let off with thirty, if he would tell what he had done with the gold. He refused. The thirty lashes were laid on, but he was as stubborn as a mule. He was then stripped, and tied to a tree. The Mosquitoes, with their sharp bills, went at him, and in less than three hours he was covered with blood. Writhing and trembling from head to foot, he exclaimed, "Untie me, untie me, and I will tell where it is!" "Tell first," was the reply. So he told where it might be found. Then some of the party, with wisps, kept off the hungry Mosquitoes, while others went where the culprit directed, and found the bag of gold. He was then untied, washed with cold water, and helped to his clothes, while he muttered, as if talking to himself, "I couldn't stand that, anyhow."

There is no doubt that a man would perish in a short time, from loss of blood, and from the fever caused by the poison of their bites, if exposed, as this man was, with no means of defence.

The largest kind of Mosquito about the Mississippi river is called the "Gallinipper." The boatmen say that it is as large as a goose, and that it carries a brickbat under its wing, on which to sharpen its bill.

Cattle are not troubled by Mosquitoes, but horses suffer terribly. The lumbermen drive them away from their camps by making low fires of chips and damp grass. In the coolness of evening, the smoke from these "smudge" fires hangs heavily over the ground, and affords considerable protection, which even animals seek.

On a still night such a camp is very picturesque. The low log hut by the river; the tall, sombre pines, towering above dense masses of maples, and ragged outlines of oaks; the straggling fires, that thrust out tongues of fitful flame, and reek with thick smoke, which spreads upon the ground, or lazily rolls over the roof; the long, level lines of blue haze which the smoke finally draws against the foliage of the trees; the solemn stillness resting over all, broken only by the hoot of the owl, the wail of the whip-poor-will, or the tinkle of the rippling stream, while the bright eyed climbing stars replace the waning twilight; compose a scene too lovely to be spoiled by millions of

myriads of swarming, howling, raving, hungry Mosquitoes.

The Mosquito is an insect of the water. Early on a summer morning, even before sunrise, the mother may be found laying her eggs. They must be placed where there is warmth enough to hatch them, and where the young creatures which pop out may go at once into the water. So the careful insect, like the mother of Moses, puts her children into a little ark, which she leaves on the surface of the pool. The ark she makes of the eggs themselves. She rests on a bit of grass, or a leaf, at the top of the water, holding to it by the first and second pair of legs. The third pair she crosses behind her like the letter X. The first egg is caught and held between the legs. Then another and another are fastened to the first by the gum which covers them, until fifteen or twenty have been set up side by side, as one might set up a number of ears of corn, or like the seeds in the head of a sunflower.

When the mass becomes too heavy for her to support, she lowers it upon the water, but still holds it by putting her feet on either side, until two hundred and fifty or three hundred eggs have been laid. Those at the sides are higher than those in the middle, while those at the ends are raised somewhat more. Thus the whole mass is shaped much like a canoe. These tiny black boats, about as large as grains of wheat, may be found floating upon the top of any tub, or barrel of water, which has stood for some days, nothing can harm them, if some other creature does not eat them

up. The storm may dash them against the shore, but they are too light to break; a torrent of water may be poured upon them, and they come out of the bubbling foam as buoyant as air, and as dry as a duck; the water may freeze solid, but their life is not destroyed.

In a few days—three are usually enough, if warm—the eggs hatch, and each sends a wriggler down into the water, through a hole in the bottom. The little fellow swims about, and presently hangs himself by his tail to the surface. If disturbed, he goes down out of the way, but soon comes back, and rests, as before, with the tip of his tail out of water. He does this, just as other swimmers do, because he would keep his nose above water. The odd thing about it is, that his nose, or, at least, the tube which he breathes through, is not on his face, but at the tip of his tail. It ends in a few hairs, which spread in a star-form, and are oiled, to repel the water. Thus the tail is both nose to breathe through, and buoy to keep itself at the top of the water. He lives upon the impurities in the water, and so serves a very useful purpose in the world.

By and by, he changes into a pupa, and then he turns himself over, end for end. He did breathe through his tail; now he breathes through his ears, or a pair of tubes which look like ears, and are thrust up, just a little, out of the water. His tail is now like the tail of a fish, and by it he can move himself through the water as he pleases. He remains thus about fifteen days, and then takes a new form, exchanging his home in the water for a life in the air.

When the warm sun shines on the water, the change comes. The pupa rises to the surface, and thrusts out his head and shoulders. The cover bursts, and the plumed head appears, followed by the shoulders, and the filmy wings. Now is the time of danger. If an unlucky puff of air sweep the water, over goes our sailor, his wings are wet, and his voyage lost, just as he is ready to come into port. His old garment lies upon the water. It is his life-boat. His body is the mast, and his drying wings are the sails. Now his slender legs are dry, and with them he feels for the surface of the pool. He lifts himself free from his cast-off coat, rests an instant on the water, and then leaps into the air, a singing, stinging Mosquito.

But all the Mosquitoes do not sting. The males wear a pair of plumes upon their heads, and spend their days in a ceaseless dance in the sunbeams. Those that bite are the females. One gently drops on your neck or hand, with footstep so light that you feel it not; she looks about for a moment, hesitating as to where she will begin to bore. Now she has found the place, and her needle tongue goes down into the skin. Now you feel the prick, and now you may see her chest heave as she pumps up the red fluid. No speculator, boring for oil, ever felt happier over a flowing well, than our borer over the flowing fountain which she has tapped. Now her abdomen expands, more and more, until it seems that she will burst. At last she has enough—too much, in fact, for her greed will cost her life. She draws

up the rod, and heavily flies away. Her light wings can scarcely bear the increased burden. She will die of surfeit.

TO A MOSQUITO.

Fair insect! that, with thread-like legs spread out,
And blood-extracting bill and filmy wing,
Dost murmur, as thou slowly sail'st about,
In pitiless ears full many a plaintive thing,
And tell how little our large veins should bleed,
Would we but yield them to thy bitter need.

