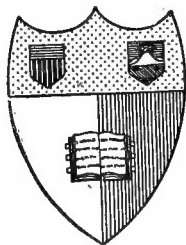


THE BROOK BOOK



MARY ROGERS MILLER

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THE BROOK BOOK



THE REFLECTIONS OF A BROOK

THE BROOK BOOK ❀

A FIRST ACQUAINTANCE WITH
THE BROOK AND ITS INHABITANTS
THROUGH THE CHANGING YEAR

BY

MARY ROGERS MILLER

LECTURER ON NATURE STUDY AT CORNELL UNIVERSITY

Illustrated



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DOUBLEDAY, PAGE & COMPANY

1902 cc

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HARRISBURG • PENNSYLVANIA

TO

JOHN HENRY COMSTOCK

Guide, Philosopher and Friend

ALL THAT IS WORTHY IN THIS BOOK
IS AFFECTIONATELY
DEDICATED

Lyrics

IN NATURE'S OPEN BOOK
AN EPIC IS THE SEA,
A LYRIC IS THE BROOK :—
LYRICS FOR ME!

—FRANK DEMPSTER SHERMAN

From "*Lyrics for a Lute*"



Throughout the year a brook is captivating. It is as companionable as a child, and as changeful. It hints at mysteries. But does it tell secrets other than its own? Does it tell where the wild things come down to drink? Does it tell where the birds take their baths, or where the choicest wild flowers lurk? I fain would know the story of its playfellows and dependents.

The brook has made its own way down the hill, through the woods and across the meadow. May we not follow it? Is it not a type of the best kind of human life?—the steep hillside of youth, the wild dash, the splashing through and under and between difficulties, the firm, steady flow down the gradual slope of middle age,—finally the safe and tranquil passing into the unknown?

And yet, in spite of its mysteries, one may really know a brook. A river is too distant,—too much an institution and too little an individual. A brook

comes to play in one's yard. It is neighborly. It invites confidences. It reflects our smiles and our tears with the same calm surface.

Nor is the brook always idle. The brook practical may typify a more useful life than the brook romantic. It may be both. So, too, may we. If the stream goes on merrily below the mill, may not we, too, do an honest day's work and keep moderately cheerful? I would that I might be like a mountain brook, never stagnant, never vanquished by obstacles. That I might do my task and be ready to play when it is finished. That I might hurry through all uncleanness, absorbing none. And that I might give myself to the future with perfect confidence and peace.

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ILLUSTRATIONS AND ACKNOWLEDGMENTS

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M. R. M.

ITHACA, N. Y., April 21, 1902.

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The Brook Book

I

MY FIRST VISIT TO STONY BROOK

IT was Memorial Day, and consequently a holiday. I had looked dubiously at the clouds which went scudding across the sky the night before, but hopefully at the weather signals. I was still half incredulous, though they assured me in no uncertain black and white that the morrow would be "fair and warmer." No wonder I was anxious, for if the weather permitted I was to go with the Professor to pay my first visit to Stony Brook.

I awoke to find the sun smiling on a world new-made. The birds, singing a roundelay in the ivy at my window, invited me to inspect their house-keeping affairs. But I had no time to putter with them. Not a minute was to be lost, for the Professor, being a prompt person, would be impatient if I kept him waiting. Breakfast over, I donned my canvas knapsack containing various articles needed on such a trip, and we started.

It was a three-mile tramp over a road that was new to me and full of delightful surprises. The sun beat down on us with a fervency that would have done credit to August. How gratefully we

rested in the shade of a group of fine hickory trees, throwing the last year's nuts up at the saucy squirrels, who enjoyed the fun from a safe distance. They evidently felt secure in the fact that the Professor wouldn't hit them if he could, and I couldn't if I would.

We were traveling south on the western edge of a valley which grew narrower and narrower until it became a mere notch between two distant hills, now veiled with blue shadows. In the valley were fields of corn and cabbages, which ceased abruptly at the eastern edge, as if unable to climb the steep bank. As we stopped to look, there rose a puff of white steam from a puny train which came hurrying along from somewhere. It seemed small and helpless, clinging timidly to the side of the hill as if afraid of falling. We watched it until it was safe in the valley and headed for the town, and then continued our journey.

"Here we are!" said the Professor, as we reached a small bridge and crossed to the opposite side. I gazed about me. To the east was the narrowing valley, and in its center a silvery stream wandering aimlessly lakeward. To the west I could see that the hillside was cleft and wooded. To the south ran the hot, white road. Beneath us was the rocky bed of what might once have been a goodly stream. But where was the water?

The Professor was on before me, seeking the shade of the trees on the south bank, and had not seen my disappointment.

"Well, I don't see the brook!" I called, rather

spitefully I am afraid, for I was tired and the day was warm.

"This is a vanishing brook," laughed the Professor; "something like the Cheshire Cat."

Then, while we rested, he told me a little about how brooks behave. It seems that they are not always open and above-board in their dealings, chattering and tattling their secrets to every passer-by, but that they are quite likely to drop out of sight, without giving notice, and to reappear again further along their course. That is just what Stony Brook does. On another trip I went down from the bridge and found where the water returns to its rocky bed and hurries along as cheerfully as if a subterranean channel had never been heard of.

We started up stream. Before we had gone far we found the water, clear and cold, just as a mountain brook should be, and breaking into a hundred tiny waterfalls wherever one flat stone happened to lie lower than another. Along the bank the trees cast a dense shadow, and the temperature began to fall as we ascended. The banks themselves began to straighten up and left us barely room enough to walk dry-shod. The Professor was picking up small flat stones from where the water ran swiftly, and I could but guess what he was finding. Almost mechanically I, too, began picking up flat stones and looking them over.

"See here!" came the summons at last; and I knew the Professor would tell me just enough to make me want to know more. I looked, and what had before seemed to me mere pebbles sticking to

a larger stone were transformed in the naturalist's hand into marvels of insect architecture. They were houses inhabited by small insects, but it was only by dint of vigorous urging that we induced the inmates to show themselves.

"Caddice-worms," said the Professor, picking up still another stone. At least a dozen of the rude little cases were firmly attached along its edges. They were in a regular row, like small city houses all of the same pattern. Each house was tenanted by a single, slender creature, not more than half an inch long, and fitting his house so snugly that there could not possibly be any room for furniture. Later in the summer I learned more of the caddice-worm's story.

We started up stream again, crossing and recrossing the brook many times, for the banks were now so steep that climbing was impossible. Soon we reached a point where the stream had crept under the edge of the banks on both sides. It seemed to deny our right to pass that way. The Professor announced that it was time to wade, and looked rather ruefully at my shoes while he changed his own. I was glad that he had brought his rubber boots, though they must have been heavy to carry all that distance. But how was I to go further without ruining my walking boots? Fortunately I had my wits about me—also an extra pair of heavy stockings. So far the floor of the stream had been composed of flat stones as smooth as the sidewalks in the town. Why not? Without waiting to consider the matter too seriously, I

retired behind some bushes, hid my shoes and stockings there and put on the extra stockings. By the time the Professor thought of me again I was in midstream, carefully examining some flat stones, and trying to act as if nothing unusual had occurred. I found the water just cool enough for comfort, and was able to walk up very slippery places. Indeed I had never been happier in all my life. The spirit of the brook had already entered into me, and I was a part of it. I kept to the water from that time on, and was able to get a point of view which is impossible from the bank.

As we emerged from the narrows, we came upon a small patch of ground, almost an island and overgrown with plants of all shapes and sizes. It was there we discovered a bit of nature's handiwork which seems to defy description. A few strawberry plants had found their way to this garden spot and, though it was at least ten o'clock in the forenoon, they were decked with jewels of rarest quality. They needed no sun to give them brilliant hues. The plant held its leaves up bravely, the three green blades not spread wide open. The

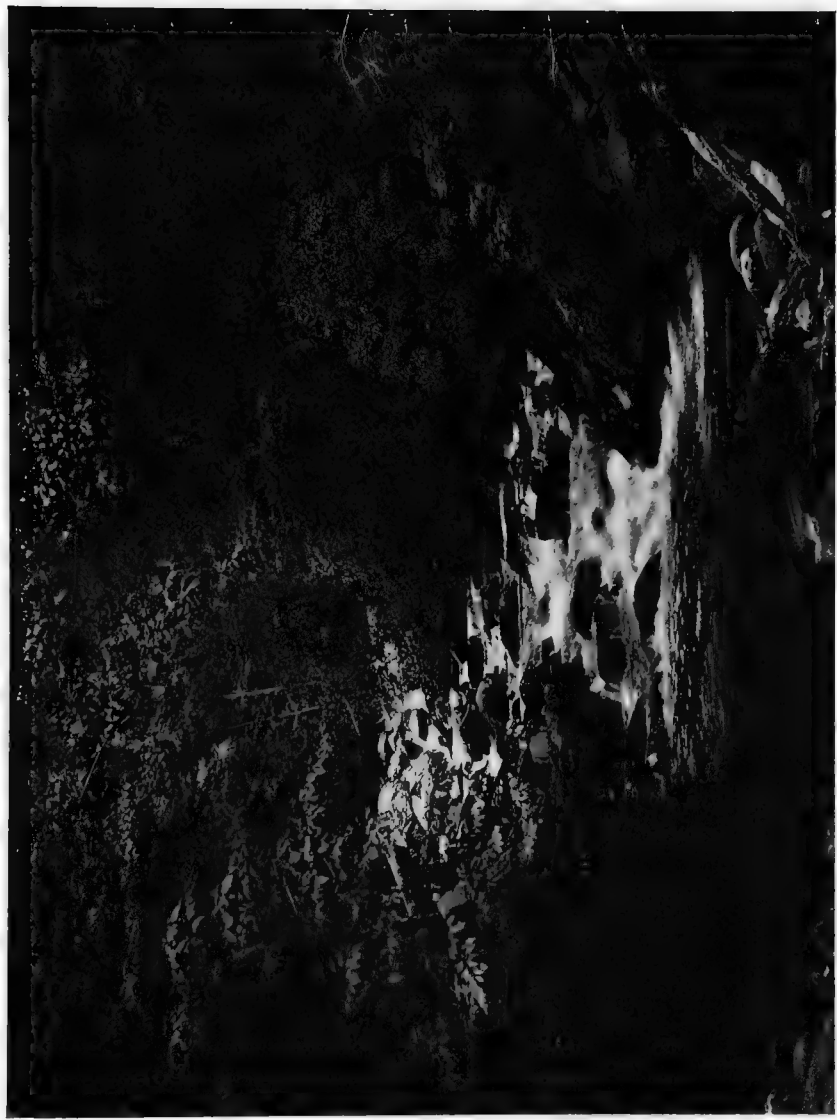


SET WITH PEARLS

scalloped rim of each was set with a row of pearly dewdrops, so perfect, so clear and so pure that there could be no doubt as to what master hand had fashioned and set them. Their beauty fairly hurt.

We continued our way, now clambering up the most entrancing little waterfalls, now crossing on natural bridges of fallen tree trunks or breaking our way through tangled bushes. Finally we came to the most pretentious cataract of them all, inviting glimpses of which we had caught from below. This was the place towards which we had struggled, for here, in the very swiftest rapids of Stony Brook, dwelt the tiny insect whose life history the Professor was then studying. To-day I was to be allowed for the first time to collect material for his studies. Above the falls was a dry mossy bank, where we sat to enjoy the beauty of the scene. After drinking in its wild simplicity, as yet undisturbed by the "improvements" of civilization, the Professor said, "Suppose we see what Eliza has put into this knapsack." He spread out a napkin and placed upon it sundry tempting packages. Never did graham biscuit, cold meat and hard-boiled eggs taste half so good as on that mossy bank, with the tinkling waterfall at our feet and Stony Brook laughing away in the shadows below.

After collecting a goodly quantity of material for study we found it was time to start home. We should be late for luncheon as it was, and Eliza could not be expected to provide two extra meals in one day, even if it was a holiday. We



STONY BROOK. "A SERIES OF ENTRANCING LITTLE WATERFALLS"

found our shoes where we had left them, and made our way to the bridge again, only casting now and then a backward glance when a series of dancing waterfalls demanded our attention.

My memory of that first trip to the brook is as clear as if I had been there but yesterday. Stony Brook is no longer what it used to be. The wood-choppers have claimed its protecting trees, and vandals have despoiled its banks of their fringe of ferns and columbine. The trailing arbutus which once made the hillsides fragrant in early May has been rooted out by thoughtless ones. Jack-in-the-pulpit and wake-robin have been dried out by the sun since the trees, at whose feet they loved to nestle, have learned the way to the saw-mill. In spite of all these changes I have only to wave an enchanted hazel wand, or to wade stocking-footed in a stream of water, to bring back that day, and Stony Brook lives again in all its bygone loveliness.

II

THROUGHOUT THE CHANGING YEAR

WHEN we first came to live on "The Highlands" it was already September and our explorations were confined to the immediate neighborhood. We did not penetrate beyond a strip of timber which seemed to mark the border of our universe. Still further lay a field, glimpses of which could be had between the columns of pine and oak. But with the soft Indian summer days came again the instinct to travel and we climbed the rail fence with its tangle of briars and found ourselves in unexplored country. Here was a broad rolling field with no houses in sight (we were glad of that, for we disliked being objects of curiosity), and yonder was a dip between two hills, which had the look of a water-way. Could we do better than follow what had once been a road until we came to this stream and then turn ourselves over to its wayward guidance?

The road itself was not devoid of interest to us. On both sides was a flower border which might have graced a garden. Wild flowers of many kinds crowded into the very roadway. Purple and yellow were the predominating colors, for autumn had possession of the land; but there was plenty of white, some blue and a little red. All trace of last night's rain had disappeared under the fervent sun, save in a few old ruts in the road. As we neared one of

these wet places a cloud of yellow butterflies, hundreds and hundreds of them, rose and danced before us. In twos and threes they flew, going through the most intricate figures. We halted and stood like statues. The zigzag lasted but a minute longer; lower and lower they flew, finally settling down shoulder to shoulder until the moist spot on the roadway was yellow with them.

As we neared the stream the air was suddenly laden with a pungent fragrance. "Mint," exclaimed the Doctor, and "mint" I quickly replied, hastening my steps to be the first to locate it.

"Peppermint

Brook" we christened this new member of the family. It was too diminutive to be recognized by the local map-maker, and we could not wonder. A brook it should be to us, though at present no water coursed through its channel. Nature seemed to have used its bed as a sort of rubbish heap and we plunged into a perfect snarl of burdock, its purple mask thrown off and true character revealed. It was hard to step between the plants: if one escaped them it was only to be thrust at by a dozen bare brown arms and left bristling with "pitchforks."



"PITCHFORKS"
(TWO-TINED)



ROADSIDE BUTTERFLIES

A stunted oak stood guard at a bend in the channel. Its arms were bare already and revealed the great rope-like vines of wild grape which reached its topmost branch and hung swaying there in the wind. They reminded me of the old non-sense rhyme about

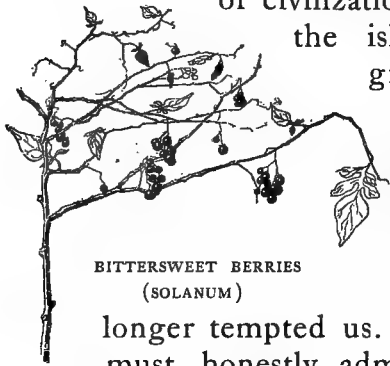
“ The Jack and the Jolick and the Jamborie,
They climbed to the top of the Banyan tree,
They climbed to the top
But they had to stop,
For no more foothold could they see.”

Our lips and tongues were soon blue with juice of the wild grapes whose clusters hung in tempting array within easy reach. This so renewed our youth that we did not mind the burdocks and the pitchforks. Below the oak tree a border of sumach glowed and burned. Leafless alders shook their dry cone-like catkins over the very middle of the stream. Belated asters hid in sheltered places. Plummy goldenrods, their gold turned to dull silver, and beautiful as old age is beautiful, bowed stiffly as we passed.

A dash of red caught the eye from among the burdocks and dead pennyroyal stalks. We had come to a place where the stream had a double channel with an island between. This island was fairly possessed by bittersweet and Virginia creeper. They climbed or clambered over each other, and over such unrecognizable weeds as had found a foothold there. The berries of the bittersweet shone as if newly burnished. They do look appetizing;

far more so than wild grapes. Only their well-known relationship to the dreaded black berries of the deadly nightshade kept us from sampling them.

The long weak stems of the Virginia creeper in this brook-bed were more beautiful in their setting of dull gray, softened by tones of yellow in the grasses, than they had ever seemed on the porches



BITTERSWEET BERRIES
(SOLANUM)

of civilization. We did not venture to the island itself, because there groped among the bitter-sweet and woodbine the dreaded poison ivy. Well had we learned the sharp lesson of "touch not, taste not, handle not" from this plant. Its gray berries no longer tempted us. If it is beautiful, and one must honestly admit that it is at times, we prefer to enjoy its beauty at a distance.

We left the island and followed along an open stretch where mint mingled with low growing plants unknown to us in their autumn guises.

"Let's come here every month for a year," said the Doctor, "and find out what these things are, and what they do." I heartily agreed.

We reached another fence and slipped easily under the wire, just where the stream would have gone if there had been any stream. We crossed the road and found ourselves against a fence of wonderful design and workmanship. It had originally been of stumps. The practical man may talk

briskly of the preëminent utility and permanence of wire, barbed, twisted or woven; the loiterer may sing the praises of the serpentine or "rickrack" fence of rails, but for me there is no fence like a good old bramble-ridden, squirrel haunted stump fence. The older it is the better. The soft gray of the bare and rugged roots, the stones imbedded between them, to me would be quite enough. But ever a good provider, nature has crowded the stump fence with bushes and peopled it with gentle wild folk who dwell unmolested in its fastnesses. What bird would have much to do with a wire fence? The meadow lark uses it as a perch, to be sure, but the stump fence with its accompanying shrubbery is a veritable playground for birds. Nervous wasps, armored and bayoneted, flit in and out. The soft decaying stump furnishes an endless supply of wood-pulp for their paper factory. The leaf-cutter bee finds the wood easy to tunnel and the wild rosebushes of the fence-row supply the necessary lining for the nest. Here squirrels and field mice hoard their stores and woodchucks burrow. The fence supplies them with parade ground and conceals their thresholds. That impenetrable tangle of wild raspberry must have been worth visiting in berry season. Its long interlacing canes are covered with hoary bloom. What a boon they are to Molly Cottontail, and what a source of exasperation to her pursuers!

As we skirted along the fence, half looking for a place to get through, we came upon a clump of shrubs, whose small but upright trunks stood like

miniature pillars roofed over by a canopy of clematis. Its feathery seeds made a soft gray curtain which hung over the entrance to a path provided, as it seemed, for our extremity. Stooping, we crossed the fence where the stumps stood aside for us, and tall sumachs gave us welcome. They formed a sort of torchlight procession back to the brook-bed and there left us to continue our journey, while they followed the fence down the hill. But a short distance below the highway the stream obeyed the natural law of its family in this region and dropped suddenly into a gully, continuing its way toward the lowlands between precipitous banks.

Our next visit to Peppermint Brook was in January. The fireside-loving family held up their hands in horror when we announced our intention of going out. We dressed for snow and found it. We found, too, mysterious stillness and wonder. Winter had so transformed the whole region that we should hardly have recognized our brook had it not been for the oak tree and the island. When we came to the wire fence we could not creep under on account of the snow. The sumachs across the road stood revealed in all their nakedness. They, too, seemed to hold up their hands in horror at our daring to pry into winter's mysteries. We fled back over the path by which we had come, refusing to be comforted until we put a friendly group of willows between us and those uplifted hands. Among the willows a bright little holly bush cheered us and tiny

gray pussies peered out at us from under their tight brown hoods.

In March it was safe to venture again. The stream was full. It talked in low gutturals as it lapped over the clumps of long dry grass which had crowded its channel. It bore a load of coarse sand which it was spreading over the island farther down. The willow catkins had pushed their scales off and stood revealed in their soft gray beauty. I stopped long enough to rub my cheek against them and could almost fancy I heard a "purr." A few were already shaking out their yellow anthers. The rim of ice left at the water's edge by the sharp night was pierced by pointed spathes of skunk-cabbage.

April brought out the dazzling yellow of the marsh marigold, whose presence we had half suspected from the clumps of bright green foliage clinging to the earth in the very center of the current.

A solitary shadbush, retreating to the border of the stream to escape the devouring ax of the clearing, revealed itself half apologetically. This tree is seen at its best in the woods along Clear Creek. Following the broad path along the right hand side one comes to an opening in the woods. Below, the stream widens into a broad tranquil sheet. Beyond there is a mass of closely grown pines and low shrubs. The bank rises, the eye follows up toward the sunlight—all unexpectedly there comes from among the treetops a shimmer of silver, a



PUSSY WILLOWS BY THE WATER-SIDE

handful of sparks, a delicate spray, a shower of white petals. It is the shadbush! It does not seem to belong to the ground. One does not require to see



"A SOLITARY SHAD-BUSH RETREATING TO THE BORDER OF THE STREAM"

the tree. Has it a trunk? Has it leaves? Will it bear fruit? No matter, the questions are irrelevant. It is enough that we have seen it to-day and that it will come again next year. May we be there on the path to catch its message and be glad!

In May the oak tree shakes out its loose catkins. These endure but a few days, and one must be on time to get a glimpse of the sparsely set pendants. The young acorns stay on, nestling among the thick leaves. It was not until May had passed and we were ankle-deep in June that we began to discover the great variety of fruit borne by this brookside oak. Oak apples of various sizes appeared on the leaves. We had seen them on fallen leaves last November, but here were the beginnings. Bright green like the leaves, they were well disguised. Scarcely a branch had escaped the attentions of the tiny gall-fly which leaves its young to be nurtured and cradled by the tree. Why the presence of a particular species of insect on leaf or stem should cause the oak to provide always a dwelling of a special pattern is one of the most fascinating mysteries offered by nature. An oak tree is a wonderful "apartment house" well worth visiting.

June gave us abundantly of her best. We had explored the brook in both directions before this time. Up stream was a dilapidated rail fence which, with the aid of a broad tangle of briars and vines, emphasized the boundaries of adjacent farms. How we gloated over that fence-row and watched with eagerness the coming out of the leaves on the various brambles! At the very place where Peppermint Brook came smiling from under the fence there hung a thick curtain of wild roses. As their buds multiplied we promised ourselves a trip thither, "long about knee-deep in June." When that time



"ROSES ARE — ROSES"

came how great was our enjoyment! The roses far surpassed our hopes. We sat beside the stream and looked at the flowers and their glossy background of foliage—could we ever get enough of such wild, natural beauty?

Something in roses defies description. They have a language of their own. All understand but few can speak it. Roses are—roses. Wild roses are even more of the same. Add to them the rustic fence, the soft lapping of water through long grasses, a glimpse of far-away purple hills, and will you ask for more?

As long as our brook received the waters of its tributary springs it kept up a merry flow. Cresses were plenty and many a crisp salad was supplied to our table. Late in June the stream began to fail. In August its bed was again given over to the burdocks, the pitchforks and the bittersweet. Asters and goldenrod, briars and bushes, choked the passage. We turned Peppermint Brook over to its rightful occupants with the request that we be allowed the privilege of continuing our monthly visits so long as we live in "The Highlands."

III

BEECH WOODS IN MAY

IT was well along towards the end of the month before my cherished plan to visit the beech woods was carried out. There were so many growing things to take note of, so many paths to re-explore, so many spring openings to attend, one hardly knew which way to turn. With a fixed purpose and a trusty alpenstock, I started. There would be need of both, for the way to the beech woods lay along steep and rocky banks, little frequented by unattended women folk.

Leaving the street just where it changed from a city thoroughfare to a country road, I followed a most inviting path which no sooner had me well committed to its leadership than it brought me face to face with an impertinent wire fence. The path slipped under with difficulty and was away. I could see to some distance where it skirted along between the edge of an unknown ravine and a wide field of wheat. Brown butterflies dodged in and out among the low shrubs. The sun and the south wind played hide-and-seek with the waving grain. Long I gazed on that fair sight! Then I looked at the wire fence, tested its tension with an impatient toe, considered for a moment, and concluded that I could get down into the gorge just as easily by some other route. A clump of sumachs along the

road stood out bare and grim against a luxuriant new growth of wild grape-vines. The contrast was striking. It was as if summer and winter had been brought face to face. The grape-vines were even beginning to blossom, and there were wild geraniums and violets along the border of the woods. But the sumach's buds showed no hint of green. Its lateness surprises me every year. "Little Indian" gorge lay just below me, but how should I get down to it, how pass by these growing things which kept distracting my attention?