Unwillingly, I own, and, what is worse,
Full angrily men hearken to thy plaint;
Thou gettest many a brush and many a curse,
For saying thou art gaunt, and starved, and faint:
Even the old beggar, while he asks for food,
Would kill thee, helpless stranger, if he could.

Beneath the rushes was thy cradle swung,
And when, at length, thy gauzy wings grew strong,
Abroad to gentle airs their folds were flung,
Rose in the sky and bore thee soft along;
The south wind breathed to waft thee on thy way,
And danced and shone beneath the billowy bay.

Calm rose the city spires, and thence
Came the deep murmur of its throng of men,
And as its grateful odors met thy sense,
They seemed the perfume of thy native fen.
Fair lay its crowded streets, and at the sight
Thy tiny song grew shriller with delight

At length thy pinions fluttered in Broadway—
Ah, there were fairy steps, and white necks kissed
By wanton airs, and eyes whose killing ray
Shone through the snowy veils, like stars thro' mist;
And fresh as morn, on many a cheek and chin,
Bloom'd the bright blood thro' the transparent skin.

Sure these were sights to touch an anchorite!
What! do I hear thy slender voice complain?
Thou wailest, when I talk of Beauty's light,
As if it brought the memory of pain.
Thou art a wayward being—well—come near,
And pour thy tale of sorrow in mine ear.

What says't thou—slanderer! rouge makes thee sick?
And China bloom, at best, is sorry food?
And Rowland's Kalydor, if laid on thick,
Poisons the thirsty wretch who bores for blood?
Go! 'twas a just reward that met thy crime—
But shun the sacrilege another time.

That bloom was made to look at, not to touch;
To worship, not approach, that radiant white;
And well might sudden vengeance light on such
As dared, like thee, most impiously, to bite.
Thou should'st have gazed at distance, and admired.
Murmured thy adoration, and retired.

Bryant.

About Beetles

Articulata.—Insecta.

Order—*Coleoptera.* Sheath-winged,

Knightly armor of proof protects the Beetle. First, there is the strong helmet, with shut visor, and crest of varied device. Then comes the solid cuirass, which protects the body, and below that the full-orbed, or oval shield, which covers the abdomen, and the upper joints of the legs. He carries neither sword nor lance, mace nor battle axe, but from the joints of his visor project two ponderous jaws, which grip like a vice. He is horse and horseman in one. His thick shield parts in the middle, and when the two leaves swing apart, they disclose a pair of light, gauzy wings, which, with a great deal of fussy buzzing, lift him from the ground and carry him away, when he,

"Drowsy beetle, wheels his droning flight."

The plates of his coat of mail fit each other very exactly. The helmet makes the neatest joint with the corselet, and the corselet with the shield. The wearer can move every part with perfect freedom, and yet each joint is closed against prick of arrow or thrust of spear. Yet the Beetle is not the swift horseman of to-day, but resembles more the heavy man-at-arms of three hundred years ago. When he was pushed off his horse in sham or real fight, and lay sprawling on his back, boxed up in his heavy plate

armor, he needed a stout esquire to set him on his pins again. Just so, if a bumming beetle be knocked on the floor; it takes him a long while to overcome his astonishment, and make ready again for a tilt at the lamp, or at your face.

Our knight has little of the swift dash of the wasp, who pricks with his sharp lance, and then rings his shrill defiance. He has none of the stealthy adroitness of the spider, who lassos his victim, like a Mexican, and then stabs him in the back, as coolly as an Italian bravo. Indeed, he does very little at offensive warfare. If you are in his way, he gives you a sharp pinch, or whacks you in the face, but that is all. His heavy mail serves mostly to ward off the assaults of others.

The style and the ornaments of his armor are very various, and often are very beautiful. Sometimes the whole suit is plain black, or dark brown. Sometimes it gleams with brilliant hues of green, crimson, purple, and gold, or blazes with precious gems, set in polished metal. In any case, he keeps his armor scrupulously clean, no matter how filthy the work which he is busied about.

The order contains over one hundred thousand kinds, divided into various families. We must be content with noticing a few of the most remarkable. Some of them do great injury to vegetation, either while grubs, as the borers in trees, or the young of the cock-chaffer, which eat the roots of grass; or while fully developed beetles, as the

curculio, which kills the plums, the striped cucumber-bug, the rose-chaffer, and many others. Other kinds confer decided benefits. The Water Rovers, the Skin Beetles, Carrion Beetles, and Dung Beetles, are scavengers, disposing of the filth in which they and their young live. The Tiger Beetles, Ladybirds, and Diving Beetles, prey upon caterpillars, and plant lice. The Stag Beetles, Bark Beetles, and others, help destroy old trees which are going to decay. The Blister Beetles, or Cantharides, are pounded up by the druggists, and the dust is spread upon plasters, to raise blisters when applied to the skin.

The first on our list is the Sexton, or Burying Beetle. If the body of a dead bird, or mouse, or any piece of meat, be left upon a spot of soft earth, it will often be found, on the next morning, half sunk in the soil. Take up the bird, and you will find under it one or two beetles, sometimes entirely black, sometimes barred with orange. During the day the insects will usually be quiet, but at nightfall they will begin work again. The work of burying is done almost entirely by the male Beetle, the female either hiding in the dead body, or sitting quietly on it, and being buried with it. The male begins by turning a furrow all round the bird, about half an inch away. His head is held sloping outwards, and like a strong plow, turns the earth aside. When the first furrow is made, a second is turned within it, the dirt being thrown into the first. Then a third is made, and this is quite under the bird, so that the Beetle is out of sight. The work may be traced by the heaving of the

earth, which now makes a wall, and as it grows higher, the bird sinks. After hard work for about three hours, the Beetle comes forth, and crawls upon the body, to see how he succeeds. He rests half an hour, goes down again, dives into the grave, and pulls the bird down by the feathers. He works two or three hours more, plowing and pulling; then comes up, takes another survey, and drops down, as if suddenly fallen asleep. When he is rested, he pulls the bird about, this way and that, tramples it down, and settles it to his mind. Then he goes behind the rampart of earth, and plows it back into the grave, with great skill and strength. He bends his head down first, and then turns up his nose with a jerk which throws the earth forward. When the grave is filled, and carefully examined, no feather being left in sight, he digs a hole in the loose earth, and having already buried the bird and the female, next buries himself. The female lays her eggs, the pair take a full meal of the carcass, then dig their way out, and fly away.