I followed the road around a corner and came plump against a high-fenced chicken yard. The path was right after all. I went back to it and found that it was possible for me to squeeze in under the lowest wire just where the path itself got through. Under more wild grape it led me, past more cautious sumachs and through a grove of young poplars. It was impossible to pass these by without a caress. Their soft gray-green color and downy texture has great fascination for me. "Feels jel-like a kitten's ear!" I murmured, stroking a leaf between my thumb and finger, with a tender recollection of "Uncle Eb." Then a gleam of living sunshine shot past my face and I left the poplars to wonder where the oriole's nest could be. The bird was far away and I saw no more of him.

The path was still there waiting for me, and we went on together, not stopping again until we reached and crossed a tiny brooklet. Here I must look back and view, from a new standpoint, the way by which we had come. At my feet were two sturdy

plants of Jack-in-the-pulpit amid a company of anemones and violets. A dozen stalks of the false Solomon's seal in blossom hung like a white fringe at the water's very edge.



STURDY JACK-IN-THE-PULPIT

From the treetops there floated down maple keys and seeds of elm. They fell into the stream and were borne away. A delicate May-fly no

bigger than a gnat fluttered up and down over the water. Here and there little blue butterflies floated on the air, like flower petals or tiny feathers from a bluebird's wing.

Suddenly my path came to a standstill, for there was the road which I had started out to find and which would soon leave me down by the mill from which one always took fresh start. For there one was in the gorge itself and soon came to the "Narrows" beyond which the hills drew apart, leaving a wide amphitheater. The broad, level area between the hills was crowded with young beech trees. They came down to the very water's brink and hung their long branches out over the stream. One could hardly believe that the water which flowed with scarce a ripple here among the beeches would hurry through the

Narrows, rush over the rapids and at last pour through the mill-race in a seething torrent. But such are the ways of the "Little Indian."

The ground was sandy in places and the sweet clover had taken possession. Coltsfoot and dandelion filled the air with seeds and their bald-headed flower stalks were everywhere. The young leaves of coltsfoot covered every inch of space they could get. Gathering these one after another I experienced much joy by reason of their velvety surfaces.

Down among the grasses and humbler plants which throng the forest floor I searched for beech nuts. The first thing I picked up was a notorious little three-cornered thing which richly deserves the name it bears, a "stink bug." Perceiving my error, I gently put it down and transferred my search to another quarter. The next thing I found proved to be strongly attached to a violet root, and I discovered for the first time the seed-pod of this plant. Later I learned how the pods open and shake out their seeds, and found the cunningly hidden underground flowers by which the violet makes assurance doubly sure. But no beech nuts were to be found that day.

On the bank among the coltsfoot and sweet clover I sat me down and reflected. Above, an ambitious



VIOLET GONE TO SEED

branch hung far out over the stream, reaching almost to the further side. The season had been late and the leaves were as yet in their infancy. To-day they hung there above my head all limp and silky. They seemed but half awake. In their tender delicate beauty they were as appealing as young birds or babies. The smooth stream held a mirror before their faces, but they were too young to notice their reflection.

I am glad I came to-day, for this one picture is compensation for all the hard climbing. To-morrow, these lovely half-open leaves will have stiffened into smart, erect, self-assertive foliage. They will go about their prosaic business of starch-making just as if they had never had a moment of hesitating, helpless babyhood.



"BABY BEECH LEAVES HALF AWAKE"

IV

A LIVING CARPET

JUST above the pond where the skaters and the ice-gatherers hold high carnival in January, Cascadilla Creek narrows into a brisk but friendly stream a little too wide to cross dry shod yet not wide enough to make it seem worth while to bridge it. Exploring along its banks one day in early summer I was attracted by patches of dark moss on the flat stones just where the current ran swiftest. I looked for a place near enough to the edge for me to examine it more closely. It looked so soft and velvety and cool that I knelt on a flat stone and reached out to smooth it with my fingers. This living carpet was not of moss but of separate and distinct "things." My eyes discovered it first through the rushing water, but not in time for me to reconstruct my ideas and stay my hand. I fear I gave the mass a rather rough "smoothing" and sat back against the bank to reconsider the matter. But my hand needed immediate attention. It had not returned to me empty. A half dozen or more of the "things" were clinging feebly to my fingers. Another was hanging below my thumb by a thread like that of a spider. The creature had evidently spun out this silken line as a means by which it might escape to its element. As the water fell from my hand they all seemed less com-

fortable. Without further delay I washed them off in the current and saw no more of them. What a story of adventure they might have told if they had gone back to their fellows on the stone!

It is surprising how quickly one loses the old horror of squirming things when once the spirit of investigation is awakened. Ever since that memorable first visit to Stony Brook I find that no living thing, however dull and repulsive it may seem to the casual observer, is without interest and even beauty to me. Now that I know each insect has a wonderful life history, and is so marvelously adapted to its conditions, my disgust has changed to admiration and my fear to respect.

I had a wide-mouthed bottle with me which I now filled with water. Using my fingers more skilfully this time I scooped out a dozen or more of the creatures and transferred them to the bottle. I found that they gave up their hold on the rocks rather easily, and wondered that they were not all washed down stream long ago by the current. It seemed a dangerous place for such weaklings to cling, if they did cling. How did they do it and why were they there, deceiving the credulous wanderer and challenging her with their mysterious behavior?

"The Professor will know them and will help me find out their story," I thought, as I gazed at the bottle. My "things" proved to be almost black, cylindrical, worm-like creatures about three-fourths of an inch long and not very fat, perhaps as large in diameter as a Japanese toothpick.

They had attached themselves to the inside of the bottle and were moving about. They did not walk along nor crawl but proceeded by loops like a measuring worm. Looking closely I discovered that they had no legs at all. As if to make up for this obvious oversight nature had provided each with two suckers, one near the head, the other at the tail. By judicious application of these suckers the creatures succeeded in getting about at a fairly lively rate. One was standing still holding on by its tail disk only. It seemed to be waving something about its own head. I could see the motion well enough and even the fan-like appendages sweeping back and forth. "Another mystery for the Professor," I said, and set forth to find him.

By the time I reached the laboratory the creatures were all still. I feared that my bottle was a poor exchange for their clear rushing brook. For a moment I even contemplated carrying them back and trusting my powers of description to acquaint the Professor with my new friends. But I carried them along and was glad of it when I learned that they were none other than the young of black-flies; not the worst species, I was assured, but closely related to the "punkies," and to the terrible cattle flies.

"These larvæ," said the Professor, "are nearly full-grown. They hatched from eggs left in great numbers glued fast to that flat stone where you discovered them and have probably been there ever since. They always stay where the water is swiftest, for two reasons. There is better aëration

in the current, and a chance of a plentiful supply of food without the necessity of going after it. They don't live long in still water. These larvae have special contrivances for breathing the air that is mixed with the water, as do many aquatic insects. The great fans which you saw waving back and forth have a very important function. They are forced through the water, literally sweeping hordes of microscopic plants and animals down the hungry throats of their owners."

"But how do they get to be flies?" I inquired.

"They spin a kind of cocoon," he went on, "in which they pass the pupa state still clinging to the stone. I have never yet seen them emerge from the water. Some say that they rise in a bubble of air and escape when the bubble reaches the surface. How they get the bubble, or manage to get themselves inside of it, is not so easily explained. I mean to find out for myself. I know they do get out and fly, but I'm not satisfied with the bubble theory."

"It's a wonder they ever manage to get out, isn't it?" I ventured. "And do the real black-flies, the 'bity' kind, live in the water and look like bits of soft mossy carpets on the rocks as these did?"

"They all live in the water during their immature stages," he replied. "We have much to learn of their habits."

V

A - MAYING

SISTER ELLEN had never seen the trailing arbutus in its native woods. The rills and brooks near the city had been so greatly "improved" by their contact with civilization that scarcely a leaf remained to suggest the sweetness of the Mayflower. It had retreated before the ever-advancing army of flower pickers with baskets and grasping hands. With it had gone the pinxter-flower, and even the more rugged columbine had been driven to establish itself on the steep sides of the gorges, where no human foot had ever trod.

We were wont to chuckle at the exasperation of certain Philistines who fairly ground their teeth when a fine clump of these blossoms gleamed from some inaccessible ledge. We were grateful that the fringed polygala and the saxifrage had escaped the notice of wild-flower exterminators. But one azalea remained in our near-by woods and a chosen few knew its station. It served us for a calendar. When its buds were pink at the points we knew that the north slope of Tower Hill would be covered with arbutus and the south side with pink azaleas.

With baskets and small black pail we started, Sister Ellen, the Doctor and I. "Why baskets?" one might inquire, since hunting the wild flowers

with baskets is so harshly condemned! But would you have us miss this chance for the first picnic of the year? The baskets were far heavier on the trip to Tower Hill than when homeward bound. Confirmed picnickers all three, we never missed a chance for a meal in the woods, though we had to carry the heavy baskets several miles.

The roads were good, for a wonder, and with the basket and the coffee-pail swung on a stout stick we began our climb. To go round Tower Hill would be too long a trip; besides, the view from its bare top was part of the fun. When we reached the summit and had gazed off into the next county, besides seeing a fair share of our own, we began the descent of the north slope.

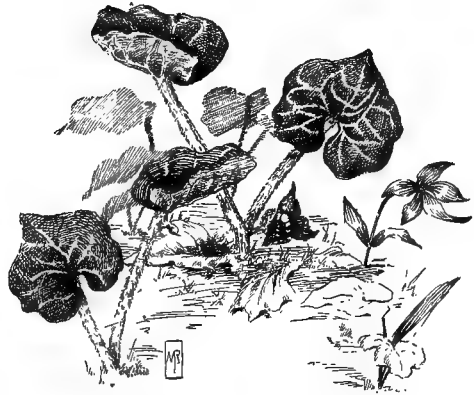
"Do you hear the falls?" said the Doctor, whose hearing was as keen as a hunter's.

We listened, and followed him. Soon we too heard the splash and trickle of the water and hastened our steps. It was along this stream that the "Walking Party" had discovered years ago the first "morels" I had ever seen. Taking them home to learn their history I was told that they were good to eat and that nothing else on earth looked enough like them to be mistaken for them.

We followed the course of the stream, making our own path as we went. Ellen pounced upon the first promising bit of green which showed under the carpet of dead leaves. It proved to be a small plant of arbutus too young to have a blossom.

"Wait till we get farther down," I advised knowingly.

Clumps of wild ginger next engaged our attention. The broad leaves shone like watered silk in the light. We had to go over one whole patch to see that each plant was doing its duty in the making of flowers, and we never failed to find a flower between each pair of overarching leaves. Such a quaint, unpretentious wilding, with its cheek against the ground! Further along, the ground was taken up by May-apples now in full blossom. Here again I stopped to

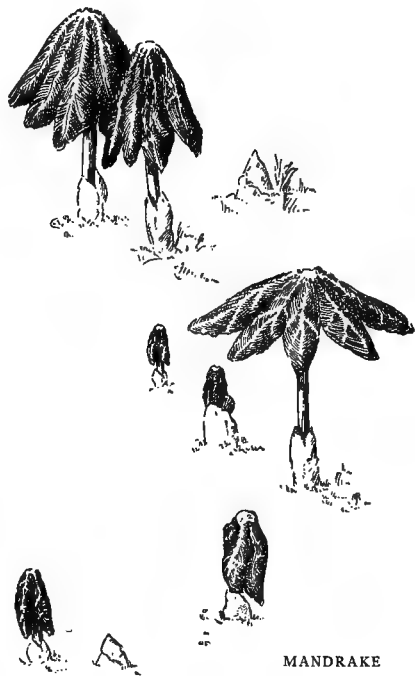


THE QUAIN'T WILD GINGER BLOSSOMS

point out to Ellen how stoutly these plants cling to their old habits, for, as we lifted the umbrellas of the single-leaved plants, seeking for a flower, not one did we find. But between the twin leaves of each fruitful plant drooped the solitary waxen blossom. In a renovated fence-row near home the mandrakes had come up weeks ago. Even when the folded umbrellas first broke through the soil we could tell which ones would bring forth apples. The flower bud comes first from the ground, being borne aloft by the leaves. As the umbrellas spread on their ever stiffening ribs, the buds grow bigger, but not until the leaves spread wide apart does the bud droop on its lengthening stem and hide its face in their protecting shade.

We were coming to the arbutus country, by the signs which we who had been there aforetime recognized. Soon now the patient scrapings of Sister Ellen would be rewarded. We must keep near her and catch the glow of her first "fine frenzy."

For the twentieth time she dropped to her knees among the dead leaves. This time was her reward. There lay the most exquisite clusters, like pink ivory, delicately wrought. The faint elusive perfume enslaved us all. Down on your knees and offer homage to this woodland princess!



MANDRAKE
UMBRELLAS

I felt the old intoxication coming back. I could hardly wait till I had found a finer cluster—finer only because 'twas mine. The supply was inexhaustible. The slope was thickly carpeted with the leaves and flowers. What a pity our flower-loving friends could not all see it? Here we might with unhurt conscience cut (not pull) enough sprays

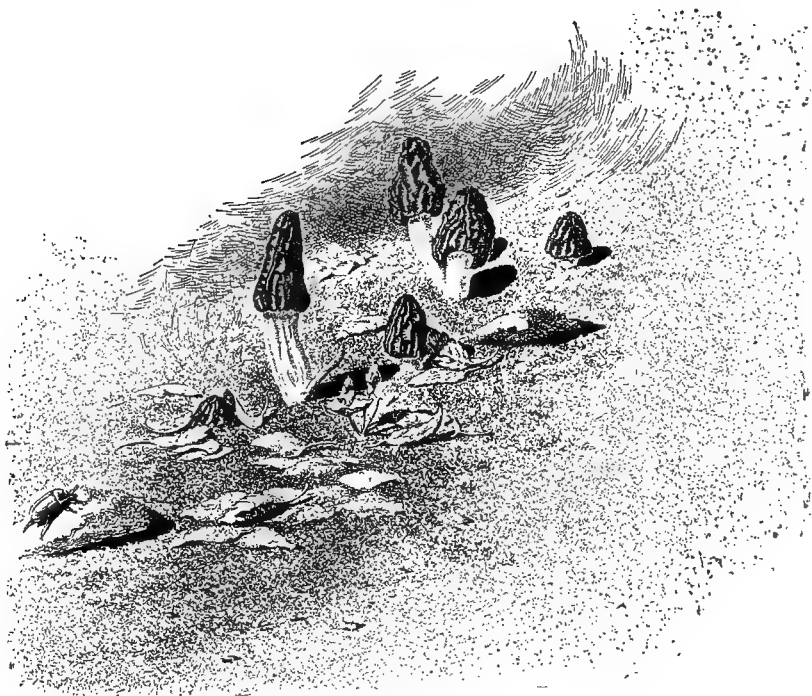
to fill a small box to send out West. For years had the New England born father longed for a whiff of this precious odor. He should have it; and the flowers would never be missed.

While we sisters gloated over the happiness the arbutus would bring to the prairie home we were startled by a shout from down stream. It was dinner time and the Doctor was prospecting for fire-wood. We followed, expecting to find the fire built and the forked sticks ready for the coffee-pail. Instead we found an excited man with a basket half-full of brown fungi and still picking them.

"Morels!" he had been shouting, when we thought he had said, "Girls!" "More than you ever saw before!" and the basket proved it. "Did we bring any butter?" "Shall we broil 'em or fry 'em?" I might have said we'd do neither without a fire; but instead, I, too, hunted morels. They were not easy to see, though unlike anything else, but we each found some and left all the old ones "for seed."

We broiled them one at a time, stuck on a pointed stick and held over the coals. How like toothsome bits of tenderloin they tasted, with our plain bread and butter! Persons who have a prejudice against miscellaneous fungi and prefer to eat only those which have been "warranted" by a grocer, would do well to leave this plant to the millipedes and snails, and to us. We are willing to trust the experience of our own palates and the wrinkled brown surface of the morel is warranty enough for us.

After luncheon we reluctantly made preparations for the homeward trip; we washed the coffee-pail and the tin cups in the brook, watched the waterfall in silence for a while, then started. A kindly farmer going townward for a barrel of salt, as he told us, gave us a lift, and we reached home full of memories of that perfect day with the arbutus and the woods-folk.



MORELS

VI

HOUSEHOLDERS

THE caddice-worms which we found living in the rows of tiny gray stone houses in Stony Brook have plenty of poor relations whose houses are built of wood or even of less durable material. Some of these are so shiftless as to have no fixed habitation, but roam about from place to place, drifting with the current, if there is one, or hanging about among the stems of water plants. Others are even worse, and might be compared to the semi-civilized people found in the old geographies. (I have never encountered them elsewhere.) These live under stones in rude houses made of pebbles tied together with threads of silk, and pick up a precarious living by trapping and fishing. So far as known these creatures never visit their more civilized relatives. But if an inhabitant of a neat little gray stone house happens to stray into the region of the hungry fisherman's trap, woe be unto him! Caddice-worms are not discriminating and this particular kind is known to be carnivorous. "All's fish that comes to their nets." They would probably think little of eating a near relative, much less a distant cousin. Since they are cannibals, perhaps it is unfair to class them with the semi-civilized folk. Away with them into the outer darkness of the savage tribes, in spite of the fact that they are skilful net makers and

practice a rude form of architecture. They appear again in a chapter called "An Insect Law-breaker."

Perhaps the most well-known of the caddice-worm family are the little "Householders." They can hardly be counted civilized, since they have no fixed homes. They are more like the nomadic tribes, for they are at home wherever they happen to be, even in the small boy's aquarium or in a fruit jar on my study table. They are literally "Householders," for they carry their houses everywhere they go, not on their backs like the turtles, but all over their bodies. When the outlook from the front door does not please, this caddice-worm retires and its house floats up near the surface of the water.

When I first looked into the water I did not see that these differed from any other small stick or bundle of sticks. But warily, without wishing to awaken suspicion in any one's mind, out from the



CADDICE-WORM CASES

little bundle I was watching came a head. Several legs, long and spidery, then reached forth and made a rather poor show of paddling away. The first water plant which

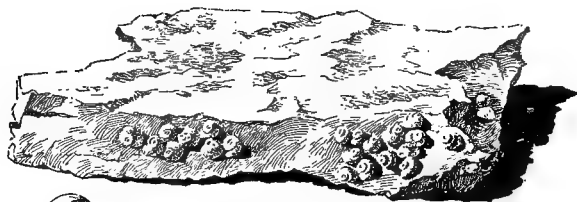
happened to be reached was seized with avidity, and the caddice-worm, house and all, hurried away among the stems and leaves.

Evidently the "cob-house" style of architecture did not originate with our family, though one of our childhood joys was the manufacture of high

turrets of fresh clean corn-cobs. Caddice-worms must have used this style of building long before we learned it. Instead of cobs these creatures use short bits of grass stems, pieces of dead leaves or small sticks. The case is usually larger at the head end than at the tail end, increasing in both length and breadth as the occupant grows.

The caddice-worm is not easily lured from his home. It takes a quick, emphatic poke from the rear to dislodge him, and no wonder, for near the tail end of the body are two strong forward-turning hooks which he fastens securely into the inner lining of his case. Right manfully will he hold fast when an attempt is made to pull him from his house.

Not all the "Householders" make their cases of stems laid in cob-house fashion. Some tie sticks together lengthwise while others pick up whatever



CASES OF SAND, SHAPED LIKE SNAIL SHELLS

seems to be handy, including the empty shells of water mollusks and snails, small stones, glumes of grasses, twigs and sand. Some select only bright colored bits of quartz, making a most ornate mosaic dwelling, while a few have been known to go so far as to pick up a live snail, shell and all, and after

attaching it securely, to carry shell and owner wherever they go, without so much as saying "by your leave." Among the most curious of these is the species which constructs cases of sand in close imitation of snail shells. These are often attached in colonies to stones in streams. Why they should thus infringe on the snail's patent is a mystery.

The houses of the nomadic caddice-worms are well ventilated, which is more than may be said of their human namesakes. A front doorway and a back doorway, with no doors to open and shut,—a thoroughly simple and entirely effective system. Sometimes there will be a screen of silk over the small back doorway, but it is usually wide open while the owner is active. The healthy caddice-worm simply revels in a constant stream of cold water; a draught never gives him a cold.

The builder of the caddice case, whether it be of stone, wood or sand, is also a spinner of a sort of silk fiber useful oftentimes in holding the building materials together and in making the inside of the house comfortable. The caddice-worms are fond of silk linings. Since they have no furniture they upholster the whole house inside, sparing no pains to make it smooth and soft and suitable for their uses. If deprived of its case the caddice-worm makes a new one. It will even do this in the aquarium for some people—but not for me.

VII

"FLAT BUT NOT UNINTERESTING"

STONY BROOK tumbles along, over and between rounded boulders through part of its course, but just below one of its principal waterfalls the character of the bottom changes. The stones flatten out and lie upon one another more as if they had come to stay, and had no notion of being rolled along by the current. Over these flat stones the water ripples with a most delightfully gentle voice; one loves to go there and think thoughts.

Flat though the floor of the stream may be, it abounds in interesting living things. Sometimes when thoughts worth the thinking refuse to come, I poke about among the loose flat stones at the edge of the water. By examining closely the under side of each, I am able to discover from one to a dozen small squirming objects so near the color of the wet stone that they seem mere moving bubbles on its surface. They hurry to get to the other side of the stone as if to avoid my too inquisitive gaze. If I do not turn the stone quickly they will disappear, and I shall pick up another hoping to find larger ones. Once while thus engaged I was accosted by a boy carrying a fishing rod.

"Ketchin' bait?" he inquired, knowing by some occult means that I was of his ilk.

"No," I replied. Then to lead him on I showed

the jar into which I had put three big stone-fly nymphs.

"Are these good for bait?" I said.

"Ay-uh, fer trout, but it takes all a fellah's time to ketch enough, an' he don't have no time to feesh. What *you* goin' t' do with 'em?"

"Oh, I don't know; watch 'em to see what they do," I said.

"I never see 'em do nothin'," he said, discouragingly, as he left me to what seemed to him a footless task. I saw that I was losing favor in his eyes from the moment he found I was not "ketchin' bait." If he had not been in such a hurry I should have told him the stone-fly's story. I believe he would have admitted that the creature had some claim to attention, though too wary for his purpose.

The story of the stone-fly is very like that of the dragon-fly, the May-fly and other insects which live in the water most of the year and fly for a few weeks only. Left while in the egg by its winged mother, the stone-fly nymph waits a few days, then calmly emerges from the eggshell and crawls about. Pressing its flat little body close to the under side of a stone to escape notice, it waits for some creature smaller than itself to come that way. If it succeeds in catching its prey, life begins in earnest for the young stone-fly. It may seem unfortunate from the stone-fly's point of view that brook trout should choose to live in the cool waters of Stony Brook. Many nymphs make glad the stomachs of many hungry trout during the sum-

mer. Shall we all admit that this is a wise provision of nature? If it were otherwise there might be more stone-flies, but fewer trout suppers.

When it becomes necessary for a stone-fly nymph to move, it uses its six long legs and makes very good headway. When at rest it clings, with legs outspread, to the surface of the stone, holding tight with its claws. Just back of each leg is a bunch of soft short hair, gray in color. These tufts are the tracheal gills, by means of which the creature obtains its air supply. The water flowing constantly over the gills keeps them in contact with fresh air. In another chapter the action of the tracheal gills of aquatic insects is discussed at some length.

Happy the young stone-fly which, having escaped the mouths of hungry trout and other enemies, fulfils its destiny. Many of them live to maturity if we may judge by the number of cast skins found on the banks of our swiftly flowing streams in June.

May their tribe increase!

VIII

THE ALDER FRINGE

WHO has not heard some gentle and harmless poet singing of a brook fringed with alders? Not such a bad thing in its way either, especially when in autumn the bending limbs are twined with red-berried bittersweet. The entomologist has a tale to tell of another kind of alder fringe. He tells it in the sober prose his profession demands. In the first instance the alder is itself the fringe along the brook's border. In the latter case the fringe is of another sort. The alder stems are hung with strands of filmy white silk.

In early summer, when the brook has become a mere thread trickling along under the heavy green of its border plants, the stems of alder begin to whiten. One need not wonder long, for a single look discovers the cause. The canes are covered with "woolly aphids," so called from the white downy threads which exude from and cover their bodies. At first sight one turns away in disgust from the pulpy gray creatures which looked so white and silky at a little distance. But wait—let the entomologist continue his tale and disclose to you the really marvelous inter-relation between this downy insect and its neighbors. But for its presence on the alder stems there would be less sweetness set free in the world and

one species of butterfly might perish from the earth.

The Wanderer butterfly has long been known to be fond of brookside paths. In and out among the shadows it takes its zigzag flight; now resting for a moment on an alder stem, now lost in the dense foliage. This rover was ever a puzzle to other brook lovers. It was odd, too, that these creatures should have preferences. Are the waters of the Little Indian sweeter than those of yonder willow-haunted stream? I may follow the banks of my own meadow brook through its whole course without meeting one Wanderer. Half a mile away is an insignificant rill, dried up at midsummer, but the butterflies are always dodging in and out among the alders and wild-cherry sprouts which mark the border.

May I not call this a rather invidious distinction?

With unprejudiced though spectacled eyes the entomologist looks at this question. If the Wanderer prefers alder-fringed brooks there must be a reason for its preference. The answer to the question lurks deep under the mass of down on the alder stem. The Wanderer, really no mere adventuress but an anxious mother, has left her eggs among the clinging aphids. All is explained



WANDERER BUTTERFLIES

and forgiven. We cannot blame her since it is instinct that leads her to neglect our pet brooks. A lusty young caterpillar, destined later to become a Wanderer butterfly, hatches from each egg. A score of these can produce great havoc in a colony of woolly aphids. Nature provides that not all shall be destroyed, and year after year the fringing alders are themselves decorated with this living fringe.

The alder-blight produces honey-dew, and thus supplies nourishment for other forms of life. Ants, bees and wasps take a share, and there is yet another pensioner. Down on the ground a lowly fungus had long been struggling with its neighbors for mere existence. At last it reached a point where the soil was wet with honey-dew as yet unused by the other plants. The fungus feasted, grew and throve, rearing its black spongy bulk above the surface of the ground. The alder-blight blessed it with clear showers of liquid sweetness day by day. Wanderers of a human kind may know this pensioner of the woolly aphid by its black spongy mass, and if they like may learn to call it *Scorias spongiosum*. If they wish to be very entomological they may call the alder-blight by its given name, *Schizoneura tessellata*. Whatever we call it, let us learn its history and take note of its useful life, though in time it may destroy a part of our pet alder fringe.

IX

SLOUGH CREEK AND MEADOW BROOK

THE only brooks I knew as a child were those which in times of high water filled the irregular channels between our reedy prairie ponds. In summer most of them disappeared altogether and the pond retreated to a central mudhole surrounded by tall grass and cat-tails. Arrow-leaved plants grew there in abundance. We children used to pull these up and make whistles out of the stems. I remember even yet the first taste I had of this plant. It was "pondy," and far from pleasant, but with the first reedy note drawn from the stalk all bitterness and rankness was forgotten. The great god Pan himself might have envied our satisfaction.

In spring the red-winged blackbirds owned the "swunch," as we called it, and built their nests among the reeds. Swinging on the highest cat-tail the brilliant male bird would "pour his melting ditty" to the gratification of all hearers. In winter the ponds and their connecting streams were skated upon. Weaving in and out, dodging hummocks of coarse grass, steering clear of air-holes, we skaters learned quickness of eye and an ability to turn short. One pond larger than the others, to which we smaller children were never allowed to go, had a large clear place in the center where

the water was reported to have a depth of five feet. Unfathomable it seemed to our inexperience. Out among the bulrushes and cat-tails which surrounded this center were mysterious mounds made of coarse, dry swamp grass and larger water plants and weighted down with pieces of water-soaked rails, fence boards and other rubbish. These were the homes of muskrats—"mushrats," the town boys called them, and planned raids upon their dwellings. Being a girl and therefore "afraid of rats," I was naturally debarred from a part in these sports. Nevertheless my sympathies were always with the muskrats, and in many a hot argument have I upheld their right to peaceful possession of that part of the pond which was of no use to the skaters.

When pastures were dry with the scorching August sun the slough was sought by heat-oppressed cattle. The bottom was said to be inhabited by myriads of bloodthirsty leeches. This was so firmly believed by the children of the neighborhood that only the boldest dared trust their precious bare legs in the cooling water. The girls used to long to wade in "Slough Creek," which ditch-like followed the line of least resistance across our pasture. The boys did it and told of their experiences with "bloodsuckers," thick, soft, slimy and black. Horrible thought! With fingers in ears we ran terrified from the neighborhood. Whenever my natural desire to wade came near overcoming my acquired habit of wearing stockings and shoes, the thought of those creatures held me back. I

used to try to imagine how it would feel to have a leech clinging to me, and know that it was *sucking my blood*. The boys said it was "awful," but they were proud of their large experience. I never quite dared to take the risk.

In later years the real meadow brook came into my ken. The first time I saw one was from a car window. We were speeding along a broad valley, hemmed in by low-browed hills broken here and there by other valleys, at right angles with the main body of lowland. To the right,—now near, now far,—flowed the river that gives the valley its name and fame. To the left, as we went eastward, the land was full of promise. It seemed one perpetual meadow, varied only by scattered trees and planted fields. All at once I became aware that a stream of water had been there all the time and that I had been but dimly conscious of its presence. It was the very *windingest* stream I ever saw. In and out, bending, almost doubling on its course at times, it followed us merrily, not loudly demanding our notice but always there to offer a smile and to reflect a bit of white cloud into our faces if one chanced to float over at the right moment. "What a treasure!" I exclaimed, and the meadow brook became a member of the family.

My own personal and private "Meadow Brook" belongs to another man. Yet he does not own it, though his broad acres form its banks. He knows that it supplies water to his herd of high born cattle. That is enough for him. The brook is

mine because I know its ways, its inhabitants and have a speaking acquaintance with the families of plants which dip their feet in its waters or dwell unmolested in the fence rows under which it creeps. What watercresses have I gathered there, what mint, what marsh marigolds more golden than the butter made by the high born cows!

The meadow itself yields me great joy, for a fear of cows was fortunately omitted when my budget of undesirable characteristics was allotted to me. In winter when the first light snow has covered the closely cropped grass, sentinel mulleins and teasels stand firm and stark. Well I know that at their feet are the young plants from which new flowering stalks will rise to replace the veterans when the season of growing things returns. Have I not felt the soft flannel of the young mullein leaf and admired, without handling, the prickly rosettes of the teasel? Some of the mulleins are like great index fingers pointing heavenward with short thumbs on one side; others are like branched candlesticks.

"Have you noticed that mullein stalks stand always in rows?" inquired the budding scientist. "Strange fact, isn't it, as regularly as if they had been planted out so—in rows, two in a row!"

One certainly does get that impression in looking across a field punctuated with scattered mullein stalks, especially in winter, when they stand out black against the snow. Fix the eye on one near at hand and a second lines up with the first, "two in a row." A meadow in winter would be a dreary



A MEADOW BROOK

looking waste without these plants. They enliven the flat brown surface. Without them the meadow would be as dull as a page without question marks or exclamation points.

Meadow Brook is full of wonders. In its sluggish reaches polliwogs lurk in May. Yonder where the ground is low, the main stream makes a turn, leaving a considerable body of water at rest. There under a willow tree the sedges and skunk-cabbage and false hellebore crowd each other on the margin. Below the surface delicate water plants afford safe retreats for a million insects and shell-fish. In the air above dragon-flies "knitting to and fro in the sun" baffle the ambitious collector, or, intent on their own affairs, heed him not. There the tragedy and comedy of the world of "little people" is enacted with no regard for the onlookers. There, too, breed in innocence and fear the naughty mosquitoes which will later hunt out the most philosophical of us and make life a burden.

Flow on, Meadow Brook! I am not weary of your companionship. No matter what iniquitous deeds are done under cover of your glassy surface, let me sit by your side and hear your voice. Let me but absorb your cheerfulness and share in your placidity and I'll know how better to understand your world and mine.

X

THE PRIMULA

"HAVE you never been down under the bridge to see the Primula?" inquired the Doctor. "Why, is it possible? Can you go at five o'clock to-day?"

Of course we could and did. It was a warm afternoon for the middle of May. How grateful was the cool shade at the bottom of Fall Brook gorge, after descending the many steps which lead one down from the haunts of men to the home of ferns and saxifrage, away from the sound of many hammers to the soothing splash of flowing water.

After a rest at the end of the swinging bridge, we began our walk up the stream. It was half scramble and half run or slide. The banks were steep and moist, but their mossy sides were full of delightful surprises. Many were the distracting sights on this zigzag path, which zigzagged in at least three dimensions. The partridge berry set forth its red fruits in tempting array. Never had they seemed so large or so brilliant as now against their glossy green background. Would they not grow in that shady spot in the garden? Should one take them up now or make a special trip?

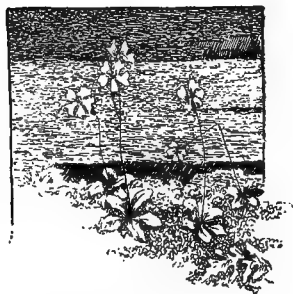
The interest in partridge berry is suddenly crowded out by a clump of snowy tiarella or false mitre-wort, now lit up by a sunbeam strayed in from the outer world just to give such shadowy flowers a

moment of perfect loveliness. As we go forward, and up and over a huge tree trunk, we lose the tiarella and see only the ferns delicately traced against the wet moss or clinging to a bit of soil on the very edge of an overhanging rocky bank. Down now to the brookside we go, leaving wet footprints on the flat stones from which the water has receded toward the center since the passing of the spring rains.

Single file we go forward, now over and now under the trunks of fallen trees. Suddenly, splash! scramble! swish! and the Doctor barely escapes a wetting by seizing a leafy branch. Laughing at his mishap, and bending to escape the rebound of the branch, I ignominiously repeat his manœuvres, with variations, and get a very wet foot. Sister Ellen following more sedately with her hands full of alder blossoms, gets through without accident.

A shout from the Doctor made me forget my discomfort in watching an object in mid stream. Rolling over and over, tossed lightly from one eddy to another, a big wet barrel came bounding and blundering along. What helpless appealing attitudes it took; how mercilessly the stream bore it on towards the rapids. We watched it go out of sight in a deep pool and then come up on the other side with one of its hoops broken. It now looked more as if it were entering into the spirit of the thing and we were tempted to move back and see it make the final dash over the dam below the swinging bridge. But remembering the Primula we pushed up stream. For years I had heard that a tiny primrose dwelt on

those rocks, far up on the side of the gorge, where the water dripped and few other plants could gain a foothold. A sort of romance clung about this wee plant, by reason of its retiring habit and from the fact that this particular spot, in our own Fall Brook gorge, was the southernmost "station" in the world of this little stranger from the Arctic zone. Added to these things was the tale of an enthusiastic collector who had almost lost her life in an attempt



THE ARCTIC PRIMROSE

to obtain a specimen for her herbarium. Each year the Primula generously scattered its seeds in such a manner that they fell to the bottom of the gorge and grew up the next year. These used to be sufficient to supply the annual crop of collectors. In later years the demand outgrew the supply and the Primula retreated farther and farther up the bank. At last the colony found itself unmolested and grew and multiplied.

By some strange fate it came about that the place selected for one end of the new iron bridge across the gorge was just above the home of the Primula. By a special providence, however, the workmen did not find it necessary to excavate so far down. Huge quantities of stones and earth were thrown from the top of the gorge to the stream bed, very wide at this point, making a great mound. Not a Primrose was injured, for the debris went far over their heads on its way to the ground.

Finally we came to a spot directly under the bridge and painfully climbed to the top of the mound. It was as if a stage had been erected from which to view the assembled Primulas. We clasped hands and gazed on the sight before us. It was a picture for an artist. A background of shelving rocks rose in huge rugged outlines before us. Far above hung a tapestry of deep green moss, sparkling with jewels of spring water. Clinging everywhere, on the bare flat edges of the stone wall were literally thousands of tiny plants each bearing its star-like flowers of rosy or paler pink. We looked and looked, trying to make the impression deep and lasting. It was an enchanting sight.

A few fine, dainty ferns and sedges were the only plants which bore the Primrose company in its seclusion, save where a single columbine, more daring than its fellows, burned on some jutting ledge.

"Good thing?" inquired the Doctor, as we turned our steps homeward.

"Good thing," we replied.

Words are poor things. We found little else to say. There are some feelings too deep for expression, some sights too sacred for description.

"Let us come to this place every year," said one of us, and the others gave silent consent.

In this world there are two classes of things to be done,—the important and the unimportant. In Primrose time we descend into Fall Brook gorge, and make our way to the beloved spot. Our pilgrimage is important; other things can wait.

XI

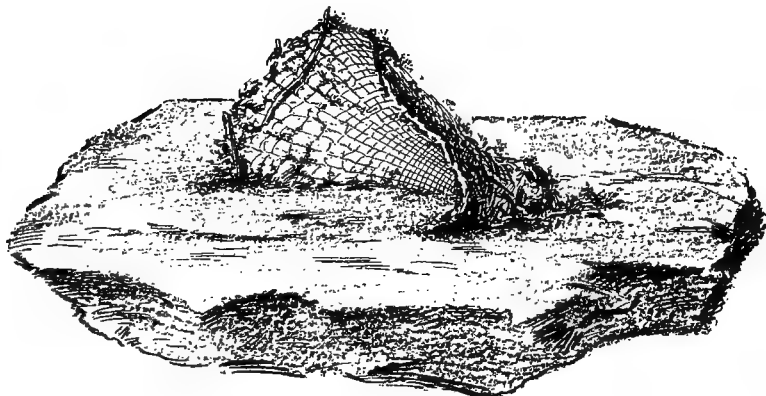
AN INSECT LAW - BREAKER

"IT is probable," said the Professor as we all crowded around him on the rugged bank of Fall Brook, "that those rocks over there are just covered with *Hydropsyche* nets."

We stared at the little cataract at which he pointed and could see only the hurrying water and the rather dirty rocks over which it flowed. We waited for the "Man with the Boots" to go out and show us just where to look. "The Man with the Boots" always seemed to know just what to look for and where to look. We learned afterward that this knowledge was not intuitive but came from taking frequent walks with the Professor on holidays and during vacation. We admired him the more and envied him his privileges. He was useful, too, and his rubber boots were kept wet most of the time on a trip like this.

We went nearer and could see that the dirt clinging to the stones in the current must be held there by something; mere dirt and rubbish would have been washed away. In the laboratory we had that very morning admired the trap of the net-building caddice-worm, called by his intimates "*Hydropsyche*." The nets we had seen were clean, funnel-shaped affairs of woven silk firmly attached to stones. At the small end of the funnel was a

marvelous little grating or screen made of strands of strong gray silk laid at right angles,—the very neatest and prettiest bit of weaving ever made by an insect. But this dirty-looking place in the waterfall suggested no such tidy worker. Some of us were disposed to prefer the museum specimen. Not so after we had actually discovered the little traps and gently freed them from the dirt about



"THE NETS WERE FUNNEL-SHAPED, WITH A MARVELOUS LITTLE GRATING AT ONE END" (TWICE NATURAL SIZE)

them. There they were just as the wily fisherman had set them. What if some May-fly nymph or other small creature should lose its hold up stream and be borne down to the falls? Might it not actually lodge in one of the very nets we had cleared out so painstakingly? Would the little fisherman, lurking in his shabby house under some stone, hurry forth and devour his prey before our very eyes? Vain hope! None came, and we could only search among the mass of tiny traps for one

which could be removed bodily without destroying it. Most of them were stretched between the edges of two stones, and could not be taken. "The Man with the Boots" found one, and the artist made a picture of it for me. The large end of the funnel was up stream, and held open by bent twigs. Being to all intents and purposes savages and cannibals, these creatures think nothing of fishing with their miniature seines regardless of the laws of the land. The survival of the fittest is the only law they recognize, and that holds good all the year round.

But we will not quarrel with them for this strange appetite. Indeed they should be looked upon as benefactors, inasmuch as they are said by an eminent authority to be the one dire enemy of the black fly larvæ, their neighbors in the swift streams. It seems that these larvæ which cling to the stones like patches of velvety moss, sometimes let go, and, since they cannot swim, are washed down stream by the current. Straight into the stretched nets of the caddice-worms the hapless larvæ are cast, and their adventures are soon over.

Hydropsyche alone of all the caddice-worms is carnivorous. His cousins with the immovable stone houses, and those insect householders which wander from place to place in the water—all these are vegetarians. They have little in common save their family tree. They all pass through the same four stages.

Strenuous life for a caddice-worm ends with the larval period of development. Hydropsyche re-

tires to his home, draws the draperies about him, attaching pebbles enough to protect himself, and passes into the resting or pupal stage. From this he emerges later a winged caddice-fly to lead a short life in the upper air. Many of the mothlike insects attracted into houses by the lights are adult caddice-flies. They are distinguished from true moths by their wings, which, when not in use, lie folded roof-wise over the body.

XII

CONCERNING DRAGONS AND DAMSELS

“Little Brook—sing a song
Of a leaf that sailed along
Down the golden-braided center of your current swift and strong,
And a dragon-fly that lit
On the tilting rim of it,
And rode away and wasn't scared a bit.”

JAMES WHITCOMB RILEY knew the ways of winged folk. How he would have laughed with us at the persistent efforts of some slender blue damsel-flies to perch upon the face of the fair-haired German youth who spends his summers with us by the lakeside. His swimming was at once our envy and delight, especially when he doubled himself up like some great fish and dived to escape the attentions of his winged tormentors. The flying spray would frighten them away for a moment, but whenever the swimmer's face appeared above the surface they were back again, their wings a-flutter, to perch upon his nose.

“And a dragon-fly that lit
On the tilting rim of it,”

we jeered in chorus; whereat he would dive again and after what seemed a dangerous interval would come up suddenly so near the timid bathers as to disturb their equilibrium.

But why should dragon-flies and their slender



"DOWN BY THE KILL"

nervous relatives, the damsel-flies, be so fond of floating leaves and other objects on the water's surface? Do they not run some risk of wetting those gauzy wings? They are built for a life in the air and sunshine, and it would seem the part of wisdom for them to keep to their "crofts and pastures."

"Where do you look for dragon-flies?" I asked some little children in eastern New York. "Down by the *kill*," they replied with one voice. "We saw them flying out in the middle of the lake," said another group. "Down by the mill pond," "Up by the brook!" There must be some good reason for the dragon-fly's universal devotion to the water.

I watched the creatures idly at the water's edge, until I became aware of their intentness. Then I, too, became intent, and watched them carefully. They alighted on floating leaves, sticks or chips, and stood still. Then I saw one move its body up and down, dipping the end into the water. Again and again it dipped, then flew and poised and dipped again. It was worth seeing.



"KNITTING TO AND FRO IN
THE SUN"

It is hard to catch a dragon-fly. Any one who has ever tried will agree with me; but I did it. I think it was the very one I had been watching. It made a great fuss in my net, but I knew better than to fear its "needle." Long ago I had learned how harmless this creature is. It might have saved its strength, for I had meant it no harm. It was the work of but a moment to discover on the tip of its long abdomen a cluster of pale yellow eggs. The creature had been washing these into the water a few at a time. Ah! here was the link that had long been missing from my chain of observations. I had seen the dragon-fly come from the water and escape from its nymph skin, but now I could understand how the young ones happened to be in the water in the first place. Their mother had left them in their snug little egg cradles, for the water to toss and rock until they were ready to hatch into little groveling water-babies. It is well that the eggs were left in the water, for young dragon-flies and damsel-flies are aquatic. In their native place they are fairly able to take good care of themselves and to make life a constant series of narrow escapes or sudden deaths to a myriad of smaller insects. Their favorite dish is mosquito larvæ *au naturel*, which fact greatly endears them to the hearts of the enlightened. But dragon-flies are not the only "birds of prey" inhabiting our waters. They, too, have their troubles, and fall easy victims to such larger creatures as are fond of dainty bits. This is nature's way of keeping down the number of dragon-flies. If all the young of all the dragon-

flies were to thrive and reach maturity, there would be little room on earth for any one else!

Dragon-fly nymphs taken from the shallow bays of some of our brooks, or from ponds, will thrive in aquaria. Their behavior is diverting, and a study of their anatomy discloses many marvels. Some of them depend on their long, spidery legs to take them about over the floor of the stream. Others are able to expand the posterior end of the alimentary canal so that it fills with water; when occasion demands, they contract the abdomen with force, throwing a jet of water backward and their bodies forward at the same time. They trust to cunning rather than to speed in capturing their prey. Some green ones hang motionless on a water plant, until they seem to passers-by but a part of the landscape. Suddenly they thrust out their sharp claws, and there may be one tadpole less in the water world. A favorite trick of certain others is to cover themselves with bits of rubbish. So completely are they disguised that even the most wary of their neighbors do not detect them. They are thus able to creep stealthily very near to their victims or capture them as they pass. The on-looker whose interest is bound up in the dragon-fly nymphs will find much instruction in the way they catch and handle their captives. A close examination of a specimen will reveal a vicious pair of claws with horny tips. These are at the end of a jointed appendage which serves a double purpose. When folded it is the lower lip, but when extended it becomes a formidable seizing organ. Woe be unto the

unsuspecting "wiggler" that feels the close embrace of these sharp claws!

The main occupation of a nymph is eating (or being eaten!), and growing. Its only protection from enemies is the suit of leathery armor covering its body. If this skin were elastic and accommodated itself to the increasing size of the occupant, no change would be necessary. But it is inelastic, and must be shed at intervals. This is a process all immature insects must undergo, some molting as many as twenty times. The dragon-fly contents itself with



CAST-OFF CLOTHES

fewer changes. After one or two molts there appear on the creature's back four small pads, or pockets. These are the first indications of the "grown up," winged existence, and I wonder if they are not regarded by the young dragon-fly with something of the same pride that a boy regards his first full set of pockets.

It is generally believed that it takes at least a year and in some cases longer, for dragon-flies to mature. There comes a time when the nymph must leave the water, and spend a few weeks in the air. The transformation takes place during warm weather, and may be observed at any time from May to September. Creeping from its watery home, impelled by some "inner impulse," the young dragon-fly climbs up a few feet from the water, and grasps firmly the stem or leaf of some water plant. Or, if necessary, it creeps painfully out on the bank and attaches itself to a stone or a piece of rubbish. While shedding the nymph skin and waiting for the wings to dry the creature is helpless. This is the most critical period in its life. Out of its natural element, and not yet free from the armor which binds its wings, it falls an easy victim to insect-loving birds and other enemies. This final molting process lasts two or three hours, or even longer. On the banks of streams, lakes or ponds one may find in great numbers the cast skins of dragon-flies. I once gathered a cigar-box full of them along a few rods of lake shore. They seem very life-like and one must look closely to see that they are empty. Along the back of

the thorax is a triangular opening through which the perfect dragon-fly emerged. The long threads which one finds attached at these openings are not the basting threads which held the old suit together, nor yet the threads with which the dreaded "darning

needle" sews up the ears of naughty little children. They are the linings of its large breathing tubes, left with the rest of its cast-off clothing when the creature quits the water.

Some people are wont to sentimentalize over these dry and hollow husks; but I always feel like congratulating the dragon-flies and damsel-flies I meet on their fortunate escape from such a narrow life. Better joyous hours, how-

"CLINGING TO SOME PLANT OVER THE WATER"

ever short, in the high, free air, than a groveling existence in the mud!



No description can possibly take the place of the actual experience of seeing the transformation of the dragon-fly. Those who have seen it once are eager to see it again, but they usually have very little to say about it. The marvel is too great for mere words, and they would not rob others of the delights of discovery by trying to give a minute description.

Dragon-flies have many common names, and strangely enough these are all well founded on the most reasonable sounding fictions. For example, in one section of the country they are called "snake-feeders," or "snake-doctors," because they are supposed to take pleasure in ministering to injured or diseased snakes. How plausible! Yet who has ever seen a dragon-fly take the slightest notice of any snake, sick or well? As children, we were taught to fear the dragon-fly with a deadly fear. When we saw one darting about in the sunlight we were wont to cover eyes or ears or lips for fear of being "sewed." (For some reason or other it always seemed to be my mouth which was threatened, according to the warnings of my teasing aunts and uncles.) The names "darning needle" or "devil's darning needle" (the last to be spoken under one's breath), were also common among us. Now that "I too, have become an Olympian," how hard it is not to pass along the superstitions to my little nieces and nephews, thus "getting even" with the past generation. Had we lived long ago when the world was being made we might well have feared the

dragon-flies. They were indeed giants in those days. Imagine meeting a dragon-fly three feet long out on some foraging trip! No doubt the mosquitoes of those times were large in proportion, which is added reason for preferring the twentieth century, bad as it may be. The name "dragon-fly" is generally in use now, and is one of the most descriptive of common names. To smaller insects both in the water and in the air this creature is a truly fearsome dragon. To the more graceful, delicate species of dragon-flies, the French have given the name "damsel-flies." Quick to see its appropriateness, our entomologists have adopted this name, and it has come into common use in this country.

Like its fiercer and more brilliant cousin, the damsel-fly lives the larger part of the year under water. The nymphs are very common in the more leisurely parts of our streams. They cling to the water plants and are difficult to see because of their slender form and green color. They differ from the nymphs of dragon-flies in having at the hinder end of the body three flat, oval appendages which look like little tail feathers. These are plate-like tracheal gills.