If the creature is no bigger than a mouse, a single day will be long enough to bury it in. One buried a mole, forty times as large as itself, in two days. A French naturalist placed two pairs of these Beetles under a glass case, and furnished them with dead bodies. In fifty days they had buried four frogs, three small birds, two fishes, one mole, two grasshoppers, and three bits of flesh. All this work is done to secure a nest and food for the young, and to protect it from other creatures, as the fox, or the raven, which might devour flesh and young Beetles together.

The work is done very much as men sink wells in sandy ground. They sometimes lay down on the earth a ring of plank, as large as the well is to be. Then they build a circular wall of brick and mortar upon the ring. The sand is taken out from under the plank, and the whole wall sinks slowly down. So the well is dug as deep as may be necessary, while the wall is built up at the top, as fast as it settles into the ground.

Another burying Beetle is the Dor Beetle, called, in this country, Tumble-bug. This is akin to the sacred beetle of ancient Egypt, or the Scarabæus. Its image was engraved on rings, which soldiers wore to show that they were warriors. On temples or columns it was a symbol of Divine wisdom, which regulates the universe, teaches mankind, and is self-existent. In its singular habit of rolling about pellets of dung the Egyptian astrologers thought it represented the revolutions of the sun, moon, and stars.

When this insect finds a patch of cow-dung, she sets herself at work. First she digs a deep hole, smooth and round. Then she cuts off a portion of the patch, lays an egg in it, and rolls it about into a rude ball. Now she rests her fore feet upon the ground, and with her hind feet rolls the ball hither and thither, until the outside has gathered in the dust and sand, a thin, hard crust or shell. Then, always pushing backwards, she rolls it to the hole, tumbles it in, and covers it with earth. The egg is soon hatched, the grub feeds on the substance which surrounds it, changes to a chrysalis, and remains in the shell, which still serves to

protect it, until it is ready to come forth, a perfect Beetle, qualified to roll pills on its own account. The smooth surface of this beetle, which gleams like polished steel, retains no trace of its work. Not a spot or a stain defiles it, nor does any odor betray its occupation.

Some of these rolled cocoons are very large. A specimen in the British Museum, made by the *Goliath*, is as large as a swan's egg. The walls are quite thin, and are strengthened by a belt about the middle. The insect which grew in it is still inside, and may be seen through an opening at one end. Its plates of mail are rich, velvety chocolate, edged with broad bands of white. This species, the largest now known, has a body about four inches long and two inches broad; when walking, it covers a space of nearly six inches.

An interesting family of Beetles includes the Dors, May-bugs, Cock-chafers, and Rose-bugs. They are very common and well known, both as Beetles and as grubs. The perfect insect does not live more than a week, and the species is not seen more than four or six weeks in a season. The females burrow in the ground about six inches, to lay their eggs—some say, as many as two hundred. In about fourteen days the eggs are hatched, and produce white grubs, each having six legs near the head, and a pair of strong jaws. Their skins are white, and partly transparent. When thrown out by the plow or spade, they are found coiled like a ring, or a horse-shoe. A full grown grub is

nearly as large as one's little finger—a plump, fat morsel, very eagerly swallowed by crows and chickens.

They do much mischief, eating the tender roots of grass, grain, herbs, and trees. When very numerous, they have so cut off the roots of grass, that the turf could be rolled up in many places like a carpet. As winter comes, they descend below the reach of frost, and lie torpid until spring; then they change their skins, and go back to the surface. At the end of the third summer—some say the fifth—they go down about two feet, and each one, by moving from side to side, forms a hollow oval space, about the size of a pigeon's egg. Here it casts its skin, and becomes a pupa, whose clear salmon-colored skin shows under it the head, eyes, jaws, wings, legs—all the parts of the perfect beetle. In February this skin bursts, and the insect is ready to dig its way out when the first warm week of May has clothed the trees with leaves. In digging out decayed stumps of trees, fine opportunities may be had for observing these grubs in every stage of their lives.

The winged beetles do as much harm by eating the leaves of trees, as the grubs did by devouring the roots. During the day they remain on the branches, hidden under the leaves. At nightfall they begin to buzz about, humming among the trees until midnight. They often come into houses, attracted, and blinded, by the light. They dart about with very uncertain aim, putting out candles, whacking unlucky people in the face, and banging against trees and walls so hard as to throw themselves

stunned upon the ground. Hence come the sayings "blind as a beetle," and "beetle-headed." When very plenty, the attempt has been made to check their ravages by shaking them from the trees upon cloths spread underneath. They are then thrown into boiling water, and fed to fowls or hogs. In this way they have been gathered by pailfuls, and in a few days no more could be found. Many years ago these beetles were so plenty in Norwich, England, that a farmer and his men claimed to have gathered eighty bushels of them; and they and their grubs had done so much harm, that the city gave the farmer twenty-five pounds for relief.

The Rose-chafer, like the May-bug, does much harm in gardens and nurseries. It is about one third of an inch long, covered with yellowish down. The slender, red legs end in long feet. They come forth about the second week in June, and remain about a month. The eggs are hatched in the ground, and the grubs feed upon roots until autumn, when they descend below the frost. In the spring they come up again. In May they pass the first change, and in June come forth fledged Rosebugs. They can be destroyed only by crushing, burning, or throwing into scalding water. They eat the leaves not only of rose bushes, but also of fruit trees.