After we have watched the dragon-fly through the changing year, dragging the nymphs from their muddy haunts and watching the flight of the gauzy winged "darning needles," hawking their prey in the air, we shall know better how to understand why they hover so persistently over the water, never minding the danger to their fine coats

of mail. After we have found the cast-off nymphskins on the banks and watched the wonderful transformation from nymph to adult, we shall better appreciate Tennyson's beautiful lines:

"To-day I saw the dragon-fly
Come from the wells where he did lie;
An inner impulse rent the veil
Of his old husk; from head to tail
Came out clear plates of sapphire mail.
He dried his wings; like gauze they grew:
Thro' crofts and pastures wet with dew
A living flash of light he flew."

XIII

THE ANT-LION

SISTER ELLEN, the Professor and I sat in the shade after a warm morning's trip with the field class. Idly we watched a small ant hurrying along, now dragging, now pushing before her the dry wing of a grasshopper.

"Now how much nourishment does she expect to get from a scrap like that?" asked Sister Ellen.

"Oh, it may be something like a soup-bone, five cents a pound if you deliver it yourself," said the Professor, shifting from one elbow to the other, the better to view the ant.

"She has no time to gallivant, she has no tail to wag"—I quoted, but stopped my nonsense seeing the intent look on the Professor's face. Evidently there was something worth looking at, and my eye had learned to follow the direction taken by his, when the signs were right.

We were sitting under the bank which rose a sheer fifty feet above and even hung out over our heads, its projecting border of hemlock and pine standing out clear against the summer sky. The ground was dry and sandy where we sat, while Fall Brook chattered scarce ten feet away. Following the Professor's gaze, I realized that we had all but sat down upon a prosperous village. That shift from one elbow to another had brought the Pro-

fessor into their very midst. The sandy soil at the foot of the cliff was dimpled with tiny funnel-shaped pits such as a child might make with his little finger except that these pits were carefully hollowed out to a point at the bottom. We knew at once that here were the ant-lions in their native sand pile. No jungle for them nor nocturnal stalking of prey like the king of beasts. "Ant-trapper" would be a more descriptive name. These wary creatures lurk in their pits until chance brings some victim into their clutches.

I took a grass stem and carefully lowered it to the bottom of the pit. It was seized with no uncertain grasp. I jerked away suddenly. Surprised out of his caution, the creature forgot to let go of the grass until I had him out where we could look at him. Such a pair of jaws! They were long and curved like sickles, with wicked looking points. No doubt they were sharp, but I preferred not to let him try them on my finger, as suggested by the Professor. There are some things on which I am willing to let my eyes alone bear witness to my understanding.

When I offered the grass stem again to my lion he seized it, then let go and began to retreat, his hunched back adding to his awkwardness. No wonder he preferred not to stalk his prey, if this was his rate of speed! His body seemed a mere storehouse attached to the great jaws and head. I shoved him toward his pit, and in he tumbled head over heels. In an incredibly short space of time, his body was out of sight. All we could see

of him was the tips of his jaws, motionless and sand-colored. I looked down into each pit in turn and assured myself that all were occupied.

"Here comes that ant with her soup-bone!" cried Ellen.

"Now we'll see what happens if she undertakes to cross one of these pits without a bridge," said the Professor.

Nearer and nearer came the ant. Why had she come that way? She passed the first pit safely with her cumbersome load. On, on! What fatal instinct led her to the very edge of the pitfall occupied by our late acquaintance, who had not much more than settled himself in his old quarters? The grasshopper wing caught on a pebble, the ant ran round to get a better hold, lost her bearings, and rushed over the brink of the pit. The treacherous, shifting sand gave way under her weight, she lost her balance, slipped, regained her footing and made a rush for the solid ground, rattling a quantity of sand down upon the motionless jaws of the lurking ant-lion.

Suddenly a jet of sand shot out of the bottom of the pit. The aim was not perfect, but the scattering sand so bewildered the foolish ant that she lost the ground she had gained. She floundered, fell, and lost hold of her troublesome burden. The grasshopper wing fell lightly to the bottom of the pit and was seized by the jaws in a clutch that knows no loosening. Instead of taking advantage of this lucky turn of affairs, the ant continued to rush about on the sloping sides of the pit, rattling

more sand down upon the lion. We grew more and more excited, our sympathy with the ant rather ebbing as we saw how little she was mistress of the situation, despite her much talked of wisdom. In another minute the ant-lion would discover that his capture lacked that flavor of formic acid he so liked in his dinner and would throw the sand more fiercely than before. Sister Ellen would have rescued the ant, but I demanded fair play.

After many trials the ant succeeded in making good her escape from the pit of our acquaintance. But her experience availed her nothing. No sooner had she left the first, than she floundered into a neighboring pit, where she met her doom.

XIV

TEASEL HOLLOW

TEASEL HOLLOW lies in the farther corner of my meadow, just at the margin of the woods. The tiny brooklet comes slipping out of the shadows here and feels its way down the slope to the main stream.

The teasel demands attention and gets it, from bee and butterfly, from bobolink and red-winged blackbird, from wanderers human and bovine. In summer and winter it captivates me. The self-respecting cow, after testing it once, passes it with a disdainful switch of her tail; but I sit down near by, regardless of the hot sunshine, and watch the yellow-banded bumblebees roll in and out of its honey-laden flowers. Over yonder a bobolink sways back and forth, the stiff teasel, graceful for once in its life, keeping time to the melting music.

Even the teasel, a coarse, ungraceful, though hearty and vigorous plant, has its zenith, a time when life reaches its highest point and justifies itself. The teasel's glory comes with the bees and the bobolink, and the crown of purple which it wears. If you look curiously at the heads on a single plant you will see that they are not all alike. At the very top of the central stalk is the head which was the first to wear the purple. Its crown has become a mere tuft at the very top and just below the head a few straggling petals show like the wisps of

beard under an old man's chin. On some of the side branches the purple appears in a horizontal band around the middle of the head, while in others the center is brown and bare, with bands of purple above and below.

I watched a teasel head come into flower and learned the secret of these alternate bands of purple and brown. The head is made up of hundreds of flowers, each guarded by a bayonet-like point which makes the teasel so thistly. The flowers do not all mature at once. Those midway between the top and bottom of the head



"TEASEL AND MULLEIN, LIKE MARKS OF PUNCTUATION"

come out first, a narrow band of them perhaps a half-inch wide. These are discovered by honey-loving insects, rifled and pollinated at the same time. Their needs satisfied, the flowers shrivel and

leave only the sharp-pointed guards lined up to mark the place where for a few days they showed their delicate faces. Above and below two more bands of purple appear, not suddenly, but a few



"THE TEASEL WEARS A CROWN
OF PURPLE"

flowers at a time; they open, are visited, close, fade, and are followed by those below or above them. By this device the teasel seems to be surer of making its way in the world.

I am grateful to it for evolving such a charming habit, and for choosing my particular meadow as a basis for its operations. I shall "shoo" all the bees from my own garden off into Teasel Hollow, where they are needed. By so doing I shall "acquire merit." The teasel colony is as yet not thoroughly established and in danger of being

run out by my neighbor's unromantic timothy. Perchance this fall I shall gather some teasel seeds in this hollow and sow them discreetly in a certain brook-bed I know.

XV

MAY-FLIES IN FALL BROOK

WHAT can the Professor be looking at? He picks up every flat stone he can reach and holds it, dripping, close to his eye, peering at something through his lens.

The class in entomology were studying brook life, and this was our first field trip.

"Now, here," said the Professor, dropping to his knees at the water's edge, "we shall find May-fly nymphs on the stones." We had all seen the pictures, carefully made from nature, but somehow the tiny, flat, squirming creatures on the wet stones did not do the engravings justice. Presently a member of the class found a larger one which really began to resemble the picture. We all grew enthusiastic and would have turned the whole bottom of Fall Brook topsy-turvy in our search, but for the size of the stones.

May-flies are the most delicate and refined of insects. They are blessed with many common names. They have more crimes laid to their charge than they could bear were there not millions of them to share the blame. In July I have seen a building on the bank of the St. Lawrence fairly white with their cast-off nymph-skins in early morning. Later in the day I have heard credulous "summer girls" relate tales of poisonous stings or

bites (no great matter which) inflicted by these dreaded creatures!

The truth of the matter is that no May-fly ever stung or bit anything. Each one is possessed of two or more extremely long appendages on the hinder part of the body. These are useful to the owners, but not as weapons of defense. As for biting, nothing is more impossible.

This fragile creature is not framed by nature to survive for long the dangers of an aerial existence. Its trembling, gauzy wings, its ghost-like body, its timid behavior,—all suggest its brief sojourn among us. Its life is short, we know not how short. Let poets sing its praises, enjoy its iridescent wings and ephemeral existence. For once they are in the right of it. Since it lives but a day, "or two or three at most," nature has not deemed food essential, and provides the winged insect with but rudimentary mouth-parts.

But the May-fly has its time of feasting. It has an existence that the poet wots not of, extending over months and possibly years. The May-fly nymph eats, drinks and is exceeding merry with the laughing brook and the water bugs, just as if it had a premonition of its mouthless future.

The young of May-flies, like those of dragon-flies and others, dwell in the water, usually preferring rather rapid streams. They feed upon smaller animals and delicate plants, with which the water abounds, and cast their frail nymph-skins in very much the same fashion as the young dragon-flies. They do not closely resemble any

other kind of water insect, except the stone-fly nymphs. After a little careful observation one learns to distinguish the two. The young May-fly gets about by the aid of six stout legs, which may, on occasion, be used oar-fashion. Behind the legs are pairs of fringed gills, through whose walls the air is mixed with its pale blood. Still further back, at the very end of the body, are two or three long appendages, thread-like or feathery. These appendages are the only feature in which the young resemble their winged parents, or give any suggestion of what they shall be. No indication of wings appears on the creature until after several molts have taken place.

It is a general rule that insects never change their skins after reaching the adult form. They cease to grow after attaining wings and molting is no longer necessary. In the May-fly we have an exception to this rule. When it leaves the water and sheds the skin it wore as a true nymph, it leaves behind its gills and hungry jaws. It is able to fly rather awkwardly and joins thousands of its brothers and sisters and cousins in a search for some suitable place to undergo its final molt. Sometimes the sides of buildings and the trunks of trees on the banks of the streams are covered with the frail bodies, especially early on a summer morning.

The last molt is accomplished very quickly and the cast skins are extremely thin and delicate. The creatures which emerge are the gauzy May-flies which so richly deserve the poets' praises. They

reck nothing of praise or blame. They have but one duty, that of depositing eggs, and time is precious. One might suppose that instinct would lead them directly to the water from which they came and in which their young must be developed. We know to our sorrow how strongly they are attracted to lights and how many are thus destroyed. Enough do go to the water to insure a great army of May-flies for the coming year.

The ease with which this creature may be studied and the sentiment which attaches to its short life make it especially attractive to the lover of water brooks. The nymphs do not thrive in still water and are, therefore, unsuitable for the ordinary aquarium, but every stream abounds with them, and who would not rather go to the brook than to the aquarium?

XVI

THE MAY-FLY'S MOLTING

"WHY, look, look! It's changing right here in my hand!" exclaimed my neighbor, Miss Barron.

We were sitting on the veranda of a hotel which stood but a stone's throw from the bank of the St. Lawrence. It was the second week in July, and the night before the air had been alive with dancing, whirling May-flies, and now everything was covered with the creatures,—the walks, the sides of the building, the very floor at our feet. We had been trying to catch one in the act of casting its skin in the final molt, as yet without success. But for this Miss Barron's words would have meant nothing.

As it was, we crowded around her and breathlessly watched the transformation. It was soon accomplished. A few moments of struggle, a weak straining of untried muscles, a final pull, and out walked a perfect May-fly. For a few minutes only it rested, the sun playing on its glistening wings. Strength came to the limp sinews, and with no farewell word to those who had watched it so anxiously, the creature took wing and faded into the distance. Behind, in the palm of my friend's hand, lay the cast-off garment,—a forlorn little heap,—still retaining some slight resemblance to the brilliant gauzy May-fly, but useless now. I

had often watched the latter part of this transformation, while waiting for the early morning boat at the riverside station, and had formed the notion that between five and six o'clock in the morning was the chosen time for molting. But it was now two o'clock in the afternoon.

The principal features of the May-fly's early life have been told in a previous chapter. The insect never gets far from its native stream, even after it reaches the winged stage. It differs from most other insects in having a short period of existence in which it is neither aquatic nymph nor aerial adult. While in this "sub-imago stage," as it is called, the insect resembles very closely the adult form. It is full size and has fully developed wings and legs. After once witnessing the transformation there on the hotel veranda, it was not difficult for us to distinguish between those which had passed the final molt and those which had not. The adults were more lively, and their wings were thinner and more brightly iridescent. The whole appearance of the sub-imago is dull and its behavior awkward and stupid. The anal filaments are short and stout. The colors are dim, literally as if seen through a thin veil. When the final molt has taken place the creature emerges full of spirit. The movements are quick and the colors clear and even brilliant. The legs are slender, almost useless, the anal filaments taper delicately and are twice and sometimes thrice their previous length. They are often prettily marked with light and dark on alternate segments. After shedding

their pale, colorless covering the wings shine and glisten, giving out those rainbow colors seen on the surface of a soap-bubble.

After Miss Barron's good luck all of us were eager to duplicate her experience. I wandered from post to post of the broad veranda, seeking for a promising specimen. I should never be satisfied until I had seen the whole transformation. I could not hope to feel that "inner impulse break the spell of its old husk," but I wanted at least to see the first break and to watch every movement until the husk alone remained in my hand while the free, winged May-fly flitted afar "o'er crofts and pastures."

I finally selected one whose dull color and short, stout anal filaments suggested its immaturity, and gave it a comfortable seat on my hand. There it sat and did nothing till my eyes ached with watching. "Don't wait for it," they all said. But I would not be persuaded to give it up nor exchange my specimen for any others, though the floor was fairly covered with promising-looking specimens. Some were just dragging their filaments out of the old skin, others had emerged and stood sunning themselves beside their cast-off clothes. Still my specimen "lay low," and "kep' a-doin' nothin'." I was losing patience. My companions called me to join in a boat-ride.

"Fetch the bug along if you won't leave him," one cried.

Acting on the suggestion, I soon found myself seated in the stern of a St. Lawrence river skiff,

rowed by the very friend whose May-fly had behaved so well an hour before. As we danced along over the waves I kept one eye on the blue water and one on the still slothful insect.

Then the change came. The wings trembled against my hand. The whole body shook as with an ague. The few segments of the abdomen rose and fell, stretching the thin coat that covered them so that it had to burst somewhere. It split right in the middle of the back between the wings. Wider and wider this opening grew, the action of the muscles seeming to crowd the thorax up through the break. The wings had been spread out longitudinally up to this time, perhaps acting with the legs as braces. When the body was fairly free, the wings suddenly folded back against the sides fan-wise and were slowly drawn out of their cases. The trembling and straining had evidently loosened the whole covering, and it was a mere matter of pulling to get out of it. If the skin itself had not held together I don't know what would have happened.

In the meantime the head of the May-fly had been lowered, and so far as I could see no covering had come off of it. Neither could I discover that the forward part of the thorax shed any skin. After the wings are out, the head slowly rises and the stretching and pulling begins to get the six legs out. If the claws have a firm anchor this is comparatively easy. The claws of the skin are shed with it. Imagine yourself attaching the ends of your glove fingers to something and drawing

your hand out of the glove, and you will have some idea of the way the May-fly pulls its six slender legs out of their tight-fitting "stockings." Pulling and straining this way and that, dreading no doubt that its hold on my hand might give way, at last my May-fly had freed its legs. The weary creature was well-nigh exhausted. It feebly tried to make use of the new legs. They seemed to bend in the wrong places and to give no support. The wings were of no special use yet, as they were not thoroughly stiff or dry. The May-fly was much improved by its change of raiment, though at first it acted rather indifferent. By the time the legs were able to take a firm grip on my finger the creature was becoming bolder. Its main effort was expended in getting the long anal filaments out of their old skins. I longed to help but knew that accident might result if I interfered. This last act of molting seems a rather difficult one. Many break their filaments off short, one or both of them; others fly away with the whole cast skin clinging to the threads. They must be very much in the way, dragging behind in such a fashion. One might imagine that in May-flydom it would be considered a disgrace to carry such a bundle of rags about. It must be inconvenient in flying as well as a cause of ridicule amongst one's neighbors.

My May-fly found it difficult to get a firm foothold on my hand, so I transferred it to the boat seat. In a few minutes it pulled free, its handsome banded filaments stretched to their full length.

As if preening itself, it bent the body gracefully and thrust the filaments high in air, suggesting the attitude of a very proud and strutting Bantam rooster. We laughed at what seemed to us a rather premature assumption of importance. When we looked again it was gone. Away it rode on the freshening breeze to join others of its kind.

What became of it? Did it return that night to whirl with myriads of its fellows in the mad dance before the lights in the hotel veranda?

XVII

THE JEWEL-WEED'S LITTLE GAME

BOTANIZING in the flats, through which the lower reaches of Fall Brook and its companion streams take their sluggish way, is no joke, especially in midsummer when one must make a road through forests of jewel-weed. This plant literally possesses acres of ground in that region and grows to an astonishing height for an annual. Towering often above our heads, its stems set as close as the branching tops will allow, it offers a firm resistance to the would-be explorer of damp places. When swarmed over by the matted strands of yellow dodder, it becomes almost impenetrable and none but the most insistent cares to force an entrance.

At first I disliked the jewel-weed. Somehow I felt a sort of personal grudge against it. It was so juicy, so rank, so unnecessarily lusty, and crowded everybody else so. Why did it persistently choke out other plants just as worthy, in an evident intention to inherit the whole earth? What was the secret of its success?

I examined the flower and was somewhat mollified by its daintiness. Jewel-weed it had always been to me, and here were its jewels, swinging on their elastic stems, for all the world like the old-fashioned "ear-bobs" Aunt Betsy used to put in

her ears now and then just because we begged her to. But it was not until I left the flats and climbed the hill that I became thoroughly reconciled to the jewel-weed and learned the little game it was quietly playing while other plants seemed content to sit still in their places and be choked out by whatever ambitious vegetable happened to come along.



LIKE "EAR-BOBS"

In August and September I explored many runs, brooks gone dry for the season and "improved rills." All these were rapidly being occupied by meadow

plants driven thither by the plow and the fire-brand. I saw goldenrod peering over the brink of a little gorge and sending out scouts to get a footing far below on the thinly covered rocks. Aster was at the same game. Such "beggars' ticks" and pitchforks, two-tined, as could be gathered at the bottom if one cared to venture down! But jewel-weed outdid them all in numbers and in vigor. Climbing from the lower land up the narrow ravines, year by year it staked out

new claims and hold them by right of settlement,—a sort of "squatter sovereignty."

Who does not know the surprise that lurks in the pod of touch-me-not? When the seeds are ripe, the game of pitch and toss begins. Imagine a clump of plants situated at the very mouth of a tiny glen. They had been sent thither as seeds,—a sort of reconnoitering party,—by their parent weed last fall. In spring they took hold on what soil they found and in a few months' time matured seeds of their own. Up the glen is a bit of moist earth occupied last year by a bluebell. Is there room for two? Who knows? Pop! two seeds are shot into the air at random. One falls into the tiny stream and is lost. The other drops with a light bounce among the bluebell's leaves, and edges down out of sight. Planted for life, come good or ill luck! If the bluebell continues to drop all her children over the ledge to find new homes, she may never see her family spring up around her



THE "LITTLE GAME"

feet. And she herself may be jostled and even pushed off the earth by hustling young touch-me-not on the ledge beside her.

Pop! pop! pop! A bombardment has evidently begun, and missiles are flying into the enemies' country. The jewel-weed does not stop to take aim. The other plants in the shady, moist bed of



THE POP-GUN

the stream do not return the fire. They have their own little games to play. The struggle will come in the spring between the young plants when the supply of food is to be divided. The jewel-weed has begun to climb up the bed of the ravine.

Give it time, and it will reach the upper source. The plants farther up the stream throw seeds in every direction; up, up they go, adding new territory every year.

The jewel-weed's pop-gun is worth close examination. The pod is a sort of five-shooter, but is not always fully loaded. The outside cover of the pod is so constructed that a slight pinch will cause it suddenly to split into five flat strips each of which coils spirally with startling suddenness. On examining what remains after the seeds have sped away, one finds the central axis against which the seeds rested. Attached to its apex, the point furthest from the stem which bore it, are the five tightly coiled spirals whose prompt action results in the scattering of the seed. Left to itself the pod does not wait to be pinched. When the time comes it goes off automatically.

No rightly constituted prowler in brooks and rills can resist lingering among the jewel-weeds, admiring the flowers and the cunning seed-pods. Some of the pods may still be found even after the frost has stripped off all the leaves and the browning stems lie prone upon the forest floor.

I am watching a certain tiny ravine which descends at a sharp angle from the main road to the bed of Fall Brook. In early winter it sadly needs the white mantle of snow which later covers its disreputable sides. Remnants of scrap tin, broken china, tomato cans, brickbats and other evidences of civilization make this place hideous. Slowly but surely the jewel-weed is making its way up the hill. The moist rich earth is there, and the dense shade which the plant requires. This year I see that the colony has come up several feet higher, and one plant has climbed nearly to the top. Last spring the ground down there was a perfect carpet of living, shining green. Seedling jewel-weeds they were, hiding the ugliness of the littered bank. The seedling itself is a pretty tender green thing. The number of them gives undeniable evidence of the skill and persistency with which last year's plants played their little game.



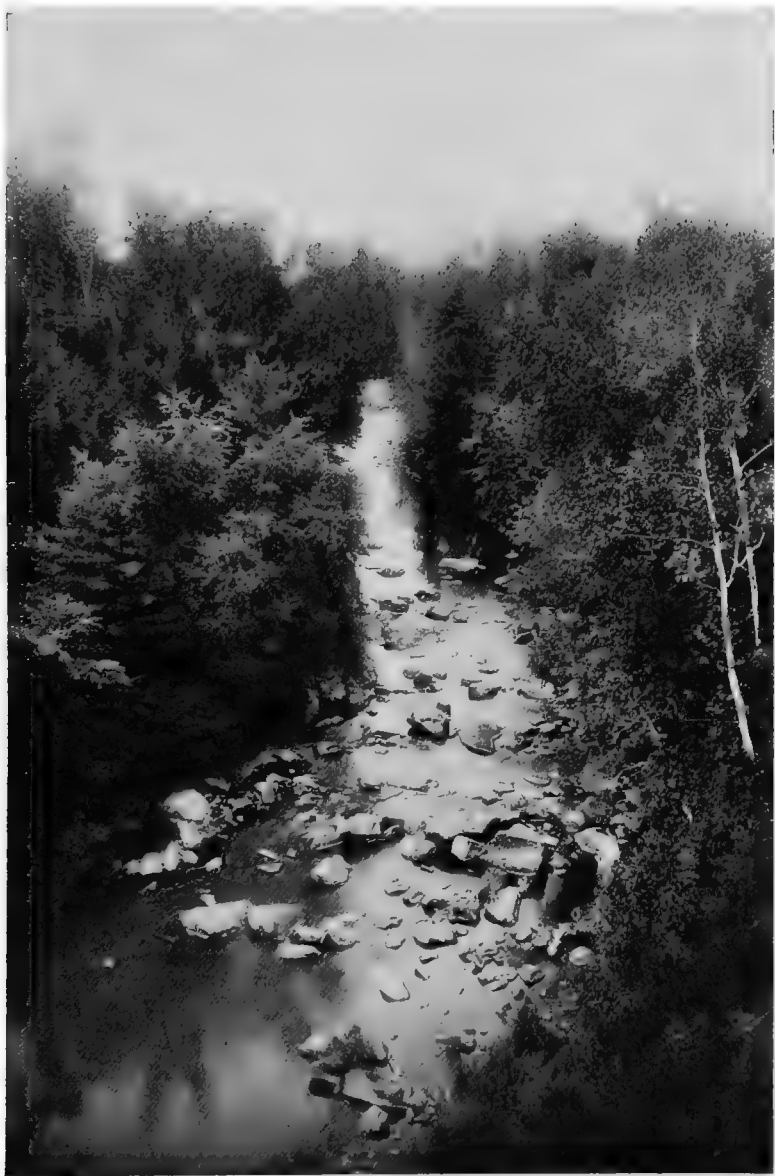
SEEDLING JEWEL-WEEDS

XVIII

WEB-SPINNER AT WORK

IT was June before we became fully aware of the activity of spider-life all about us. Four times a day we had crossed the bridge over our stream, all unconscious of the tiny engineers working so silently with their ropes of gossamer. Then we awoke and watched them. We had read in a book of the web-building of the orb-weaver and had weakly taken all its statements for granted. We had even analyzed the web after the manner suggested, and had no difficulty at all in discriminating between the guy-lines, the radii and the spiral. It was a revelation, I'll admit, to learn that the circular threads, laid on the spokes with what appeared to be geometrical nicety, were not made up of concentric circles. Artists make them so; why not spiders? Though incredulous when told that this was a spiral line, we found that it was possible to trace the thread round and round from the center in ever widening curves. Later when we actually saw the orb-weaver build her web, it was easy to see how much more economical of time and effort was the spider's way.

"The orb-weaver uses two kinds of silk in constructing her web. The guy-lines and the radii are of strong, dry and inelastic thread, while the spiral line is viscid and elastic." So said the



STEPPING STONES

book, and we replied, "show us this thing and we will believe." There on the bridge railing, on the rocks projecting over the water and among the branches of the brookside trees, were thousands of webs like silvery curtains. We tested them, and lo! it was true. The guy-lines which stretch from one support to another resisted when touched gently with a lead-pencil. The radii behaved in just the same fashion. They neither stretched nor stuck fast. The spiral line did both. We could hardly get the pencil free; the line followed, stretched to nearly twice its original length. By twisting the pencil we freed it, and the thread sprung back uninjured to its normal position between two radii.

Here was a fact, or a series of facts, which challenged us. Some thinking must be done, and we half thought, half dreamed the matter out there in the shade. One must begin at the beginning; why does the spider make a web? To catch flies, of course, and other insects. From this point it was easy to reason that the spider would get a larger dinner with a sticky web than with a dry one. But why not make all the threads sticky? We had to go back to the spider for that, and found, by experimenting and watching, that it was most important from the spider's point of view that the radii should be dry and inelastic. The web was undoubtedly stronger and more stable for having a framework of inelastic threads tightly stretched from one support to another. Now the wily spider waiting for her prey cannot

watch all sides of the web at once, even though she have eight eyes. She must trust to vibration of the threads to tell her where to run when the sticky threads have caught some winged thing. Then, too, when haste is necessary the spider must take the shortest safe route to the spot, else her prey may escape. Not even the owner of the web dare step upon the sticky threads. She must step over them. They are not discriminating, and stick to anything or anybody. To be sure, the spider knows well how to cut the threads and free herself, but the delay might lose her a dinner, besides making a bad tear in the web. So stepping high, she reaches the nearest radius and running along this and others reaches the scene of the capture and makes the quarry fast. During this interval the sticky thread which first laid hold of the flying creature has done its work well. Besides holding fast to the hairy body, it has yielded to the struggles of the captive just far enough to allow it to become hopelessly entangled in neighboring sticky threads.

After seeing all these things actually happen, we know the philosophy of the two kinds of threads, but the wonder of it is still with us. We are never weary of testing the webs to see if the spirals are still sticky and elastic, the radii still dry and rigid. And they always are.

HOW THE ORB-WEB IS SPUN

During the hot weeks of summer the bridge with the iron railing became an amphitheater. The

audiences were small though select. The doors were always open and the admission fee was trifling. The performers were tiny, but made up in numbers what they lacked in size. The performance began about six o'clock in the evening, sun time, and ended before the lamps were lit. The acrobats, for they were something of this nature, all did the same turn; but strangely enough the audience did not seem to tire of it. Perhaps since the show was cheap, they thought it mean to complain, but I have seen the same crowd there night after night, seeking out the best seats and viewing the performance with every evidence of satisfaction and even enthusiasm.

Somehow I had acquired the idea that those few favored ones who had seen spiders spin their webs had stayed up all night to see it. Therefore I took it for granted that the sight was not for me, and was calmly resigned. But one summer the word went round that it would be to our advantage to visit the bridge at 6 P. M. of a sunny day to see what we should see. We went, and returned to the place day after day to see the same performance. We abandoned all other pursuits, even preferring cold victuals after the show was over to a regular dinner.

The performers seemed to begin by standing absolutely still and eyeing the landscape. Sometimes this lasted so long that we moved to the next compartment in the iron railing and watched another spider. The first thing to be done is to stretch a guy-line between two points on the sup-

ports which are to bear the web. Some spiders are said to accomplish this by spinning a thread at random, trusting to Providence that it will catch in some convenient place. While this seems a rather unscientific method, I have no doubt that it serves quite as well as any other, since the spider seems to be entirely capable of making use of the thread no matter where it catches. When once a guy-line is established, all random work seems to end.

The silk issues from the silk-glands in the spider's body, through minute tubes on the spinnerets. By looking closely at the under side of the large orb-weaver's abdomen, near the hindmost end I could see the spinnerets. The spinning tubes, which are very numerous, cannot be seen with the unaided eye. In liquid form when they issue from the body, the many delicate streams of silk unite into one cord and harden when in contact with the air. To attach the thread at any point, the spider touches the tip of its body to the spot. The silk, still semi-liquid, clings and hardens in place almost instantly.

From the first guy-line the weaver spins others, sometimes walking down the side of her support, sometimes dropping to some object below and crossing to the desired place. In the bridge railing, made of criss-cross bars of iron, the matter became extremely simple. Our spiders seemed to show excellent judgment in choosing this place for the scene of their activity.

The orb-weavers, even the tiny young ones,

work with great rapidity, and before one knows it the guy-lines are up and the radii are being spun. Attaching the end of a new thread at a point on one of the guy-lines the spider starts for the opposite side of the area chosen. She must not only keep her balance on the line, but must spin a new thread as she goes and keep it from becoming entangled with other threads. This is done by the hind pair of legs, while with the other six the creature is able to steady herself on her tight-rope.

Upon reaching the desired place opposite the starting point, the thread is pulled taut and fastened. The spider now rushes to the middle of the new line and establishes the hub of her universe by dropping down, spinning as she goes another radius. Running back up this line to the center, sometimes spinning a thread to strengthen the first, she drops again, and swings to a point near the attachment of the first radius, where now the second one is firmly secured. Working skilfully, steadily if uninterrupted, she soon has the radii in place and firmly tied at the center. This work at the center is done as the radii are being spun. Later the center is filled with fine cross lines upon which the builder is to lie in wait when all is finished, but the web is barely begun and the twilight is falling when the gentle gnat doth flit. The thrifty spider must hasten.

We had heard that at this stage in the web-building, when the guy-lines and radii were all spun, it is necessary for the creature to spin a

thread, which, though a spiral, is not the final sticky one. It is a sort of temporary line used by the builder, like the scaffolding about a house. This, too, we had taken on faith, never hoping to see it. But stop! What is she doing now? Stretching out her long legs, reaching awkwardly from one radius to another and moving rapidly round and round, the spider was nearing the outer part of her web. Behind her, as she stepped, she left a delicate line of silk, forming an uneven spiral which tied the radii together throughout the area which was to become the web proper. There it was before us, the temporary spiral thread illustrated in the books, but seen now for the first time and really believed in. How we wanted to test it to see if it were dry and inelastic like the rest of the web up to this time! But we dared not. It was too exciting a moment. It would not do to risk disturbing the weaver. We must see the completion of one web. Next time we did test the temporary spiral and found it dry and firm. The purpose for which it was spun would not have been served by a viscid thread.

When the first spiral is finished the spider finds herself on the outer rim of the web. It is there that the permanent spiral thread, the real snare, is begun. The first step is to fasten the thread to a radius. This done, the spider walks on the radius toward the center, till she comes to a section of the temporary spiral. Upon this she crosses to the adjacent radius, spinning out as little of the thread as possible and manipulating it deftly with

her hind legs. Walking on the adjacent radius with her head now toward the circumference, she reaches a spot opposite the starting point. With a skilful twist of the body, the spinnerets are brought in touch with this line and the thread fastened. Thus the first section of the spiral line is stretched in position. This is the beginning of the end. From now on the spider seems to fairly gallop over the web, always walking on the radii and the temporary spiral and gradually nearing the center.

The performance of laying the permanent spiral is varied by two little bits of by-play. After laying this line perhaps one-fourth the way round the outer rim, the spider turns and retraces her steps, laying a line parallel to the first and continuing now in the opposite direction from that taken in starting the spiral. No adequate explanation for this has occurred to me. The second bit of by-play, and to me one of the most interesting acts of this little life drama, is the cutting out of the temporary spiral line. As she passes over a section of this line for the last time in her progress toward the center, the spider seems to realize that there is no further use for it. Whereupon she reaches back, and snip! There is nothing left of what was once a most valuable path but two delicate ends waving in the air for a moment but finally curling up against the radius or disappearing altogether. Well might the orb-weaver survey her finished work with satisfaction. In its way it is perfect.

HOW THE WEB IS USED

Down at the very edge of Fall Brook, where the shelving rocks are covered with thick moss and lichens, I found hundreds of orb-webs. It was evident from the perfect condition of the snares at four o'clock in the afternoon that little had been caught since these webs were spun. Noting this, I was moved with compassion, and cast about for some insect suitable for the spider's needs and easy to catch. At first nothing was to be seen. Then the rugged wall told me a secret. Hanging there by its toe-nails was a brown, mosquito-like crane-fly, in plain sight now that my eyes had learned to distinguish it from the stone to which it clung. There were others, in fact the place was fairly alive with them, and they hung motionless. Flying at random would have been dangerous among so many spider-webs, so they wisely kept quiet, scarcely trying to escape when I essayed to capture one.

The first fly which caught its long leg in a sticky thread of the web I had selected to study was quite near the center. The spider arrived from the hub in an incredibly short space of time. Without delay she began to enwrap her prey with fine strands of freshly spun silk. First attaching a thread to the fly, the spider began turning the body of her victim over and over, using the legs as we would use our arms in winding a line on a reel. More thread was constantly being supplied from the spinnerets until the fly was

completely enwrapped and unable to make the slightest resistance. With every evidence of great hunger the spider seized the front part of the fly with her jaws and sucked away with avidity.

Before the meal was finished another fly became entangled in the web. Hastening away from her banquet the spider wound this newcomer swiftly, but none the less securely with silk. Then she rushed back to the first, only to be called away again and again, until six flies were secured and tightly swathed.

The next fly was but half caught by a sticky thread, and when the spider, interrupted in her long-deferred meal for the seventh time, arrived at the scene, she found her prey about to escape. Just as the fly freed itself from the dreaded sticky thread, it found itself seized by one long leg and threatened with instant death. With a mighty effort of its wings it bore away and finally escaped, without looking behind,—minus one leg. The spider had commanded my entire attention. She had given herself up wholly to the chase. As the fly wrenched its foot free from the web, the spider made a flying leap after her prey, succeeded in seizing one of the fly's feet and would have made a capture but for the crane-fly's well-known "shiftlessness with its legs." The unsuccessful spider dropped straight down and I wondered what would become of her,—had even contemplated a rescue,—when I beheld her stop in mid-air, turn, and climb serenely back into her web! All this happened with such bewildering

rapidity that I was quite unable to adjust myself to the course of events. That spider had actually had the presence of mind to attach the end of her thread to the web before launching on what would have been otherwise a perilous voyage into space. Call it instinct if you like. I wish the human race possessed more of it. It always pays to take a rope in case of accident!

After this exciting adventure the spider quietly returned to her dinner. I expected to see her abandon the first capture for one of the five other victims waiting their turn in various parts of the web, but she took no notice of them. I have wondered ever since whether she built a new web the next day, according to the traditions of her family, and so wasted all that good provender. Or was she worldly-wise enough to mend the old one and make it do until her larder was empty?

XIX

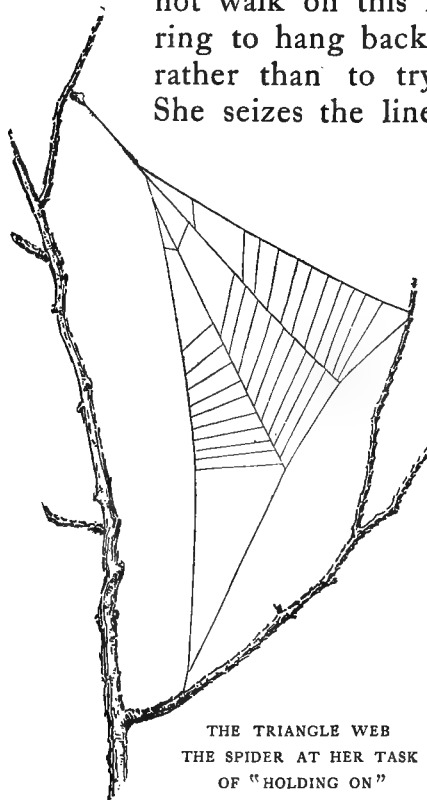
THE TRIANGLE SPIDER

TRIANGLE spiders are more retiring in disposition than many of the weavers of geometric webs. Though not confining themselves solely to any field of activity, they are most often found, by beginners at least, among the dead branches of our brook-side hemlocks. No rambler along watercourses can afford to miss this wily trapper. Where some venturesome hemlock has thrown an arm over the stream, there the triangle spider hangs her filmy web. Other spiders may weave their complicated domes and winding spirals, but the triangle maker holds the palm for simplicity of design.

The web looks like a section of an orb-web. It is always made up of four radii attached at intervals to a main vertical guy-line. Upon these radii are stretched the transverse threads which form the snare proper. From the apex where the four radii come together, a single line passes to a twig at a distance of several inches from the opposite support. Upon this single line, almost touching the hemlock twig to which the line is fastened, clings the busy builder of the web. The spider is small and very slender of body, with four pairs of strong, skilful legs. In color it closely resembles the bark of the hemlock, and when at

rest on its line the spider might easily be mistaken for one of the slight projections on the twig.

After the web is finished the triangle spider walks to the outer end of the main line. She does not walk on this line, but under it, preferring to hang back downwards on the thread rather than to try and walk a tight-rope. She seizes the line with her two hind pairs



THE TRIANGLE WEB
THE SPIDER AT HER TASK
OF "HOLDING ON"

of legs near the twig, her head toward the snare. Then, reaching far forward with the fore legs, she pulls the line in, hand over hand, until the whole snare stands taut and rigid. A loop of thread is thus made above the body of the dependent spider.

Here sits the trapper awaiting some hapless winged thing. I know not how long she may sit there without apparently changing her position so much as a hair's breadth or lessening the rigidity of the line. If I disturb the web lightly, simulating the struggles of a surprised and reluctant fly, snap! the main line is slackened and the whole web is relaxed and rapidly vibrated. If the spider comes down into her web and finds no fluttering

prisoner, she retreats to her post and resignedly stretches the line again, waiting a more truthful signal. When an insect suited to her needs actually becomes entangled in the trap of the triangle spider she snaps the slackened thread once, twice or three times. Again that bewildering vibration of the web! Is there any possible escape for the prisoner? Running down the line and out on the web to the place where the struggling insect clings, the spider soon has it enswathed in silk. Round and round she wraps it, spinning out silk enough, one would think, to weave many webs.

In each capture the whole of the triangle is usually destroyed except the top thread extending between the main support and the vertical guy-line. The spider retreats to this remaining thread, bearing the bundle, now past recognition, to a place of safety. One would think the main business after securing a dinner would be the eating of it, but this does not always begin at once with the triangle spider. She keeps on wrapping and rewrapping her prey long after there is any apparent reason for it, turning it over and over, walking under and over and around it. Experience has probably taught her that her prey is safer inside of many tight silken bandages than tied loosely in a few fine threads.

"There's a dead hemlock down by the Fall Brook road that's just full of triangle spider webs!" So I announced to the Professor one day in midsummer.

I had found isolated webs before, along the roadside or among the low shrubs bordering a woods' path, and no dead hemlock branch seemed complete without at least one web; but here was a veritable village of them. They were strung in every direction and some of the spiders had evidently feasted, as remnants of gnats hung in their broken webs. No matter what the condition of the web, whether fresh and perfect or reduced to a single thread fringed with ends of the cross lines, the patient spider sat near the twig holding the taut line as if life depended upon it.

Choosing an individual whose position was such that I could see her and sit comfortably at the same time, I determined to watch for developments. The creature remained absolutely motionless for half an hour. My eyes wandered and found a second spider holding on strenuously to a thread stretched between two neighboring twigs. Seeing them sit thus in idleness and sloth exasperated me. Neither had more than a single thread, which constituted no snare whatever. My patience began to ooze. Had I not selected these two and honored them with my attention? Should they then be suffered to sit idly, refusing to perform? I had abstained from disturbing them by any pokings or shakings and felt hurt at their inattention.

Determined that something should take place, I transferred my observations to the second spider. With my pencil I released her taut line from its support and let it dangle. For a moment she

seemed concerned, but as the thread caught on a near-by twig she seized it and stretched it tight. This accomplished, she again settled down to her task of holding on. But I was not through with her. Work she must. I made bold to take away the whole thread, even going so far as to poke her small body with my pencil. She now retreated up the twig, spinning as she went. As she toiled upward only six of her eight legs could have been used in walking. The other two were otherwise engaged. As she stepped along she pulled from her spinning tubes the fine silken thread. She drew it out "by hand," as it were, using now the right, now the left hind foot for the purpose. When she reached a point four or five inches from her starting place she pulled out a loop of thread, then quickly touched the end of her body to the twig. The silk stuck fast. She turned round and went back over the thread, spinning a second in the same fashion, and attaching it at the point of first departure. Having made the double line to her liking, she turned her tail to the attached end, seized the line as far forward as she could reach, pulled it tight and settled herself at the same old game of holding on. Over and over she repeated this performance, varying it by sometimes spinning a single thread.

Obliged to her for her efforts I returned to my first friend, to find her where I had left her. If she had moved while I was away there was nothing to show for it. I came again several hours later to find her still holding her own,—a very

monument of patience, or was it idleness? Her "repose of manner" was admirable.

It was on this same hemlock, high up between two twigs belonging to distinct systems of branches, that I found the largest triangle web I have ever seen. In order to hang it there, the spider must have climbed high and spun out a random thread. The finished web measured at least eighteen inches from end to end. The line from the apex of the triangle to the spider's position near the support was much longer than those of ordinary triangle webs. The cross lines, too, which make the snare were more numerous than in other webs. The rule is from nine to twelve cross lines; this had from eighteen to twenty-two.

I have often taken triangle spiders into the house, hoping that they would avail themselves of the profusion of hemlock boughs provided them and spin me a web. I have even tempted them with lusty mosquitoes and more delicate gnats, but no webs would they spin.

"Why is it," I complained to the Professor, "that they will spin for you but not for me?"

"Maybe you don't give the password," said he.

"What do you say to them?"

"I say, 'Good hunting, little brother,'" he replied, as he shouldered his camera and walked away.

XX

INDIAN SPRING

THE way to "Indian Spring" lay through the deep woods. When the August sun beat hotly on the open roads, and the pitch oozed in sticky bubbles from the pine sidewalks, the very thought of the moist woodsy earth along this path was cooling. One must needs have a whole afternoon to spare for this trip, as distractions along the way were many. Some people who had taken the walk even went so far as to say that there was more to be seen on the way than at the spring itself. At the very entrance to the path, where it struck off for itself from the main road, stood the "Big Maple," the region's sole relic of the primeval forest. Lofty, majestic, solitary, it towered above the tops of the hemlocks and second growth beeches. One might not pass it without stopping to admire and glorify this noble patriarch. In the edge of the woods, where the ax and scythe had fought with the underbrush, grew marvelous clumps of Joe-Pye weed over which fluttered



BLACK-EYED SUSANS

dozens of light brown butterflies. Against a dark background of young hemlock gleamed a group of black-eyed Susans, their golden cap ruffles fluttering about their piquant faces. Dewberries, less ambitious to reach the heights, crept over the ground, their shiny berries well hidden under broad leaves. We were tempted to give up the trip to Indian Spring altogether and linger along the



DEWBERRY IN BLOSSOM

edge of the woods, but the path offered many inducements, the chief of which was the constant shade, and so we finally started.

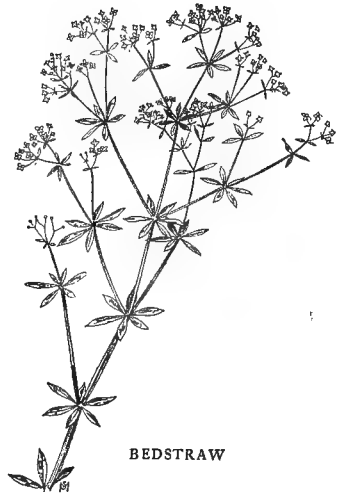
We had not gone far when the path gave itself up to windings. It seemed to bid us take our time, enjoy the coolness and make the acquaintance of the forest folk. If we missed any sight worth seeing, it was because our eyes were blind and not because the path did not lead us to the right place. When climbing over one of the many tree trunks which lay athwart our way, I discovered the first plant of the wraith-like



INDIAN PIPE

Indian pipe which I had ever seen outside the botany book. I can recall even yet the series of sensations which I experienced at the sight; incredulity, astonishment, certainty, joy, wonder,—something like that. But if this was the first, it was far from being the last. The way to Indian Spring seemed to be haunted by these uncanny flowers. When at last we counted twenty-seven in one shadowy clump we ceased to look upon them as a rarity, but I shall always feel a thrill at the sight of them; they can never become quite commonplace.

Next we passed through acres of ferns, rich in color and fine of texture, spread like a thick carpet over the stones which scattered the hollows. We crossed a mere thread of a brook, spring-fed and clear as crystal. At its border the sun came down



BEDSTRAW

through the tree tops and made it possible for a mass of low shrubs and bushes to take possession. They even disputed the way with us. Among them I recognized several old friends of more open uplands; sedges, raspberry vines, and jewelweed vied with rough tangled bedstraw and Joe-Pye weed for supremacy.

We could not resist the temptation to digress at this juncture and see where the rill would lead

us. A faint trail, leaf strewn now and overgrown with ferns, seemed to invite us and we followed, peering along the bank for treasures. One of the party spied a cunning cluster of bird's nest fungus nestling in a moist bed of leaf-mold. It held its



BIRD'S-NEST FUNGUS

little cups up as if for us to see. Down at the bottom of each one were the rounded white pellets so like tiny birds' eggs. The brooklet suddenly found a ledge and dripped away into a deep gully full of big stones

and shadows. We did not follow but went back to the Indian Spring path.

It certainly was mushroom time. Never have I seen them so varied in color and shape and so abundant. The bright scarlet *Russula emetica* was conspicuous among the green of ferns and mosses. Its beauty is only "skin deep," as could easily be seen where the outer portion had been eaten away by some woodland creature whose digestion must be better than its judgment. There was another mushroom of a delicate lavender color, very choice looking, and brown ones of every possible shade, — a feast of color.

Suddenly we were startled by a cry of alarm from one of the party who was mushroom wise. We all crowded about her while she pointed out the characteristics of the deadly amanita. What we saw was an innocent looking yellowish head

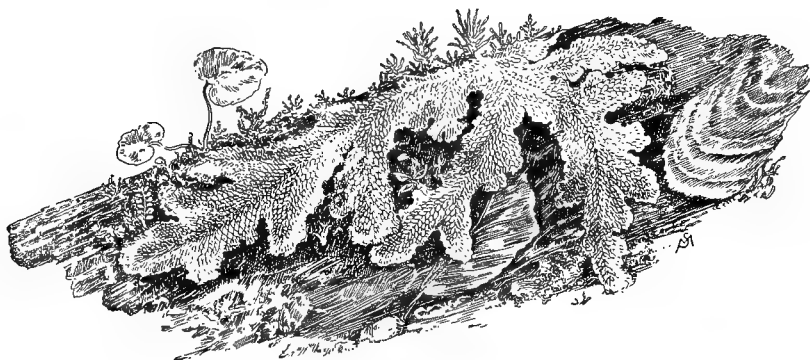
just breaking through the surface as if to say like old Brer Terrapin, "Here I come a-bulgin'!" At a short distance another and more mature plant stood high on its stalk, its wide umbrella spread temptingly before us, proclaiming its kinship to many of the edible sorts. When everybody had learned that the cup at the root should be avoided in all mushrooms, we considered the desirability of uprooting these that they might not replenish the earth with their spores.

We crossed another stream whose bed was strewn with fallen tree trunks and large boulders. Evidently here was a brook which had been mighty in its day. But the day was past and only the naked prongs of uprooted trees on its border told of its former power. The way became more difficult as we progressed. The steeps grew steeper and the fallen trees across the path were harder to clamber over. Many of these had fallen long ago and were fast crumbling to pieces. The mosses and lichens, ferns, the fungi, and even young trees of various kinds, crowded over the fallen one and helped convert its huge bulk into earth mold or new wood fiber. Great shelves of the common wood fungus had pushed out one above another. Slimy, gliding masses of another fungus



A SALAMANDER

lay close under the loose bark. We pulled off a slab of bark and out slid a smooth, lithe salamander. He did not stop to explain his presence, and seemed only to desire to efface himself as quickly and completely as possible. One great trunk lay low in the soil, having been partially buried by the annual deposits of leaf-mold. It was green with moss. Its ruin was all but complete. Above it were beech and hemlock trees.