Certain Beetles called Stag Beetles, and Horn-bugs, from their jaws, which resemble the horns of oxen or deer, belong to the family *Lucanidæ*. They fly by night, and often the lights attract them into houses, to the great alarm

of the people within; but they are quite harmless, and will not even pinch, unless provoked. Their grubs resemble those of the Scarabs, and live in the trunks and roots of trees. When full grown, they make cocoons of bits of wood and bark, glued together, and wait the changes which make Horn-bugs of them.

The grubs of the *Buprestidæ* are the borers so destructive to fruit and forest trees. They are long, narrow, and flat, with large, hard heads and jaws. They have no legs, but move by twisting from side to side, and by pulling with their jaws. They may be destroyed by thrusting a wire after them, into the hole which they are making—if it can be found. The crushed grub will come out on the point of the wire, to prove the success of the experiment. Possibly, however, woodpeckers would be more expert at this kind of thing than men.

Another family that are great pests are the *Curculios*. These spoil the fruit, attacking plums, apricots, and cherries, and not sparing apples, pears, and peaches. As soon as the fruit is set in the spring, these little insects begin their work, and they keep at work, until July or August. The Beetle cuts with its snout a little curve in the skin of the plum, then turns round and lays an egg in the wound. A maggot hatches, which eats its way into the fruit, even to the stone; this causes the plum to become diseased, and to fall off before it is ripe. When the plum is partly grown, the curved scar may be easily found. All such, with all that fall upon the ground, should be

gathered and destroyed, to prevent the maggots from going into the ground to pass the changes, and coming out afterwards to keep up the evil.

Others of this family attack the pines. Wilson says: "Would it be believed that the larvæ of a fly no bigger than a grain of rice, should silently, and in one season, destroy some thousands of acres of pine trees, many of them two and three feet in diameter, and a hundred and fifty feet high! In some places the whole woods, as far as you can see around you, are dead, stripped of their bark, their wintry arms and bare trunks bleaching in the sun, and tumbling in ruins before every blast." Besides boring into the trunks, these insects often destroy the top shoot of the tree, on which its straight and lofty growth depends. Mr. Wilson suggests that until farmers can devise some better plan of killing these pests, they had better thank and protect the woodpecker.

Another rascal of this tribe is the wheat-weevil. Several insects are known by this name, but the one meant is a slender Beetle, about one eighth of an inch long, and of a pitchy-red color. It lays eggs upon the harvested wheat, and the grubs burrow into the grain, each one taking possession of a single kernel. The worm eats the substance, but leaves the shell, so that the only evidence of harm is the lightness of the grain. They may be destroyed by drying the wheat in kilns.

After the peas have blossomed, and while they are just beginning to swell in the tender pods, the Pea-beetles gather by night, or in cloudy weather, and lay their tiny eggs in minute holes which they pierce in the surface of the pods. The maggots, as soon as hatched, bury themselves in the peas, and the small holes are soon closed. Often every pea in a pod contains a grub. They remain in the peas after they ripen, and come out in the spring, perfect bugs, ready to carry on the work. Those who plant "buggy" peas will find the bugs are quite as sure to come up, and bear fruit, as the peas. The crow-blackbird is fond of the bugs, and the Baltimore oriole, or hangbird, splits open the pods to get the grubs in the green peas. Don't disturb him, for be sure if he wants the peas, you don't.

Another nuisance in the garden is the yellow striped bug, which destroys the young cucumber and melon plants. It comes as soon as the young vines come, and it stays all summer. Great numbers visit the flowers of the squashes and pumpkins for the pollen. The eggs are laid, and the grubs grow, in the ground. Those bugs which have their heads pinched off will be sure to do no further harm. Various devices have been employed against them, such as sifting soot, snuff, sulphur, ashes, or plaster of Paris, on the vines; sprinkling them with steeping of tobacco, red pepper, walnut leaves, or hops; burning fires of pine knots or bits of tar barrels at night, but none are sure. The best preservative is a frame of board, covered with millinet, to

place over each hill of vines. If the plants can be protected for a little time, they will grow fast enough to escape further harm.

But my readers will begin to believe that all the Beetles are nuisances, and will be led to make war upon every insect which wears a hard shell. Let us find some for which something may be said on the credit side of the account.

While writing about ants, we mentioned those destructive little insects, which the ants use like herds of cattle, the plant-lice, or *Aphides*. The ants only milk their cows, but the grubs of a Beetle eat them up. These grubs become the pretty insects which people commonly call Lady-birds; naturalists call them *Coccinellidæ*. They have the size and shape of half a pea. Some are black, spotted with red; others, red with black, yellow with black, or yellow with white spots. The eggs are laid among the lice, and the grubs at once go to work catching and eating prey as large as themselves, without ever seeming to be satisfied.

This insect has always been a favorite. The German children think it brings fair weather, and the English boys and girls are afraid to hurt it, lest it should bring rain. The Norwegians call it Marspäert, and count the spots to see if there will be a good harvest. If there be fewer than seven spots, they say bread will be plenty and cheap. The children sing:

Marspäert, fleeg in Himmel!
Bring my'n Sack voll Kringeln; my een, dy een,
Alle lütten Engeln een.

Marspäert, fly to heaven!
Bring me a sackful of biscuits; one for me, one for thee,
For all little angels one.

The Scotch children call this insect Lady Lanners, or Landers. They say:

Lady, Lady Lanners,
Lady, Lady Lanners,
Tak' up your clowk about your head,
And flee away to Planners.
Flee ower firth, and flee ower fell,
Flee ower pule and rinnan well,
Flee ower muir, and flee o'wer mead,
Flee ower livan, flee ower dead,
Flee ower corn, and flee ower lea,
Flee ower river, flee ower sea,
Flee ye east, or flee ye west,
Flee till him that lo'es me best.

There are many other little rhymes in various languages, which show how children every where love this insect. Perhaps they do not know that it is useful as well as pretty.

The family of *Cicindelidæ* are called Tiger Beetles, or Sparklers. They get the first name from the fierce way in

which they seize and devour other insects, and the last from their brilliant colors. The Tiger Beetle is among insects what the kite is among birds, or the shark among fishes. He runs with great speed; he is armed with jaws like sickles, crossing each other; his eyes project from each side of his head, that he may see every way; his wings help him to fly as swiftly as a wasp. His suit of mail, of burnished steel embossed with gold, is more beautiful than any thing ever wrought by mortal armorer. If placed under the microscope in a strong light, his whole surface seems ablaze with precious metals and dazzling gems. The larvæ make their homes in the ground in tunnels about a foot deep. Here one of them lies in ambush just at the top of the ground, the head hooked to the edge of the hole. When an insect passes, the jaws grasp it, and drag it to the bottom of the den, to be eaten.

Another family of carnivorous Beetles lives in the water. Their breathing tubes open under the wing-cases. When they dive, they carry down under the wings a supply of air, and as this becomes exhausted, they rise, lift the wings above the surface, and so take a fresh supply. The larva of the Water Beetle is as active and as fierce as that of the Tiger Beetle, and the full grown insect does not outgrow his youthful tastes. If several be put in a vessel together, they will surely eat each other. A gentleman placed a pair in his aquarium in order to observe their habits. He succeeded in observing, on the next morning,

that the male had been killed and partly eaten by his disconsolate widow.

The whirligigs, that shoot from side to side on the top of still water, belong to this family.

One of the most noted Beetles is the Cucuyo, or Fire-fly of Mexico and Brazil. It wears on each side of the chest two light patches, which by day are pale yellow, but by night glow with a very intense light. When it spreads its wings, its whole body seems filled with the most brilliant flame. It flies by night, and the forests, filled with these insects, crossing and recrossing in every direction, glowing and vanishing as if suddenly lighted and as suddenly extinguished, present a scene too beautiful to be described.

The Indians catch these beetles by balancing hot coals in the air at the end of a stick, to attract them, which proves that the light which their bodies diffuse is to attract. Once in the hands of the women, the Cucuyos are shut up in little cages of very fine wire, and fed on fragments of sugar-cane. When the Mexican ladies wish to adorn themselves with these living diamonds, they place them in little bags of light tulle, which they arrange with taste on their skirts. There is another way of mounting the Cucuyos. They pass a pin, without hurting them, under the thorax, and stick this pin in their hair. The refinement of elegance consists in combining with the Cucuyos, humming-birds and real diamonds, which produce a dazzling head-dress.

Sometimes, imprisoning these animated flames in gauze, the graceful Mexican women twist them into ardent necklaces, or else roll them round their waists, like a fiery girdle. They go to the ball under a diadem of living topazes, of animated emeralds, and this diadem blazes or pales according as the insect is fresh or fatigued. When they return home, after the *soirée*, they make them take a bath, which refreshes them, and put them back again into the cage, which sheds during the whole night a soft light in the chamber. In the full glow of one of these Fire-flies, it is easy to read a letter or a book. The little Flies which dart through our meadows in moist summer evenings, are akin, though far less brilliant.

The last family we will mention, are the *Cantharides*, or Blister-flies. They secrete a substance which, when procured by itself, looks like fine snow-flakes; when it is left upon the skin it causes great irritation, and soon produces blisters. The Spanish Fly is nearly an inch long; its color is a satin green, glossed with gold. It feeds upon the ash and lilac, and is found also on the poplar, the rose, and the honeysuckle. Large quantities are taken, killed by fumes of vinegar, and exported for druggists' use. Several kinds of Blister-flies live among us. The Potato-fly, which consumes the vines at midsummer, is of this family. Another often strips the leaves from the clematis. These flies may be caught by shaking them from the vines into water, which prevents their flying, and when dry they may be used by the apothecaries.

About Butterflies

Articulata—Insecta.

Order—*Lepidoptera.* Scale-winged.

"Ugh! See that horrid, ugly worm!" Who has not heard such an outcry? Is there any good reason for the feeling which it indicates? We believe that the repugnance which very many really feel towards creatures of this kind is not, as they think, natural, or inborn, but is the result of early training. When the young mother sees her toddling baby busily watching a caterpillar, she bids him, with earnest words, with looks and accents of disgust, avoid the "horrid, nasty thing;" his growing curiosity is checked, and darling Willie Winkie comes to believe that a worm or a spider is the vilest thing he can know, as confidently as he believes he loves his mother or his sister. Whoever has overcome the feeling, thus artificially acquired, long enough to begin the study of the forms, the nature, and the wonderful transformations of caterpillars of every kind, has learned that in this, as in all other departments of nature, the infinite resources of the creative power of God are wonderfully displayed.

Considering the entire round of the creature's life, the whole world of birds, insects, and flowers presents nothing more interesting or lovely. If nature's course is not disturbed, the worm will fly on wings of beautiful form, exquisite coloring, and most delicate plumage; the

moth or the butterfly assuredly was, at some day not long since, a crawling worm. But we go yet farther, and confidently assert, that at no stage of its varied life does the insect show to the student so much that has interest or value, or to the general observer much more of absolute beauty of color, symmetry, and adaptation, than when it is so often abhorred as a "horrid, ugly worm."

We do not deny that caterpillars of all kinds do much mischief. They eat, eat voraciously, and have the instinct to select the choicest parts of that on which they thrive. Most subsist on vegetable food, and chiefly on leaves; yet some devour the solid wood, some live in the pith, and some eat only grains and seeds. Some kinds attack woolens and furs; even leather, meat, wax, flour, and lard, nourish particular kinds of caterpillars. There is, then, no reason why they may not be destroyed, so that their numbers may be kept within reasonable limits. But we should not assert that the poor creatures are ugly, and then kill them because we have given them a bad name.