LICHENS CREEPING OVER THE LOGS

Each year a few of their many seeds caught in the rough coat of their fallen brother and had there sprouted. Dozens of seedlings, one, two, and even five years old, grew on the old trunk and disputed with one another for standing room. Among the fungi hitherto unknown to me were the irregular masses of hydnum, which looked like some pieces of organ-pipe coral we used to have in the cabinet at home. The color was not the same, for the fungus had a creamy hue. The "mushroom fiend" insisted that they were good to eat,

but we demurred, though they certainly looked temptingly clean and tender. Other logs in less shaded locations were covered with lichens. Some of these were rosette-like in form and pointed here and there with soft red. Others took on weird, serpent-like shapes as they crept silently over the surface of logs and adjacent rocks. If an artist wishes to revel in color harmonies the like of which can be found in no fabric contrived by oriental skill, let him visit the deep woods and seek out these lowly plants. They will give him more suggestions in a few hours than he will be able to carry out in as many years. If he could but tell the history of each one, as well as reproduce its likeness, his fortune would be made.

We came finally to a brook more wild and mysterious than the others. There were a half-dozen stepping stones between the end of the path we were on and the place where it began again on the opposite side. After a few missteps and much laughter we were landed at last, but several of the party had wet feet to remember the experience by. We found ourselves in a space that had once been a clearing. A tumbledown chimney overgrown with brambles and vines told of an abandoned hearthstone. The blackened remnants of many a picnic camp-fire strewed the ground. A slight turn brought us to the spot where the Indian Spring welled out of the hillside. The setting was all that we could have hoped for,—great moss-grown rocks wet and slippery, deep shade which almost made us doubt the

existence of the hot August sunshine at the edge of the forest, cool water dripping and tinkling. A half-dozen great trees had been so undermined by the action of the water long ago that they had tumbled headlong into the stream bed. There they lay, heads down, criss-cross—one completely spanning the brook just below the spring—their tangled roots like great dragons twisting and thrusting at the shadows. The water trickled slowly over the smooth rocky bottom as if reluctant to leave a spot enchanted. A few yards below, the overflow from Indian Spring joined the main stream, and their waters mingled in a pretty little cataract. We went below and looked back at it. How it wrinkled and paused over the level spaces, played with the bubbles in the eddies, and ran laughing and turning summersaults wherever the ledges were abrupt!

Back we went over the path by which we had come. The woods were growing dark, and the shadows grim. The familiar landmarks did not look the same approached from the opposite direction, and even the guide-posts had assumed strange, uncanny shapes. Silence had taken possession of the party. The wonder and the mystery of the woods filled us and made conversation impossible. A shout of joy and relief arose when we came within sight of the "Big Maple" and caught the parting rays of the setting sun through its branches.

XXI

SKATING IN JULY

NO one but a water-bug ever thought of skating in July, though history tells of the sad fate of the three girls who "slidin' went upon a morn in May."

On the surface of the quiet bays, just far enough from the rapids to avoid being splashed, dwell the water-striders. Their name suits them well. With three pairs of such legs as theirs we need ask no odds of the man with seven league boots. Water-striders wear no boots. Their step is light as any fairy's, for the floor on which they tread is too unstable for any heavier weight. They skip nimbly about on the surface film of the water with never a fear of wet feet or a ducking.

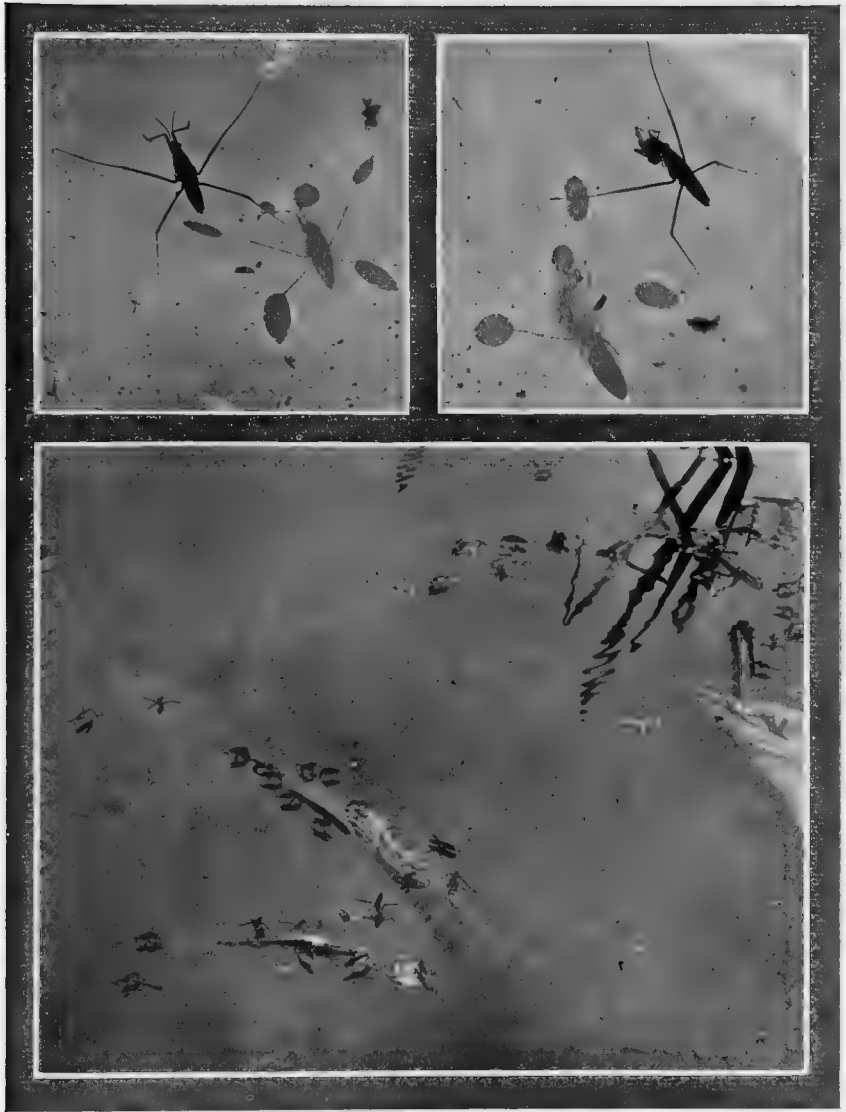
When I approached them quietly, they seemed at rest, their slender bodies suspended just above the water, their knees bent slightly upward and the tips of their toes resting on the surface. I made a sudden dive with my net and the pool was vacated as if by magic. Not one was captured. I had, at least, succeeded in getting them out of a shadowy corner. Soon a little company of them collected, this time in a spot of sunlight. Under them the bottom of the stream was as smooth as a floor. As I watched, a strider would now and then leap lightly into the air, as if at play. I learned

afterwards that in this way they capture the smaller insects which fly above them.

It was not until after several experiences with water-striders that I discovered their shadows. The shadow of a water-strider does not attend its owner closely, nor does it in the least resemble the author of its existence. Instead of being a rather vague representation of a long-legged bug, it looks far more like three pairs of eye-glasses, bobbing about at the bottom of the water. Nothing could be more fascinating than these six oval shadows outlined in white light, like silver-rimmed spectacles. As the water-strider skates across a sunlit space, his shadow moves, disappears, returns in a new place, rests, then darts out of existence as its owner is lost in the shade of the bank.

Water-striders have a family of cousins which are often seen in similar situations. These are smaller and have much shorter, stouter legs than the water-striders. The cousins are of a very adventurous turn and often take long journeys by land. Your true water-strider has plenty of wings which he can use if necessary to seek a new home, but he does not journey for mere restlessness or love of travel.

In our very sluggish streams where water plants abound, dwell also the weird, wiry marsh-treaders. These are but distantly related to the water-striders. They can hardly be said to skate, as their movements are slow, awkward and weak. The marsh-treader creeps over the surface of the water and among the rank vegetation. None but the sharp-



THE WATER-STRIDER AND ITS SHADOW

est eye can discover it. Its body is a mere thread, scarce half an inch in length, and its six legs are like stiff hairs, sharply bent at the knees.

Water-striders spend the winter under the banks or at the bottom of the pool. Their skating days are over until the warm weather comes again. The young ones hatch from eggs left on water plants, and live upon whatever they can catch. Left to shift for themselves, many of these tiny fellows fall a prey to various insect ogres. Fortunately there are always enough left to keep the family tree increasing, and when we visit the streams again next summer we may enjoy them and their shadows once more.

XXII

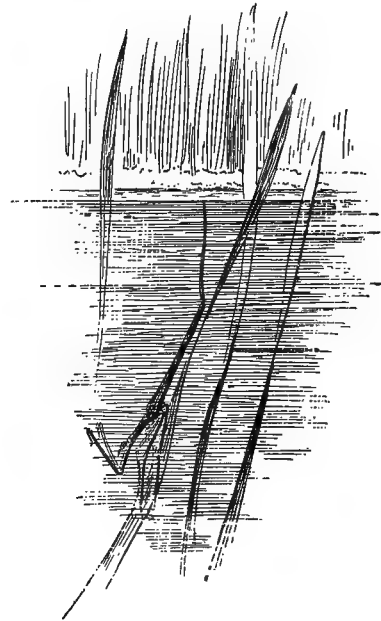
WATER-SCORPION AND GIANT WATER-BUG

IN the quiet reaches of many streams, where bright-eyed polliwogs and glancing minnows play amongst the swaying water weeds, live the water-scorpion and the giant water-bug. Two more entertaining occupants for the home-made aquarium could hardly be secured. Though their names sound forbidding, they will be found harmless and well disposed, save towards such small insects as they regard as their natural prey. The water-scorpions resemble their terrestrial namesake in form rather than in temper. Among insects the giant water-bug well deserves the name, both as to size and as to appetite.

The water-scorpion depends upon stealth to obtain a dinner, rather than upon swiftness of foot or impetuosity of attack. One of its favorite attitudes is clinging among water plants which it much resembles, being dull greenish in color and very slender and angular in form. Lurking there, with its long forearms just parted, it snatches at the unwary creatures that venture to pass by. The water-scorpion's tail is not for stinging. No sting is necessary. Once grasped in that tight embrace, its prey is entirely at the mercy of the hungry jaws of its captor. The slender tube which resembles the real scorpion's tail fulfils the somewhat prosaic

office of air-pipe, a sort of makeshift trachea. It serves its purpose well, however, since a water-scorpion finds it far more convenient to rest contentedly within a half-inch of the surface, enjoying a dinner of its own catching, with the tip of its breathing tube well out of the water, than to be constantly running to the surface to breathe, as do many of its neighbors.

The student of water insects may consider himself fortunate if he succeeds in bagging a water-scorpion. They often conceal themselves among such rubbish as always collects in sluggish streams. An inexperienced collector may be surprised to see what he took for a dirty stick awkwardly gather itself together and walk out of the net. Though not uncommon, they are still considered prizes. An aquarium stocked with water plants



WATER-SCORPION AT LEISURE ·

seems as well adapted to the needs of these creatures as are their native streams. Being by disposition inclined to peace, they are slow to resist the attacks of the more warlike inhabitants of the water. Their armor protects them from many enemies and only the most relentless hunters can pierce their coat of mail. I was once fortunate enough to watch a

battle between a back-swimmer and a water-scorpion. The back-swimmer was always on the offensive, and the scorpion merely twisted and turned to avoid the thrusts of his adversary. There would have been no escape for the poor creature had I not constituted myself a rescuing party and transferred the vicious back-swimmer to a separate jar and put him on a diet of fresh beefsteak.

The giant water-bugs are broad and flat. They sometimes reach great size and have appetites to match. To the little fish and smaller insects they are truly giants. Although vigorous swimmers, their life is not confined to the water. They can fly swiftly from one pond to another. On their journeys, which are usually taken at night, they are likely to be lured aside by dazzling street lights. For this reason they have been called "electric-light bugs." Many lose their lives in this wild, intoxicating whirl. With reckless blundering beetles, and pale ghost-like night moths, they dance, and whirr in and out, back and forth, in a mad blind ecstasy of motion. Sinister bats, most successful of all insect collectors, swoop down amongst them. On the ground, patient watchful toads await those hapless ones which, dizzy and worn out, sink down upon the pavement. Hundreds of them are swept up by street cleaners in the early morning.

In reflecting upon the appalling mortality caused by the arc light,—this new and subtle enemy of insect life,—I find myself wondering why the electric-light bug has not been totally exterminated.

Do any of these revelers ever recover from their dissipation, and finally reach the water for which they started, and settle down to sober bughood?

“It's a wonder, it's a wonder

That they live to tell the tale!”

In the muddy streams the giant water-bugs are more at home and prey upon other insects and even small fish, their great size enabling them to overpower most of the smaller denizens of the water. The young giants greatly resemble the adults in shape but are usually green in color. They lack also the heavy coats of mail and the strong wings of the adults. When full grown they measure from an inch and three-quarters to two inches and a half in length.

XXIII

THE MERRY-GO-ROUND

"ARE you going to take us all to ride on the flying horses?" cried the Frivolous One as the field class stepped from the car. Before us were set all the distracting snares of the summer resort. The odor of roasted peanuts mingled with that of pop-corn, while a general air of zoölogical garden pervaded everything. Beyond we could see the lake and could almost believe we heard its soft lapping against the posts of the pier, above the discordant din of the merry-go-round.

"I'll show you a merry-go-round more suited to a scientific mind," said the Professor, with a twinkle in his eye.

The boats were ready for us at a small wharf, and we were soon judiciously assigned to our places in them and ready to obey directions. Dredging nets and bottles and pails were conveniently placed. This excursion up the "Lagoon" had two objects. We were to get a general impression of aquatic insects in their haunts, and to collect specimens for our aquaria. Some of us had never been to the Lagoon before and were anxious to get the geography of the place. It is really the lower portion of Fall Brook. Although this stream is one of our swiftest ones, abounding in waterfalls of surpassing beauty, it flows for a

mile or so through a stretch of flat land. Into the mouth of this winding stream we rowed, keeping the boats far enough apart to avoid danger. The water was like a sheet of glass. Every plant on the bank was mirrored by its smooth surface. Clumps of Joe-Pye weed and wild sunflower lost none of their color in the reflection. After a short distance the banks came closer together and the boats proceeded Indian file. Trees hung with vines leaned over the water's edge, the reflections now broken by our oars. It was here that I caught my first sight of the forget-me-not. If I had not been in the Professor's boat I should have demanded a landing that we might fill the boat with them. As it was, I sat still and gloated. The banks were literally carpeted with the plants, which were blue with the precious tiny flowers. Although that first glimpse is never to be forgotten, it does not prevent my enjoying the same experience every year. They are just as plenty and just as "gloat-worthy" now as then. Few people know the way to the Lagoon. Those who do know it are chary about making their knowledge public. Then, too, it is a "skeetery" place and frequented only by fishermen and field classes.

The Professor had stopped rowing. He wanted to drink in anew the well-known scene, and to watch the effect on the newcomers. Not a detail escaped him, from the bold curve of the bank itself to the rich gleam of the bittersweet berries overhanging it.

We were in the lead and soon moved on around

a curve. "Here's your merry-go-round!" exclaimed the Professor. We all looked and listened, half expecting to hear the rasping voice of the driver or the dolorous note of the hand-organ. Until the rower pointed with his oar, we saw nothing.

"Look out for whirligig beetles," he called to the occupants of the other boats.

"Where, where?" they cried, and the Frivolous One began to get excited, much to the distress of the youth who was responsible for the boat she was in.

We drew our boats together and watched the antics of the beetles. They whirled in and out, going through the most complicated series of figures. They spun and curved and whirled again, their steely-blue backs fairly piercing the sight. What a May-pole dance they were having, when suddenly, plick! and it was over. There wasn't a beetle in sight. But there was something in the air which made the oarsmen pull with a will to get out of their neighborhood. The Professor had purposely disturbed them by tossing a light stick into their midst. In departing suddenly for deep water they left this astonishing odor behind them. We passed many groups of whirligigs that afternoon and captured some for our aquaria. The whirligig beetle is pictured on page 138.

We went on dipping among the water plants and in the muddy bottom. Delighted shrieks now and then announced the addition of a giant water-bug, a water-scorpion, a dragon-fly nymph of large

size or a water-tiger. Back-swimmers and water-boatmen, damsel-fly nymphs and diving beetles had been collected before, and hardly caused a ripple of excitement.

Among the water plants I pulled in for inspection was a leaf on which I found a small purse-shaped case. I handed it over to the Professor. "Ah," said he, "that's a nice thing; the egg-case of hydrophilus." I was glad to have found a "nice thing," though I hadn't meant to do it.

"What are these thin, half-starved looking creatures creeping over the tops of these plants?" asked the Frivolous One. "Why, they've hardly the strength to set one foot before another. See!" said she, picking up something in her slender fingers and holding it toward the Professor. Then, with a side glance at me, she said, "It has that thread-like effect!" "Oh!" said the Professor. "This is the prize of the day. See, people, here's a marsh-treader. You'd better try to get some specimens for your collections."

The Frivolous One caught several more marsh-treaders and was not at all haughty about having found "the prize." And I couldn't help knowing that she had about as much in her pail as the more serious ones had, and she had her good time besides. The Professor never made the mistake of tiring the field class. He didn't stay too long. We left the Lagoon before the mist began to gather and so escaped the malaria. It was a day to be remembered, and we all agreed that it was better than many merry-go-rounds.

When we got back to the laboratory we sorted our material, exchanged specimens and established our live creatures in the still-water aquaria we had prepared before setting forth. The Bookworm, so called because his devotion was about equally divided between books and insects, came round and read aloud what he had found about whirligig beetles.

"The Gyrinidæ are aquatic during the greater part of their lives, only the short pupa stage being spent out of the water. The adults are easily distinguished by their elliptical bodies and whirling movements. The hind and middle legs are broad and much flattened, being used as oars. The eyes of these beetles are most remarkable. Upon close examination they are found to be four in number apparently. The sharp margin of the body divides the eye of each side into two parts, of which one looks up, the other down. A most convenient arrangement this would seem to a creature situated as the whirligig is. When disturbed the whirligig beetle dives swiftly, never failing to carry with it a bubble of air."

With one accord we rose and flocked over to the broad glass aquarium where a dozen of the lively creatures had been put. Luckily it was not "laboratory hours" and we could be as informal as we liked. The Bookworm thrust his pencil into the midst of the spinning beetles and they went down like magic. Looking through the glass sides of the aquarium we could see them darting among the water plants. Each one had his own particular sphere of silvery white just at the tip of the wing

covers. They had shown great presence of mind, it seemed to me, and all in no time at all. The air bubbles 'gleamed like drops of quicksilver down among the feathery water plants.

"Let's catch one and see about that double-eyed effect!" cried the Frivolous One, true to her traditions even within the sacred halls of her alma mater. And she seized the first one which came to the surface. It was indeed true and we were all convinced of the usefulness of the big gray book over which the Bookworm was so constantly poring.

"Let's hear the rest of that," said one; and we returned to our mounting while the reader proceeded.

"The eggs of the whirligig beetles are laid in parallel rows on the leaves of water plants. The larvæ are long and narrow and flat. They breathe by means of tracheal gills. When full grown they leave the water and spin a thin cocoon in which to spend the pupa stage. So far as is known the pupa stage lasts about a month. The adults return to the water immediately, never leaving it, except long enough to fly to another pond or stream. Those species which have been observed spend the winter as adults. They have been seen even in very cold weather exercising on the surface of the water at some air-hole in the ice."

We looked incredulous at this, but the Bookworm assured us that Thoreau and Gibson said the same thing, whereat we were silenced, partly by the fact and partly by his superior knowledge of the literature of the subject.

"Go on," we said.

"At present thirty-six species are known in North America. These belong to three genera: Gyretus, Gyrinus—" "There, there, that'll do!" we exclaimed. "Isn't there something more about the habits? Haven't they any ears or noses you can read about?"

"No," said the Bookworm, looking aggrieved, "but there are some fine scientific names here."

Whereupon we put our fingers to our ears and made such a hubbub with our boxes and bottles that the reader gave up the effort.

XXIV

WATER-BOATMEN AND BACK-SWIMMERS

AMONG the many inhabitants of our streams, ponds, and even ditches, none are more skilful oarsmen than the water-boatmen. Their bodies are perfectly adapted to their mode of locomotion. Flat-backed, boat-shaped, and fitted with broad, paddle-like legs, they dart through the water like fragments of silver light. The bright sheen with which they are clothed is said to be a thin layer of air, taken from above the water in their not infrequent visits thither and utilized by the insect while below.

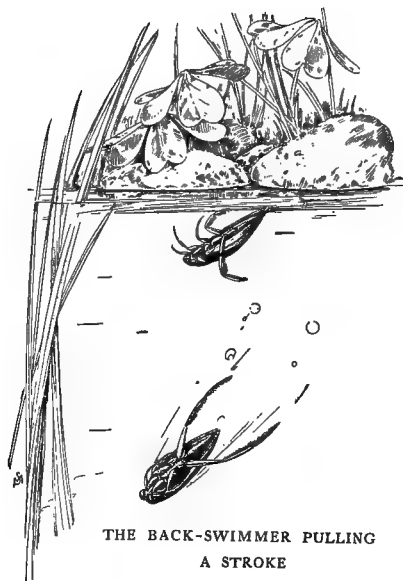
Of the three pairs of legs possessed by the common water-boatmen of our creeks, the hind ones only are oar-like in form. These are broader and flatter than the others and fringed with hairs. When spread in the water these fringes aid materially in propelling the body forward. The middle legs are very slender and are evidently little used in swimming. The forward pair are small and of great use in clinging to water plants, a favorite pastime with water-boatmen, and in holding the prey.

This insect has a near relative whose acquaintance is even more delightful than that of the small and rather retiring boatmen. The back-swimmer is a bold fellow, impatient and pugnacious, and

much better able to shift for himself than his little cousin. In the first place, he is bigger and has a sharp beak with a malignant drop of poison within easy reach. His garb, too, is more pronounced, resembling in some cases a tailor-made suit of white velvet, with facings of gray, and sometimes a touch of red. The water-boatman is modest in behavior and dress, and lacks the general air of *savoir faire* possessed by the back-swimmer. The two are easily distinguished by the difference in form as well as by size and color, the boatman's

back being flat, while that of the back-swimmer is shaped like the bottom of a boat.

There is no employment more enjoyable to me than watching the back-swimmers in our Meadow Brook. I have found them also in the large open tank in the barn-yard, and used to wonder how they came there. Surely they did not come out of the deep well from which a windmill forces the



water to this tank? When watching them one day in the tank I was surprised to see one leap through the resisting surface film of the water and suddenly spread wings and disappear in the direc-

tion of the mill-pond. No doubt he would find pleasant company there. I captured the next one that came within reach, and warily avoiding his proboscis, concerning which I had been warned, I forced him to submit to an examination. No wonder he could fly! There, under what appeared to be a seamless coat of mail, were wings well able to bear him far away. His little trip to the water tank was perhaps but one of many such adventures into the world. The one I had captured took rather unkindly to my investigations. He seemed vindictive, and had he been given any chance would surely have punctured my fingers. Was it spite or fear, I wonder, which made him rush round and round in the long-handled tin dipper in which I had caught him, striking violently against the sides? I caught two or three more and put them all together in a pail. What a clatter they made, leaping against the cover and upon each other in their headlong rush! I gave them a very comfortable home in the low, broad aquarium in my study and later transferred them to the pond again, but not until I had learned much of their ways.

The name "back-swimmer" is a translation of the generic name *Notonecta*, and is most descriptive, referring to the fact that they swim with their backs downward and their heels "in the air," as it were. Their keeled backs and oar-shaped legs make them look like tiny boats.

The back-swimmers are said to spend the cold weather buried in the mud at the bottom of the

water. In warm weather they are active, and when not engaged in replenishing their necessary air supply by frequent trips to the surface of the water, their time is taken up with capturing for food the many other insects smaller or weaker than themselves. The eggs have been found in the stems of water plants. The tiny creature which comes from the egg closely resembles its parents. I obtained a dozen or more of these lively little fellows for my aquarium. They were of assorted sizes and probably were not all brothers and sisters. They were pale in color, almost white, with a touch of bright red. They had prominent eyes, one on each side of the large head, which was set on broad shoulders without the slightest suggestion of a neck. They had no wings, so could not follow their parents from pond to pond. Even when mere babes, these back-swimmers know how to manage the oars. It is well they do, for they meet many dangers. Strangely enough, they may even fall prey to their indiscriminating parents. The back-swimmer's code of ethics makes every insect legitimate prey. He couldn't think of spoiling a good meal for relationship's sake.