Let us see what we can learn by studying the lives of a few; we could wish that every reader, young or old, could have the specimens under his own eyes, sure as we are that he would find more of interest in them than we describe.

In the month of June, when the feathery carrot leaves are growing well, we may find feeding on them a small worm, nearly black, which has perhaps grown to half an inch before we discover him; he may be no more than a

tenth of an inch long. If none are seen on the carrots, we may search the parsnips, the leaves of the celery, parsley, or carraway, for the worm thrives on either. He is about as large as an oat-straw, and a little thickest just behind his head. He wears a clean, tight-fitting coat of black velvet, with a broad white band across the middle of his back, and another over his tail; the velvet seems to be laid over him in folds, and to be studded with small black points. If touched, he throws his head back quickly, as if annoyed at the impertinence. Tickle him with a straw, and he pushes an orange-yellow horn out from the top of his head, toward the side which was touched; tickle the other side, another appears. Both issue from the same opening, and the two branch like the two parts of a V. They are scent organs. Immediately a smell is diffused, at first not unfragrant—like some kind of over ripe fruit—but soon sickening; by this odor he probably protects himself from the ichneumon-flies, which would else trouble him; and by it, also, you may know that your specimen is that which we describe.

You may gather a few leaves of the carrot, with the worm, and put them in any safe, airy place where you can watch him day by day; a supply of fresh food will keep him from going away for the present; or you may observe him on the plant where you found him.

In a few days he will quite likely cease to eat. If it were a canary, or a squirrel, which does not dispose of his rations, you might guess that your pet is sick, and so be

anxious about him, but you need take little thought for the worm. He becomes restless. He twists quickly from side to side. Presently his skin bursts just above or behind his head, and he actually begins to creep out of it. There, it is done. Your worm is yonder, in a new velvet jacket, several sizes larger, quite differently and more handsomely marked. It is arranged in crossway folds, as before. On each fold the sober black is enlivened by several bright orange spots; on the middle of the back, where the white fold lay, is a small white spot, surrounded by six others, while three more are arranged a little lower on either side. The old garment, a shriveled, useless thing, lies there, where he crept out of it, after having fastened its hinder hooks to the leaf on which he rested.

Now he takes his food with renewed relish. He moves more freely, and seems much more at ease in his new and enlarged garment. For several weeks this process goes on. He eats, grows, outgrows his old clothes, and creeps out of them in a new and larger suit,—mamma, did you never wish Bobby could do so too, instead of wearing his trousers out at the knees, and kicking his toes through the copper?—until after four or five weeks, and about as many changes, he is a full grown worm, or caterpillar. When at rest, he is rather more than an inch and a half long; when creeping about, he stretches more than two inches. The velvet coat is quite gone. In its place he wears a garment softer and smoother than the finest satin, or perhaps more like the delicate kid of which gloves are made, save that the

worm's skin is far more delicate. The color is apple-green, paler on the sides, and whitish beneath; the bands are black, dotted with yellow spots, so placed as to form regular lines along his body.

In structure, our caterpillar is an example of all others. His body is made of twelve rings of tolerably firm substance, connected by softer bands, and covered with skin. Thus he has the most perfect freedom of motion. He can stretch or contract himself, can turn or twist in any direction, can roll into a ring, or straighten out stiff, like a twig of the plant on which he feeds, or conform to any unevenness of surface over which he may creep. His head is covered with a flattened, shelly dish, provided on each side with six minute shining grains, which naturalists say are eyes. They do not say that caterpillars can see; Dr. Morris thinks "it is very doubtful whether they have the faculty of vision." One who watches a worm feeding, moving about, reaching out this way and that, quite ignorant of any danger that threatens, passing at the shortest distance the very thing which it seems to seek, never recognizing any thing except what it touches, and shrinking only when it is touched, can scarcely fail to conclude that, however many eyes the worm may have, it is, in fact, quite blind.

The mouth is armed with a pair of strong jaws, which open and shut, not vertically, like those of a dog, or a man, but sidewise. In the middle of the broad under lip is a small elastic tube, with a minute opening, whence comes the silk

which it will some day find useful. In tropical countries the head is often queerly ornamented with spikes, prickles, horns, and other things; those which we may see rarely have any thing of the kind.

Each of the first three rings of the body has a pair of jointed, tapering legs, covered with scaly or horny mail, and ending with hooks. These are the true legs. The worm has, besides, four to ten—usually eight—false, or pro-legs. These are thick, fleshy, without joints, but can stretch or contract like the body, are furnished at the end with a fringe of small hooks, and can take very different forms, as the animal wishes to cling by them to various surfaces. Caterpillars which have the full number of legs, that is, sixteen, have still four rings unprovided, the fourth and fifth, and the tenth and eleventh. The twelfth, or anal ring, has always a pair; the ninth has usually a pair; the other pro-legs vary with the species.

The motions of a large caterpillar which has the full complement of legs are deliberate and regular. First he stretches out the elastic body, and puts down the six horny legs together; then the pair of anal legs take themselves up, and replace themselves close behind the pair of the ninth ring, shutting down upon the twig or leaf, as if made of India rubber; then the other pairs of pro-legs lift and move forward, the hindermost rising and falling first, and the others following in their order; mean while, motion seems to begin at the tail, and flow gradually and equably through the entire body, ending by pushing the head on

for another stretch. The motion of such as have but one or two pairs of pro-legs is similar in fact, though different in appearance. The hind legs are drawn forward, and set down just behind the true legs, the body being thrown up into a loop; this loop straightened out, carries on the fore legs again. These caterpillars are called loopers, geometers, or measurers, since they seem to measure off the distance of their journeys. Gail Hamilton's gardener says they do so: measuring with his thumb and finger on his coat sleeve.