I never happened to be present when my back-swimmer's molting time came round. But we are told that both the back-swimmer and the water-boatman grow, as do other insects of their order, by successive molts or changes of skin. They reach maturity, if they escape their enemies, and spend the winter at the bottom, as did their parents.

After enthusiastically describing these business-

like little creatures to a neighbor one day, even persuading her to go with me and watch them in Meadow Brook, I was chilled and fairly disgusted at her question: "What are they good for?"

How could I answer her? Of the added joy of existence which they had given to me, I hadn't the heart to speak. Her question told me that no such "foolishness" would appeal to her. Neither could I make her understand that, so far as I was concerned, no utility need be assigned to any creature as an excuse for its presence among us. As well ask: "What use, to them, are we?" But I saw she expected me to speak up in defense of these denizens of Meadow Brook, and so I said: "Oh, food for fish!"—a lame response and totally unfounded on personal observation. A conciliatory "Umph!" assured me that my reply was entirely satisfactory, as there could be no question in any one's mind as to the use of fish.

How do people happen to grow up with such benighted ideas? Such an attitude can be readily understood in the case of little slum-bred children on their first visit to the country. A friend once had an experience with a class of "fresh air" children she had in charge one summer. She took them out into the fields one day, hoping to interest them in nature. In writing about it afterward, she said: "Everything was new to them and they were suspicious. The animals, the trees, the wind, even the birds, all seemed unfriendly. In the children's own language, they regarded all nature as 'layin' fer ye'! I was particularly impressed

with this when, meeting a harmless but unknown insect in the path, a small boy exclaimed, 'Say, Teacher, what does them do to yer?'

One can forgive this in children so unused to nature's kindlier moods, or to kindly moods in any form. But that intelligent grown people should demand a reason for the existence of every other creature is nearly unforgivable. May the time soon come when the silly superstitions about animals and plants will cease to be visited upon the third and fourth generation, and supplanted by personal knowledge of nature. Man will become more tolerant of other creatures and less sure, perhaps, of his own exalted position in the universe. Let us hope that he will then see himself as others see him and begin to learn to love his neighbor as himself.

XXV

HOW INSECTS BREATHE

(AN INFORMING CHAPTER)

THAT all insects breathe, whether aerial or aquatic, is so to be taken for granted that few stop to think how their respiration is accomplished. A moment's reflection shows the necessity for plenty of air as a means of purifying the blood. The "why" is clear enough—the "how" will bear looking into. In our own bodies the blood is carefully confined in a closed system of tubes varying in size. This blood is constantly receiving from the cells of the body the waste matter, and as constantly giving up in the lungs these same waste products in the process of purification. The exchange of gases takes place through the thin walls of the blood-vessels. In the case of most insects, however, the blood flows freely in the body cavity. If the body wall be cut through, the whole supply of blood is likely to flow out.

The respiratory apparatus of insects is a system of air tubes having external openings. These air tubes, hereafter called *tracheæ*, vary in size from the main trunks to the microscopic tubes which ramify the tissues of every organ of the insect's body. The structure of the *tracheæ* themselves is most interesting. They are strengthened and kept open by a horny substance which looks as

if it were wound closely in a spiral. The external openings of the respiratory system are called *spiracles*. These vary in number, size and position. They may easily be seen on the body of a grasshopper, one on each side of every segment of the abdomen. Since the blood bathes every organ constantly and these organs are ramified by delicate tracheæ like silvery threads, it is not difficult to conceive how the purification of the vital fluid takes place. The thin walls of the air-tubes allow the exchange of gases in practically the same manner as in our own lungs, though the air and not the blood is inclosed in tubes in the insect's body.

It is evident that animals which live in the water must be provided with special organs for obtaining air. For example, the gills of fishes are complicated networks of blood-vessels, with very thin walls. The water of the brook, lake or river contains much air—more than we think. Every breeze that ripples the surface, every waterfall that churns the stream into foam, every drop of rain that strikes the water, adds to its supply of air. The gills of the fish are so constructed as to expose the greatest surface to the air-and-water mixture.

With reference to their method of obtaining air, aquatic insects may be placed in two groups: those which obtain supply from above the surface, and those which breathe the air that is mechanically mixed with the water. To the latter class belong the damsel-fly nymphs with their plate-like

tracheal gills, and the dobsons and May-fly nymphs with their tufts of tracheæ. To the other class belong the water-boatmen, the back-swimmers and a great variety of insects, both adults and young.

Many of the insects living in swift streams use the air that is mixed with the water. It is easy to appreciate the difficulties of living in a strong current if one must come to the surface occasionally. Imagine, if you will, a water-tiger trying to settle himself for a quiet draught of much-needed air after an encounter with a polliwog. How disconcerting to be ordered by the current to "move along!" Is it any wonder that these voracious water-tigers prefer the quieter reaches of the stream, since they cannot breathe under water? The dobson, however, gives itself no concern about air supply. The swifter the current the more abundant the food and the less difficulty in breathing. The tufted tracheal gills spread out and the current flows over them, keeping them constantly wet with freshly aerated water. The caddice-worm has tracheal gills of a different pattern and wisely keeps both ends of its house open to insure the free passage of water. The black-fly larva sticks to its rock, waves its fans as if beckoning all to enter, and breathes through its own special form of tracheal gills without knowing it.

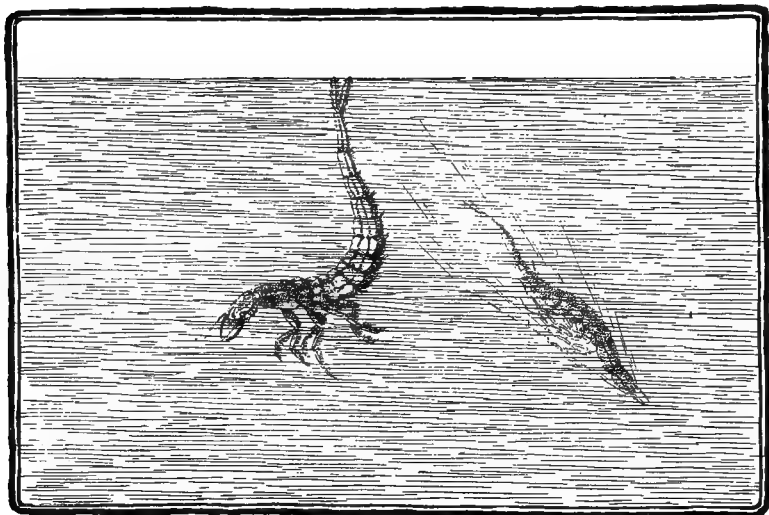
To secure air enough from above the surface of the water is quite a different proposition. If you would see how it is managed you should visit a sluggish stream or quiet bay that teems with insect life. How such a place fascinates! Can we not

contrive to make these wild things consider us a part of the landscape? If so, we may quietly study their ways.

Among the most frequent visitors to the surface is the common "wiggler," which, they tell us, is the larva of the mosquito. (None of us will ever be really sure of this until we have kept some of these "wagglers" in a glass of water and have seen them emerge as full-fledged mosquitoes,—not until we have brought a few of them up "by hand.") The favorite attitude of the wiggler is hanging head downwards at the surface of the water. If disturbed, it sinks with a twitch and a wriggle. It is only by watching a few individuals in a small tumbler of water that one is able to discover that there is near the tail a slender projection. This is the breathing tube, and through it the air enters directly into the tracheæ. According to Dr. Howard, these larvæ do not voluntarily remain away from the surface of the water longer than one minute. The microscopic plants and animals which form the principal food of the wigglers are wafted into their hungry throats by "automatic fans" which wave almost constantly in front of their mouths.

The water-tiger gets its air supply very much as the wiggler does. Now and then it is forced to leave off playing the role of ogre, and rise to the surface for air. In order to do this it needs only to let go, and the water does the rest, for its body is lighter than the water. The picture shows a very characteristic attitude. On the very tip end of its body are two hairy appendages. These

break through the surface film of the water and are supposed to aid in supplying fresh air to the tiger's respiratory system. The water-tiger has to pull manfully to get his tail under water again. You may see him beat his great hairy legs against



WATER-TIGERS

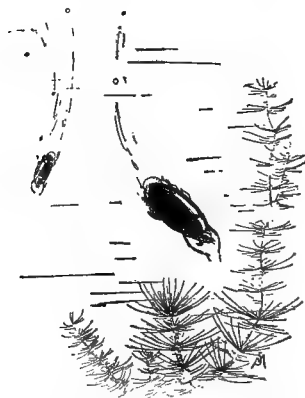
the water in order to get under way and then dart down like a trained diver.

Another frequent visitor to the surface is the back-swimmer. Like the water-tiger it often hangs head downward, with the tip of the body at the surface. We suspected it of getting its air in the same fashion. But the entomologist showed me that this was not true. We took a back-swimmer from the water and placed it in its favorite position with the wings downward. On the surface of the body now uppermost we found a distinct

ridge down the middle. On each side of the ridge is a deep groove. These grooves or furrows are not hard to find, though thickly covered with hairs. By carefully brushing away the hairs, one is able to see the large breathing pores. When the wings are closed, as they always are while the insect is in the water, they help form an opening near the tip of the abdomen, through which the air passes into the furrows under the hairs. If I had not seen it, I should never have believed it.

The water-scorpion has a most remarkable adaptation for obtaining air. It takes the form of a horny tube almost as long as the insect's whole body. This projection has given the creature its

common name, the breathing tube having a supposed resemblance to the tail of the scorpion. But the use to which the water-scorpion puts its "tail" is quite innocuous. The breathing tube is composed of two parts. These are grooved on their inner surfaces in such a way as to fit together nicely and form an air-tight tube. The length of this tube enables the insect to cling motionless to water plants in the vicinity of the sur-



THE "MERRY-GO-ROUND"

face, catch and devour its prey, breathing comfortably the while. (See page 117.)

The whirligig beetles, although they spend most of the winter buried in the mud at the bottom of their home stream, are most frequently seen spinning about on the surface of gently flowing water. When disturbed by the quick stroke of an oar or the splash of a collecting net, they dart to the bottom as by one accord. Each carries down a bubble of air attached to the tail end of the body. They have no cunningly devised tracheal gills and would very soon drown without their silvery globule of air.

Dragon-fly nymphs are able to breathe while under water, by means of complicated internal tracheal gills. They can also breathe air at the surface through true spiracles. Some insects are known to tap the air-chambers of submerged plants and to utilize the air thus obtained.

Let us all turn to and study the ways of water folk. Each has its own method of solving its own problems. They do very much as their ancestors did. If they make any improvements from generation to generation we do not notice them. They are a conservative people, and never go in for new-fangled ventilators, patent air-shafts or even automatic air-pumps.

XXVI

BROOKSIDE WILLOWS

HAVE you a meadow brook from whose margin all the willows have been shorn? Come to Willow Creek and we will make you glad. Take away with you an armful of branches cut in assorted lengths and trimmed. You need but to drive these into the moist bank of your stream with the flat of your ax: next year they will surprise you with the abundance and length of their lithe branches. In a few years they will have restored your willow "fringe." In summer you may sit in their shade and admire their glossy foliage. When the branches are bare the wind will convert each tree into a great harp of a thousand strings upon which to play the song of winter.

Willow Creek is well named. Though it wanders through many a mile of pasture and meadow land, it is never anything but a creek, and it has always its willows. Sometimes they are mighty trees and stand off in dignified seclusion from the border. But the cattle come down to the creek to drink, and after long, satisfactory draughts of the clean water they rest under the willows and chew their cuds after their ruminating fashion. Whether theirs be the cud of sweet or bitter fancy will depend largely upon whether they have nibbled boneset and wormwood or devoted their attention



WILLOW CREEK

to grass alone. But it is evident that they enjoy the noonday shade of the brookside willows.

Willow Creek is never in a hurry. It has time to reflect, and its reflections are always truthful though sometimes they may be unlovely. It wanders past the house of my well-to-do neighbor and his ducks are made happy. In turn I am gladdened by an occasional glimpse of the ducks diving or preening, from my side of the creek. The stream seems scarcely to move between the ranks of pollard willows. I, too, delight to linger there when the late afternoon sunlight sifts through the branches. I do not even inquire what is hidden beneath its smooth surface, content to think its depth as unfathomable as its mystery.

In early spring the willows sound the note of the coming season. The willows are "yallerin' up on us!" is a familiar slogan and a signal for a return to freedom. You can fairly see it come in March. Yesterday 'twas winter. To-day 'tis March, and there are promises of May. The gold comes back to the willows before the green.

Most people's willows bear catkins or pussies and are content. Mine bear all these and more. They bear cones, as smooth and regular as those of the most proper conifer. They are soft and green and silky in late summer, but by spring they are dry and brown. How the cones come to be on the willows is another story, which is told in the next chapter. Still stranger "fruits" grow on shrubby willows along our brooks. Sometimes the tip of a branch, instead of ending in an ordinary

terminal bud, is enlarged and then tapers off into a long point like a beak. When opened these enlargements disclose a small squirming creature, whose life-story is mysteriously linked with the beak-like end of the willow's branch.

The willows have many other oddities. Their witch's brooms are almost uncanny. I never saw but one of these and was greatly impressed by the strange growth. Stung to desperation by the attacks of a tiny mite in its growing points, the willow branch develops beyond all reason. The growth of the main shoot having been arrested, the side buds, set for next year's growth, suddenly burst forth and put out leaves and buds. These buds, too, are stimulated and in turn perform their duty two years too soon. As the weeks of unnatural development go on, the mass of branches and twigs and leaves becomes denser and denser, suggesting a mammoth crow's nest. No wonder they call it a "witch's broom." There is enough witchery about the growth of such a tangle of ambitious branches to give color to the superstition; and as a cobweb eradicator in regions celestial it could have no equal!

The facts of its history are almost as marvelous as the fancies. I hope my willows may never produce another broom. One in a lifetime is quite enough for me and for the tree that bore it.

Happy the boy who knows the secret of making a willow whistle! He must know the best kind of willow for the purpose, and the exact time

of year when the bark will slip. The country boy seems to know these things by instinct. When the day for whistles arrives he puts away marbles and hunts the whetstone. His jackknife must be in good shape, for the making of a whistle is a delicate piece of handicraft. The knife has seen service in mumblepeg and as nut-pick since whistle-making time last year. Surrounded by a crowd of spectators, some admiring, some skeptical, the Boy selects his branch. There is an air of mystery about the proceeding. With a patient, indulgent smile he rejects all offers of assistance. He does not attempt to explain why this or that branch will not do. When finally he raises his shining knife and cuts the branch on which his choice has fallen, all crowd round and watch. From the large end between two side twigs he takes a section about six inches long. Its bark is bright green and smooth. He trims one end neatly and passes his thumb thoughtfully over it to be sure it is finished to his taste. He then cuts the other end of the stick at an angle of about 45° , making a clean single cut. The sharp edge of this is now cut off to make the mouth-piece. This is a delicate operation, for the bark is apt to crush or split if the knife is dull or the hand unskilful. The Boy holds it up, inspecting his own work critically. Sometimes he is dissatisfied and cuts again. If he makes a third cut and is still unsuccessful, he tosses the spoiled piece away. It is too short now. A half dozen eager hands reach for the discarded stick, and the one who gets it fondles it lovingly.

I once had such a treasure and cherished it until I learned the secret of the whistle-maker's art. He next places the knife edge about half an inch back from the end of the mouth-piece and cuts straight toward the center of the branch, about one-fourth the way through. A three-cornered piece is now cut out, and the chip falls to the ground unheeded.

When this is finished the Boy's eye runs along the stick with a calculating squint. The knife edge is placed at the middle, then moved a short distance towards the mouthpiece. With skilful hand he cuts through the bark in a perfect circle round the stick. While we watch in fascinated silence,



A WILLOW WHISTLE

he takes the knife by the blade and resting the unfinished whistle on his knee he strikes firmly but gently the part of the stick between the ring and the mouth-piece. Only the wooden part of the handle touches the bark. He goes over and over it until every spot on its surface has felt his light blow. Now he lays the knife aside and, grasping the stick with a firm hand below the ring in the bark, with his right hand he holds the pounded end. He tries it with a careful twist. It sticks. Back to his knee it goes and the tap, tap, begins again. When he twists it again, it slips, and the

bark comes off smoothly in one piece, while we breathe a sigh of relief. How white the stick is under the bark! It shines and looks slippery. Now the Boy takes his knife again. He cuts toward the straight jog where the chip was taken out, paring the wood away sloping up to within an inch of the edge of the bark. Now he cuts a thin slice of the wood between the edge of the vertical cut and the end of the mouthpiece.

The whistle is nearly finished. We have all seen him make them before and know what comes next. Our tongues seek our moist lips sympathetically, for we know the taste of peeled willow. He puts the end of the stick into his mouth and draws it in and out until it is thoroughly wet. Then he lifts the carefully guarded section of bark and slips it back into place, fitting the parts nicely together.

The willow whistle is finished. There remains but to try it. Will it go? Does he dare blow into it and risk our jeers if it is dumb?

With all the fine certainty of the Pied Piper the Boy lifts the humble instrument to his lips. His eyes have a far-off look, his face changes; while we strain ears and eyes, he takes his own time. The silence is broken by a note, so soft, so tender, yet so weird and unlike other sounds! Our hands quiver, our hearts beat faster. It is as if the spirit of the willow tree had joined with the spirit of childhood in the natural song of earth.

It goes!

XXVII

A HOME IN A WILLOW TREE

A LONG time ago, before a certain back yard of my acquaintance began to put on airs and become citified, there used to be a clump of willows on its border. These grew in a comfortable place where they could dip their feet in the water of a tiny, easy-going stream during the part of the year that such a stream would be likely to show itself. The rest of the year the willows were not very busy and did not need to drink often. In winter how freshly yellow were the long lithe whips which waved gently with every breeze! And in the spring no wonder the children all stopped on their way to school to gather bunches of the soft gray pussies.

We all knew in a vague sort of way that these pussies were the willow's blossoms, but it never occurred to us to look for the seeds later in the summer. I do not know to this day whether that willow clump ever made any seeds or not. Surely no self-respecting plant would neglect such an important enterprise! There seemed every year to be a crop of young ones at the foot of the old trees, and why should we be concerned as to how they came there?

One day, when the spirit of investigation was stirring my blood,—or perhaps it was the promise

of spring which filled the air in spite of the thermometer,—I sallied forth. It was March, and the willows certainly needed immediate attention. They shone like new gold in the spring sunshine. But what were those strange objects bobbing about at the end of the very highest branch? In fact, almost every branch had a knob at its tip. They were too small for deserted birds' nests and too numerous. I was at a loss to explain their presence. What was my surprise to find on closer examination that they had every appearance of being pine cones! How absurd! Everybody knows that willow trees do not bear seeds in cones, however else they may bear them. Besides, no seeds could be found under the dried scales which formed the body of the cone.

What could I do but wonder? I had intended to take some of the branches into the house to watch the early pussies. Luckily, I bethought me to cut off some of the cone-bearing branches. Otherwise I should not have had this story to tell.

We all enjoyed the pussies, but they were soon neglected and dried up. There stood the willow twigs, stiff and stark, bearing their queer fruit.



PINE-CONE WILLOW-GALLS

Seized by a sudden inspiration, I split open one of the cones. Was the riddle solved? No; but there was a clue, and one quite worth following. In a small, tidy compartment near the center of the cone was a small grub or worm which squirmed feebly, as if it did not fancy being wakened so rudely from its nap. It must have been asleep for a long time, and stubbornly refused to be fed or to return to its nest. It finally fell a victim to a pet canary, which did not seem to be injured by swallowing it.

Now, how did the grub get into the cone, where did the cone itself come from, and what would happen next? These were the questions which challenged my wits. I somehow felt sure that it would take at least a year to find it all out, but I certainly could watch the twigs in my room and the trees along the stream.

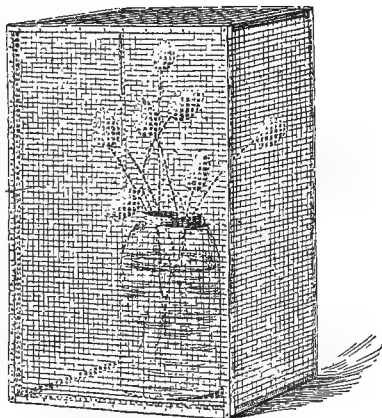
I built a rather unsteady rectangular frame of strips of wood, and covered the whole with mosquito netting. This I placed over the jar in which the twigs stood in water. If anything hatched out of those cones, I meant to make its acquaintance. Well, several things did come out, leaving neat little holes behind them. These little things were small gray flies, which roosted airily on the mosquito netting. They resembled mosquitoes so much that I was recommended by an unsympathetic family to dispose of them at my earliest convenience. This I did with some reluctance and set about watching the willow trees. The old cones had little holes in them and some of them had fallen to the

ground. I couldn't help noticing that the twigs which bore cones seemed to have lost interest and did not lengthen as the free ones did.

It was some weeks before I was able to go down and sit by the willows again, and in the meantime the leaves had come out and the trees looked very flourishing. I searched for traces of my pine cones, but not one whole one was to be seen. I examined the twigs which had been forming that spring, and was amazed to discover little knobs at their ends, just where the terminal bud should be. They were round knobs, and the scales of which they were made were grown very tightly together. This was too much for me and I determined to consult the Botanist. I knew he was acquainted with willows, for it was he who had told me that some of the pussies grew up into catkins full of fluffy willow seeds.

The Botanist shook his head and referred me to the Entomologist.

This good man, who had worked with his "little people" so many years that I always fancied that he had grown to look just like them, peered at me over his spectacles (Why do they always wear spectacles?), took the willow twigs from my hand and told me—



A CAGE FOR STUDYING GALLS

THE STORY

Just before the leaves began to come out on the twigs in the spring, while the buds were full of life and vigor, there came to the clump of willows a dozen little mothers. These slender creatures were dressed in sober gray and flitted noiselessly about on two gauzy wings apiece. (I began to recognize my mosquito-like friend.) Each little gnat (gall-gnat, he called it), had a sharp spear with which she deftly cut a tiny gash right in the tip end of the bud where it was all tender and juicy. In the opening an egg was placed, and away went the busy gnat to repeat the operation on another twig. In a few days there hatched from each egg a white grub, which was the baby gnat. (The Entomologist said "the larval form" and I translated it for myself.) It seems that young gall-gnats of this particular sort like tender willow wood to eat, and that

"Sweetness and light and good fresh air
Are things for which they do not care."

They never venture out of their cells. They live a most secluded life, none ever growing larger than a grain of rice. By fall their appetites fail them and they go to sleep in their narrow beds. But all this time they have exerted a strange influence on the willow shoots. Instead of developing into ordinary twigs, the buds which the little gnats visited do not make branches at all; at least, the branches are so short and the leaves crowded

together so closely, that the poor discouraged branch looks just like a pine cone!

"Now, don't ask me," said the Entomologist, "what made the bud grow that way, for I should only have to tell you that it was because the little insect larva was inside, and you would be no wiser than before."

That was just the question I was waiting to ask. Some day perhaps he will find out for us, and finish the story. In the meantime, I mean to cut open some more of those cones and see what a young gall-gnat looks like before it goes to sleep.

XXVIII

THE ANTS' "COW-SHED"

FEW readers of books on natural history have not heard of the "cattle" kept by ants, but how many realize that our own ants, the creatures which seem to us so common and so insignificant, are among the species which engage in the homely occupation of "milking"? They do not, however, drive their herds to pasture in the morning and go for them at night. Perhaps this is because there are no "boy" ants to attend to such chores. The ants, however, know when it is milking time, and have learned that ill-treatment is not the best way to persuade the cows to give copious supplies of "milk." Each ant stands near one of the tiny cattle and strokes and pats the creature until it good-naturedly gives of its sweet honey-dew.

But what of these "cows that ants milk," and where may they be found? On milk-weed stalks, on maples, elms and hickories; in fact, on every roadside weed, however ordinary, and on every tree, they are likely to be found. The ants know where to look, and if you would see them "go a-milking" you have only to sit down by some thrifty weed and watch. The aphids, or plant-lice, for these cows are none else, are literally in herds. They swarm over the plant, especially on the tender young shoots at its top. They are

usually wingless, spidery creatures, with half-a-dozen legs apiece, but with no inclination to move after having once established themselves in any particular spot. Into the tender, juicy stem their thousands of tiny needle-like beaks are thrust, and the sap is drawn from the cells as if by miniature force pumps. Up the stem come the hungry ants. Do they fall upon these hordes and bear them triumphantly home to feed their young? No, indeed. Their every movement is soothing, conciliatory, gentle. Their stroking and patting is soon richly rewarded by the flood of honey-dew, which exudes in drops from the body of each aphid. The ants drink it, carry it away, and come back for more. The honey-dew produced by aphids seems to be entirely useless to the creatures' themselves. Its production may be necessary to their development. If no ants are there to profit by the fluid, it rains down on the ground. At certain seasons, when the quantity produced is particularly large, one may often see the sticky incrustations of honey-dew on the sidewalks.