The looper caterpillars can not shorten or lengthen their bodies like others, but only bend them. Some are round and stiff, of the same color as the bark on which they live. They grasp the stem or twig with their four pro-legs, while the body stands out stiff and motionless for hours together, and the observer mistakes them for twigs, or leaf-stems. Each kind of caterpillar feeds by choice only on certain kinds of food, and most will refuse any other variety. They usually prefer leaves; after that, flowers; a few eat the pith of the stalk, and occasional species, the pulp of fruits. Most feed by night, and remain quiet by day, as if torpid; some are so voracious as to eat constantly. A silkworm devours its own weight of mulberry leaves, daily. Reaumur gave to a kind which eats cabbage, bits of cabbage leaf which weighed twice as much as their bodies. The pieces were consumed in less than twenty-four hours, while the worms increased their weight one tenth. What if

a man weighing 150 pounds, should eat 300 pounds of food in a day, and gain 15 pounds of flesh!

When a caterpillar wishes food, it creeps out to the edge of a leaf, and twists its body into such a position that this edge passes between its legs, which hook on upon each side. It bites a mouthful from the edge, then another, and another, moving its head in the arc of a circle, and cutting in three or four bites, as a reaper would cut handfuls of grain with his sickle; the head moves back to the edge of the leaf, and begins another sweep; the fore legs move slowly on from time to time, until the caterpillar has stretched its body to its full length. Then the body draws itself back again, the pro-legs keeping their places, and the head cuts in again for a new swath. The pulp of the leaf is eaten down to the ribs, and often ribs and all disappear between the voracious jaws.

But we must return to our caterpillar of the carrot-leaves. When he has finished eating, he becomes uneasy. He no longer rests quietly on his leaf, or he moves only to find fresh pasturage; he begins to wander about, and if we do not shut him up, we shall lose him altogether. Presently we find him quiet again in some secluded corner at the top of the case; if he could, he would have found a retreat in a knothole, a crevice between boards, or an obscure nook under the fence rail. He now presses the elastic tube of his under lip to the wood; the silk material adheres to it; he draws his head away, and stretches a fibre of silk to another point, where he fastens it by pressing the fresh material

against the surface. He crosses and recrosses the threads until he has covered a little space with a hillock of silk, to which he fastens himself firmly by the hooks of his hinder feet. Now clinging by his pro-legs, he bends his head back to about the fifth ring, and fastens a thread to the wood beside him. This thread he carries over his back, and fastens on the opposite side; he lays beside it a second, and a third, and in a little time has spun a stout band or loop of silk, in which he may rest securely.

Some caterpillars, like the dark-colored worms, covered with spines, which infest the hop vines, do not spin the band for the back, but content themselves with the little mass of silk into which the hinder hooks are fastened. These simply hang themselves up, and let their bodies fall into a vertical position. The next business is to throw off, for the last time, its skin. To do this, it constantly bends and straightens its body, until the dried skin splits along the back, and part of the body beneath appears. Next, it draws the fore part of the body out of its covering. Then it lengthens and shortens itself by turns, each time splitting the skin still further, and pushing it, like a stocking, nearer to its tail, where it is soon a mere crumpled packet. Now comes the most difficult part of the whole. Out from its caterpillar skin the creature has come in a smooth, horny armor, laid in rings about its body, while its head, back, and breast, are swathed, like a mummy, in folds which firmly confine every limb. It can only wriggle, jerking itself from side to side. Its tail is yet in

the folds of the caterpillar skin, which is hooked to the silk above. It must draw itself out of this remnant, throw away the cast off garment, and hook itself by its tail to the same place. We see now the utility of the silken band of our worm of the carrot leaves, but the hop worm has no such assistance. It has neither arms or legs—how can it do so much without losing its own hold, and falling to the ground?

The supple, contracting rings which cover its own body are the limbs which it uses. It seizes a portion of the skin between two of these rings, and so holding on, it curves the tail until it draws it entirely out of the sheath which covered it. But its body is shorter than before this change, and it must climb to reach the tuft of silk to which it should hang. It stretches its body as far as it can, and seizes the skin higher up, between two other rings, at the same time letting go below; this process it repeats with different rings in succession, until finally it reaches the tuft of silk, and fastens to it the hooks in its tail.

It now gives itself a jerk, which sets it to spinning rapidly; it rubs against the skin, and loosens its hold on the silk. If one whirl is not enough, it whirls again, in the opposite direction, and this time will almost surely succeed. Reaumur saw one which, after several efforts to dislodge the old skin, was forced to leave it where it was so firmly fastened.

In about thirty hours after our caterpillar has made himself fast, he has effected this change, and now hangs by his tail, or in his hammock, a pupa, or chrysalis. Here he will remain in unconscious security, during all the quiet days of autumn, and through the bitter blasts and piercing frosts of winter, until the warm breezes of another June awaken his dormant powers to a new life.

Other caterpillars make for themselves cases, or cocoons, spinning them of silk, and often working in other materials. They are for the most part oval, or egg-shaped, sometimes boat-shaped, and are usually white, yellow, or brown in color. In some, the threads cling very slightly; in others, they are closely gummed together; some are single, others double; some so closely woven as to quite hide the pupa within, others so thin that it may easily be seen; some bind together leaves, within which they hide; some work into the shell bits of earth; while some weave into the fabric the hairs with which their own bodies had been covered.

One variety pulls out its hairs with its teeth, lays them against the web already spun, and then fastens them by spinning more silk over, or, rather, under them—for the outside of the cocoon is spun first, and thickened from within. Another does not pull out its hairs; it cuts them off. Another works its hairs through the meshes of the silken net, and then wriggles about until it rubs them off. Another pulls them out in the first place, then sets them

up like the stakes of a palisade, and spins a light web within, curving them inward so as to form a sort of cradle.

Many caterpillars go into the ground to become chrysalides; there they make round or oblong cocoons. These are always smooth and shining within, and are often fitted with a lining of silk. Reaumur took a cocoon out of the ground, broke it open, and placed it in a glass case containing nothing but sand. In four hours the injury was repaired.

The caterpillar began by coming almost entirely out. It moved its head forwards until it could seize a bit of earth, which it drew into the cocoon; then it came out for another, and so wrought for an hour, gathering material. Then it began to rebuild the broken place. First it spun a band of loose web over a part of the opening; then it placed a few of its grains of earth in the meshes which it had made; it spun more silk, and put more grains in place, binding them together with silken cords. Presently the whole was closed except one small opening, which it filled with crossed threads, and then finally stopped by pushing among the threads the bit of sand which it had saved for the purpose, and which made all tight.

A caterpillar found on the oak trees cuts off thin strips of bark, which it builds into two compact blades; these it so arranges as to form a hollow cone, or boat-shaped shell, in which it becomes a pupa. It is at once architect, cabinet-maker, and weaver.

In due time—sometimes in a few days, sometimes not until another summer, and in one instance, after as many as seven years—the time comes for the last, and most glorious transformation. The poetical Greeks found in this change a type of the liberation of the soul from its mortal tenement, and its entrance into a higher and happier life; hence they called the Butterfly, Psyche, the soul. This idea is most natural. The worm seems to spin its own shroud, to make its own coffin, often to enter its own grave. Yet within this shroud, this coffin, this grave, it lives, a dormant, waiting life, until the day comes for its resurrection. Then it bursts its cerements, and emerges in a new and beautiful garb, into a brighter existence. But the new life, unlike that of the soul, is brief and mortal; a few short days complete its round, and it perishes forever.

The pupa-case is dry, brittle, and easily broken. The least movement of the fly within opens the dry skin over the middle of the upper part of the thorax; the split extends over the forehead; the pieces separate, and the insect finds an opening through which it may escape. But the escape requires time, for the head, the antennæ, the wings, the legs, sometimes even the tongue, are each in a separate case, and must be liberated one by one. All the parts are soft and moist. The wings, especially, are a pair of crumpled packages, fastened to either side of the thorax. Gradually they unfold, they expand; the insect clings to a twig, and suffers them to hang in such a position that they may expand the more freely; in time they

become dry and firm. If the pupa is in a cocoon, there is yet more to be done, for it is still within the silken envelope. In some, as in the *Cecropia* moth, the end of the cocoon opposite the head is only partially closed, and the moth more easily creeps out. Others cut their way through the silk, for which, Reaumur says, they use their compound eyes as files. Others exude a liquid which softens the silk, and assists their escape.

The perfect insect has four wings, covered with minute scales of varied forms; these, under the microscope, glow with the most beautiful metallic tints. "Suppose a painter could present on his canvas, in all their splendor, gold, silver, the ruby, the sapphire, the emerald, all the precious stones of the East, he would use no color, or shade of color, which might not be found on some scales of some *Lepidoptera*, where nature has concealed them from our gaze."

The thorax, or chest, is strongly made, in order that it may give support to the wings, and to the six legs. Many have the legs of equal length, and use all in walking; in others, the two fore legs are very short, and are kept folded back against the chest. The body is long, oval, composed of five rings, joined by membrane. The head is rounded, flattened in front, and furnished with hairs. The globular eyes consist of a great number of facets, on which, in different species, glitter all the hues of the rainbow. In the compound eye of the *Papilio*, more than 17,000 facets have been counted. The antennæ are placed near the

upper border of each eye. Reaumur has figured six different shapes, and upon them the classification into families partly depends. What is their use? Certainly not for sight, taste, or smell. They are of little use as feelers, and there seems to be nothing else for them to do, which we can understand, except to serve as ears.

The jaws of the caterpillar have disappeared. Instead, the Butterfly has a long, flexible trunk, which it coils up into a small spiral, and carries in a cleft just between the eyes. In some species of Hawk-moths, the tongue is longer than the whole body. It consists of three hollow tubes, a small one placed between two that are larger. Through it the insect draws honey and the juice of flowers. But how can it eat even the most solid sugar? On examination it appears that it sends down through one or two of the tubes of its trunk a fluid which dissolves the honey, or sugar, which is then carried back through the other tube.

After the Butterfly has found its mate, it lays its eggs, some hundreds or thousands in number, upon the plant which is the proper food for its young. They vary much in shape and color. Usually they adhere by a gummy substance; sometimes they are covered with the down from the abdomen of the mother, to protect them from cold, or injury. Some species place them in clusters; others scatter them, leaving only a few upon any single plant. In a few warm days they are hatched, producing minute caterpillars, and the round of nature's course is completed.

Of the *Lepidoptera* some fly by day, others in the twilight, others still in the darkness of night. Hence authors have classed them as diurnal, crepuscular, and nocturnal. But this division is not found to be entirely useful, since some that fly by night fly also during the brightest and hottest sunshine, while even the night flyers do not fly all night. There are three principal sections.

First, there are the Butterflies. These fly by day, have club shaped antennæ, and when at rest, the fore wings in some, and all the wings in most, stand perpendicularly, turned back to back.

Second, the Hawk-moths. These fly, some by day, but most in the morning and evening twilight; they have the antennæ thickened in the middle, the wings narrow in proportion to their length, and confined together by a bunch of stiff bristles on the shoulder of the hind wing, which is held by a hook beneath the fore wing; the wings, when at rest, are more or less inclined like a roof, the fore wings covering the under ones.

Third, the Moths. These fly mostly by night. The antennæ taper from the base to the end, and are naked, like a bristle, or feathered on each side; the wings are held together by hooks and bristles, the first pair, when at rest, covering the under pair, and more or less sloped.

Our space will not allow us to describe any of the many varieties of Butterflies and Moths which fly among us. The worm whose changes we traced from the carrot-tops,

produces a large, fine Butterfly, called *Papilio Asterias*, which expands from three and a half to four inches. Its color is black; it has a broad band of sulphur-yellow spots across the wings, and a row of fainter yellow spots along the edge. The hind wings are tailed, and have seven blue spots between the two rows of yellow, and an eye-spot of orange, with a black centre.