In its relation to the aphids the ant certainly sustains its reputation for thrift. One need not go to South America and Africa for evidences of what seems little short of wisdom and forethought on the part of these highly specialized little creatures. In our own northern cornfields we have proofs that certain kinds of ants take the corn aphids into their nests and care for them over the winter. In the spring they carry them out to pasture on the fresh young corn. We have, too, a species of

ant which builds a shed for the protection of its herds. Finding a well-established family of aphids on a convenient shrub, these ants turn to and construct a mud-walled shed inclosing as many as possible. Thus protected from their enemies, the aphids live comfortably. I doubt if either aphid-lions or young lady-bugs know enough about cow-sheds to search for them, and the chances are strongly against their happening on the small doorway of these rare and innocent-looking mud houses. As older generations of aphids pass away, their numerous progeny take their places and the supply of honey-dew is constant.

I never see a certain specimen in the university museum, of which the illustration on this page is a careful copy, without a thrill of pride. Not that I was so wise as to know where to look for such a treasure, but that fortune smiled on me one day and directed my eye to the particular plant that bore the first "ants' cow-shed" which had ever been discovered in that locality. The field class in entomology had just turned about and faced homeward after a successful day collecting on the banks of the "Little Indian." We came finally to the high bluff up which we must climb to get out of the gorge and into the road. No one had thought of ants or aphids since up in the beech woods we



AN ANTS' "COW-SHED"

had come upon a few trees which were white with the fringes of the woolly aphis. How cheerfully they waved the long white strands with which they were covered, when we jarred the trees!

As I loitered among the low-growing weeds in the valley, loath to leave the water's edge and climb the steep to the roadway, I happened to see a curious, muddy-looking object a few feet from the ground on the stem of a shrub. Half afraid of being laughed at, half hoping that I had really found a prize, I called out to the Professor. He indulgently came back down the steep path to see what I was pointing at.

"Ah-h! do you know what that is?" he exclaimed, excitedly. "I never took but one before." Then turning to the class,—*"People!"* he called, and scrambled back over the ridge, bearing aloft the "cow-shed," which he held at arm's length for fear of crushing the fragile thing. We all sat down and listened to his story about ants and their cattle.

The shed was coarse and sandy, but thoroughly dry and solid. It was firmly fixed on the stem of a plant which we recognized as a young dog-wood. The ants had shown great wisdom in choosing the place for their cow-shed. They had put it in a crotch of the shrub where small branches came out, one on either side. This not only gave more surface for the attachment of the walls of the structure but more pasture for the herds. The entrance to the shed was plainly visible, a small round hole on one side, just large

enough for one ant at a time. There was no door to open and shut, and no window. Only the ants of the shed-building colony knew the way to this "dairy." I could not help wondering if the aphids thus protected were especially "good milkers" or if they ever "went dry."

"This is a valuable specimen," said the Professor. "Will you sell it? I'll bid two dollars on it for the university collection. Do any of you want to raise me?" he said, turning to the class.

I blushed to my toes and stammered out my willingness that he should do what he liked with it. I really was glad to be rid of it, for the responsibility of getting it home had weighed on me. The specimen eventually found its way to the entomological museum. The Professor was as good as his word. I think I spent that two dollars five times over for luxuries I couldn't afford.

Every year since then the field class has visited that particular spot on the right bank of the "Little Indian." The members of the class have not found the nest of these shed-building ants, but every year they find a dozen or more of the little mud cow-sheds and always on dogwood. Other specimens have gone to keep mine company in the museum, but I like to single out my own and gloat over it.

XXIX

THE HERMIT THRUSH

By standing on tiptoe we children were able to see the tidy little nest in the arborvitæ while Grandpa held aside the branches. Only the tallest of us could see down into the nest; once we smaller ones begged so hard for a peep that each was lifted to the level of the nest and gazed at the five greenish blue eggs in wide-eyed wonder and admiration. After the others had returned to their play I used to go and sit under a neighboring pine and watch for the mother bird's return. Only once was my vigil rewarded by a glimpse of the bird. A flash of red-brown and white at the top of the arborvitæ, that was all! It disappeared as suddenly as it came, and left no trace. There was no flutter, no chirp, but I knew she had returned to her own and fled from the spot to tell my story.

Grandpa said it was a thrush, and when we sat on the porch in the summer evenings we heard its song, so powerful, and yet so exquisitely sweet, that it made the tears come. It was the first real bird song we learned to know. How different was its quality from the noisy choruses of the blackbirds in the elms or the robins in the cherry trees! The song, the soft red-brown color, the spotted breast of this wood thrush are among the most cherished memories of my childhood.

To know the thrushes at their best one must not depend on chance inhabitants of orchard or garden. They are more often heard than seen, the wood thrush alone venturing to nest near dwellings. In the deep woods, along wild and unfre-



HERMIT THRUSH IN THE MAPLE

quented streams, the shyer veery and hermit thrush live their secluded lives.

Among the New Hampshire hills and especially by the side of her clear mountain brooks, the hermit thrush finds a most congenial dwelling. For where are the deep woods deeper, the clear streams clearer than there? Other hermits retire from the busy marts of trade to the mountain fastnesses and

rest and invite their souls in the rarer atmosphere of the Old Granite State. The hermit thrush is there, and from early July until the end of summer his song may be heard mingling with the music of his chosen stream. One of his ardent admirers writes me of the brook and the bird in glowing terms:

"The brook comes from a near mountain and wanders tortuously through aisles of dark spruces

and birches till it reaches our maple orchard. There it takes on a more cheerful but scarcely more beautiful aspect, as it moves placidly toward the river. It has its waterfalls, its rapids, its pools, and its shallows. The colors of the cascades are charming—gray-blue, old gold, and emerald, the pink-buff granite fringed with the white crystal water! They are never to be forgotten.

“The hermit thrush is constantly singing over our woodland brook, sometimes in the high tops of our maples, sometimes among the low dog-woods. His flute-like music is extraordinary for its brilliancy and rapidity. His song motives are few, but exceed in mastery of thirds and fifths that of any bird singer the world has ever known. Take my word for it, he ‘out-nightingales the nightingale!’”

In some parts of New Hampshire the hermit thrush is lovingly known to the farmer folk as the “fife-bird,” and as they listen to his music their cares are forgotten. Wanderers from their native granite hills are loyal to the bird and speak of him with a tenderness that brings a thrill and a tear.

XXX

THE WALKING PARTY

" We gather as we travel
Bits of moss and dirty gravel,
And we chip off little specimens of stone,
And we carry home as prizes
Sundry bugs of handy sizes,—
Just to give the day a scientific tone."

WHO knows not the joys of a walking party has not yet exhausted the possibilities of college life. In organizing such a party the less organization the better. The essential elements are, first, people of the right kind—our kind, let us say—not too many, at most a dozen. Let there be both men and women. It is not necessary that there should always be "six of one and half a dozen of the other," for "definite tendencies" should be discouraged. Second, a region worth walking for: gorges, waterfalls, glens, brooks, hills, a lake perhaps, and above all fences of wire, of stone, of rails, of boards and of stumps. Third, a large tin coffee-pail, well blackened without, but shiny within. You may recognize the true "picnicker" by his zeal to carry this pail across the college campus. Many a gilded youth was tried by this great test on his first trip with our walking party. If found wanting, he lost caste and was not asked again.

Other necessities may appeal to other parties, but these three were our essentials. The dozen



A VISTA FRAMED BY NATURE

people were always laden with baskets containing eatables to go with the coffee, simple viands unlike the usual picnic fare. The coffee-pail was not empty, for in it were packed the cups and spoons, with the carefully measured ground coffee and the egg which would finally combine to form our unexcelled brew. We tried tying the tin cups on a string and giving them to the Philosopher to carry. But alas, the jangle drowned his improving conversation, and that was not to be thought of. So the cups were packed in the pail.

Every Saturday afternoon in warm weather the party assembled at two o'clock for the start. We never parleyed long about the direction to be taken or how we should reach the place. The member who made the most attractive or vehement suggestion was allowed to have his way, and was held responsible for getting us there by the time we were hungry. Every gorge, hill, field, glen, brook, waterfall and forest path within a radius of six miles was explored by that sturdy band. We built our camp-fire wherever it suited us—in the dry bed of a tiny brooklet, with broad sheets of moss for seats; on the broad, flat stones along the lake shore, where the red beacon of our camp-fire stretched away over the tranquil water to meet the rising moon.

A recital of our menus would give a nervous shock to the conventional picnic-goer. We tried all known out-of-door dishes and some which had been previously unknown. It was hard for even me to see the appropriateness of two long-handled

saucepans in a picnic outfit unless it was to be a fishing party, which it never was. But when our gentle and efficient "Bee," whose duty it was to provision that particular picnic, whispered in my ear that she had two uncooked chickens in one basket and most of the necessary ingredients for "pancakes" in another, I confessed myself outdone.

"But, my dear girl," I said in astonishment, "where are you going to get sour milk?"

"At a farmhouse," she replied, serenely confident that there would be a farmhouse.

I felt considerably less certain that the neighborhood abounded in sour milk and hoped there were plenty of sandwiches. In fact, I scarcely believed in the "flapjack" plan, about which I had not been consulted. When we reached the end of our walk and built two camp-fires and set the Southerner to fry the chicken, I began inwardly to exult, for I felt certain no farmhouse would be found. But they found it, and it generously yielded enough "clabber" to make all the pancakes we could possibly eat. I was glad I had not exulted aloud. My punishment was just beginning. They soon discovered that no one as yet enlisted in the cause of pancakes had the faintest idea of how to combine flour, sour milk and soda into the edible "viand." Making mock courtesies, they came and earnestly begged me to help. I could not escape my reputation for being a "practical" person, and of course that included an intimate knowledge of batter. I began to feel

magnanimous, and shall have to confess that the cakes were not "half bad." The chicken, too, was prime, and many were the demands for the recipe for that particular style, served in the saucepan and with plenty of "nibbins."

Though botanizing, specimen gathering and observing had their place in our earlier plans for these regular excursions, they soon came to be openly discouraged. The Walking Party had no reputation to sustain as a scientific body, though its individual members might be as famous as they pleased in seminary or laboratory. Saturday should be devoted to the pure joy of living and of being together. Nonsense was encouraged. If we happened on a stone-strewn field, it was hardly a minute before we were in the midst of a game of "duck-on-a-rock." Out of breath with this brisk exercise, we would pick up our baskets and away again up hill and down dale. Though we knew every farmhouse where they had a good well, and had made friends with many a loud-voiced dog, we flattered ourselves that we were not distinguished by the country people from the many really serious-minded parties which took sober excursions to study "flora and fauna."

There were few hills within a radius of ten miles which knew us not, few glens left unexplored! We had crossed and recrossed the many streams of the region, on fallen tree trunks which formed natural bridges, on stepping stones if there were any, or on hastily constructed foot-bridges if it pleased our fancy to cross "where ford there

was none." Many wild leaps were made from stone to stone over rushing torrents, where a borrowed fence board happened to fall short. On one occasion it was the leap that fell short, and a gallant rescue was the result. Certain members of the party were too chivalrous to mind a few steps taken in mid-stream if there seemed no better way to reach the other side. Perhaps some of the burdens carried across were heavier even than the dinner baskets and coffee-pail; but I never heard any complaints. Sometimes it rained, but, though our camp-fire burned less brightly, our spirits were waterproof. What sights we saw, what stories we told, what songs we sang! No chronicler can ever recount the joys of that year.

As I look back over those days of precious memory a vague sense of sadness always comes over me. Why should such days go by, such comradeship pass? New generations of college folk come and the old ones scatter. It is only a few years since the last famous "Gesellen" picnic, yet one has gone alone to walk the paths which lead beyond life's border land. Another, across distant seas, looks out at night on the Southern Cross and comes not back to us. It is wonderful how elastic are one's heartstrings. The "Walking Party" was and it is not, nor can it be again save in the hearts of those to whom the comradeship was dear.

XXXI

OTHER PEDESTRIANS

"THE Walking Party" had arrived at the place agreed upon. The firewood was being collected and forked sticks for the coffee-pail were already in place. Two of the party had drifted away from the rest, in a way they were beginning to have, in spite of that article in the Walking Party's constitution which said: "All definite tendencies shall be discouraged." (This by the way was the only article; it was not written, but frequently spoken.) These two, then, found themselves at the mouth of what seemed to be a defunct brook. Somehow it occurred to both simultaneously that they had come out on purpose to explore this stream bed, and with faces toward its source they began to investigate.

It was August and the fall flowers were in possession of the open spaces. As we went further, the shade grew denser and the plants became more woody. On a bed of piled-up leaf mold glowed the red spikes of Jack-in-the-pulpit, and the



BUNCH-BERRY

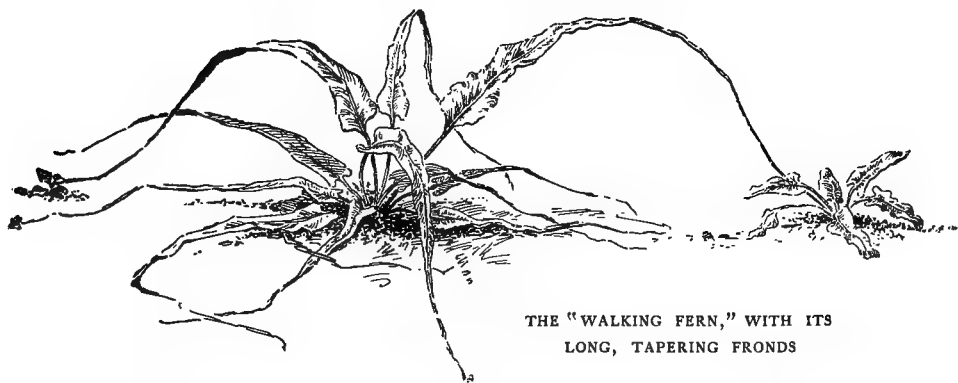
tight little bunches of cornel berries. There, too, we found the rich crimson fruit of trillium, which was new to me. The blue bullets of Clintonia (so the Botanist had called it), were held aloft on a tall stalk, between the orchid-like leaves; the red ones of the cucumber-root looked tempting enough. Pokeweed, too, was there, and from a distance we could see the birds busy gathering those juiciest of purple berries.

So much has been said and is still being said about spring flowers, that I often wonder why so few writers seem to have followed these same plants into the late summer. Their fruits are every bit as varied and often more showy than their flowers. Their ruddy or russet colors give character and spirit to the woods of early autumn, just as their delicate blossoms are the charm of May.

Peering among the mosses and lichens which clung to the rocks we discovered another pedestrian. It was none other than the "walking fern." The finding of this rare and beautiful plant was a thrilling event. Long ago the Walking Party had chosen it as one of its symbols. The "walking stick" was another. I have forgotten the original application, but the rate of speed of these two creatures might well be taken as symbolic of the lagging habits which some of our members had lately fallen into.

The walking fern we found that day was the first I had ever seen outside the herbarium. It had come climbing over the edge of a bank, and already one of its long tapering fronds had "taken

a step" over the edge and had found an anchorage. Another was waving gracefully, reaching for a place to gain a foothold. After the first rejoicings over this discovery we made a compact—the first of many—to keep the whereabouts of this plant a secret from the rest of our party. We had a zealous young botanist among us who needed



THE "WALKING FERN," WITH ITS
LONG, TAPERING FRONDS

discipline. It was well enough to gather saxifrage, and violets, and even trilliums for the herbarium—but when it came to rare arctic primulas and walking ferns we grew reproachful, then indignant. Why will people collect for the mere sake of adding one more specimen to their stupid hoards?

So we marked carefully the location. Unless some one cuts down that big yellow birch which looks like a "raggedy-man," or moves that pine trunk which spans the dry bed from bank to bank, we shall find the place next year. Perhaps the walking fern will have traveled many steps during

the season, but its pace is more leisurely even than that of the famed tortoise.

Our other chosen symbol is less shy than the walking fern. A big walking stick once signified his wish to be of our party by dropping from a tree to the shoulder of the Philosopher one September day. There he remained undisturbed until discovered by one of the party. The likeness of this creature to a twig must certainly have saved his life many a time. We put him down among the branches of a fallen tree and lost him almost immediately. He had only to "freeze" and he was quite safe. The Philosopher was slim himself, and confessed his sympathy with the creature, which evidently had more legs and arms than it knew how to handle.

Earlier in the season Sister Ellen had found one in the act of shedding its skin. It was a young one, only about half-grown, and exactly the color of the leaves. As these creatures grow, they literally change their green coats for brownish ones, more nearly matching the colors of branches. The green skin comes off in one piece, and the brown one is revealed already fitted on the body of the wearer. A favorite attitude for them is to lie outstretched against a twig, with the extremely long, slender antennæ and fore legs held straight out in front. When disturbed they amble off with awkward steps.

The Professor told us of the walking-stick's tropical relatives which, when full-grown, bear the

most remarkable resemblance to the leaves of the trees on which they live. Unlike our species, these southern ones have wings. They look just like animated twigs, with leaves attached. The wings are not only leaf-like in form and color, but, stranger still, the principal "vein" in each wing appears like the midrib of a leaf. Some of these most uncanny "leaf-insects" are green, while others are dull brown, imitating a dead leaf, even to the irregular, curled edges. We would have found the story hard to believe if we had not had our own walking-stick to bear witness to the effectiveness of its protective form and coloring.

XXXII

SISTER ELLEN'S FISH STORY

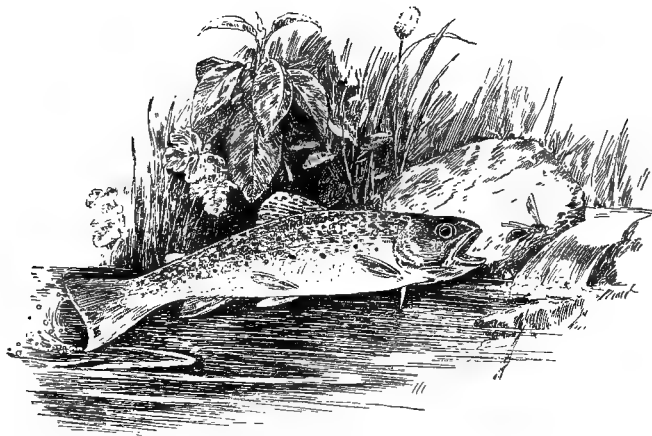
I ALWAYS envied Sister Ellen that trip to the Big Horn country. What tales she told of sage-bush and prairie dogs, of mountain climbing and camping out, of hunting and fishing, of narrow escapes and exploits of daring! She brought back pressed forget-me-nots and alfalfa, a glass of jelly made from buffalo berries, a huge pair of antlers, and a dozen other souvenirs. With these to bear witness, we were obliged to give credence to her stories. There was one trophy whose significance she was never tired of explaining. It was in the form of a fish, rudely carved from a piece of pine board, and duly inscribed with statistics. Here is the story as she wrote it out for me. It makes me long to go a-fishing.

It is a simple matter to catch a fish. Given an angler with hook and line and a fish in the water. Hunger impels the fish to take the bait, and the hook takes him. The angler does the rest.

But among fishes, as among men, individuality is strong and variations are infinite in number. It is this personal element that keeps alive a perennial interest in bouts piscatorial, and justifies on rhetorical grounds the recital of such adventures. To tell a fish story is human. Being possessed of

one in my own right, I succumb to human frailty and tell it.

We had been traveling for many days in a "mountain wagon"—my father, myself and Uncle Sam. We had crossed the Big Horn mountains, with all their deceptive miles of terraced foot-hills; we had seen with awe and wonder the rich valleys



BROOK TROUT

overhung by barren peaks that never put off their caps, no matter who came by. All these glories were left behind us, and we were wearily traversing the alkali plains that lay between us and Paint Rock cañon, our journey's end.

All day we had seen as through a glass darkly. There was but one color on the landscape—a dull, grayish dun. Far and wide grew nothing greener than the spectral sage-bush. The herd of antelope that swept like a phantom over our horizon line in the early morning, the coyote that followed us

afar off, and the skulking sage hens, all so blended with the general color scheme as to be invisible except when in motion. Even the squatter and his wife, at whose wretched cabin we drew rein, were singularly in harmony with their surroundings, and the children looked and acted for all the world just like the funny little horned toads that darted in and out and blinked at us from under the prickly pears.

"We'll soon be there," said Uncle Sam late in the afternoon. He was the only amiable one in the party. He had his pipe and his sanguine temperament. We had the dust of the desert in our throats and a deep-seated conviction that we would pass the night in that howling wilderness.

All of a sudden a sharp turn and a steep descent brought us to a ranchman's gate! It was like the transformation scene in the pantomime! It was too wonderful to be believed. There were a house and a barn, and a garden gay with flowers. Behind a thrifty young orchard waved a field of alfalfa. A stream wandered through this Eden, murmuring as if it apologized for seeming to intrude. We knew right well that without it this oasis would be a part of the dreary desert that hemmed it in.

This ranch was "Medicine Lodge," watered by Paint Rock creek. The "squaw-man" and his Sioux consort gave us welcome. It was long since they had seen our genial guide. A mile up the valley he would find his old camping ground and plenty of grass and fuel.

"Good fishing?" I asked, eagerly.

"Fair," responded the squaw-man, "but better up the cañon."

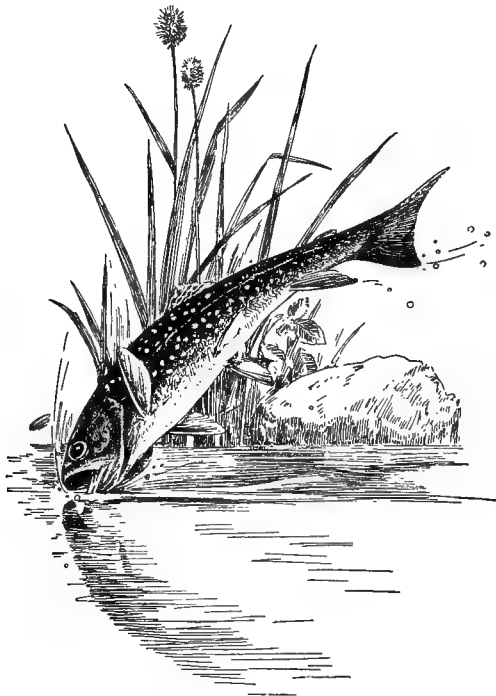
From my earliest childhood I had heard my father tell stories of fishing for trout in mountain brooks. It was the one sport I most longed to try. Like Kipling's Tomlinson, "I had heard, I had read, I had thought," but the opportunity had never come till now. And here, with the goal in sight, were my easy-going uncle and my unnatural parent making a plan to pitch our tent beside that trout brook—to lie down and sleep—without casting in a single line! To-morrow we were to make an early start, and go up the cañon, where Uncle Sam would show us—yes, he would—trout-fishing that was worth crossing half a continent to find!

I liked not their Fabian policy. What if the Bannock Indians should happen along and scalp us before morning? They were on the war-path not so far away. I determined to take no risks.

A discarded tobacco-pouch soon swung at my belt, with two big grasshoppers in it. I saw a smile and an impressive wink exchanged by my indulgent relatives, as I shouldered my pole and started for the water. They knew (and I knew) how much I *didn't* know about fishing.

The sun was sinking into a bank of yellow mist some distance above the horizon, but to all intents it was already sunset. A delicate fragrance floated over to me from the bank of sweetbrier that stood guard over our camp on the side

opposite the brook. A fringe of willows, interspersed with the silvery foliage of the buffalo berry, leaned over the water. It was a wide stream, and so shallow that my rubber boots were quite unnecessary, as I stepped from stone to



"THE WHISK OF A FINNED TAIL"

stone. But in mid-stream the strong current had cut out a narrow channel, and I paused just where it jumped down into a dark pool. Three pieces of granite thrust their noses out of the water above this little Niagara, and they looked so stable that I relied upon them. With a foot on each of the highest two, I cast my line valiantly from me, up stream! I knew in a moment that that

was the wrong way, for the current bore my grasshopper right back. An eddy curled it in behind a rock, where it seemed to catch on something. Before I could make a move to disentangle it, a thrill, the like of which I had never felt before, reached my nerve centers, via the pole! It was none of

your tremulous little twitches, but a masterful tug, a disdainful wrench that bent my pole and sent the blood back into my heart!

I lifted with might and main. The whisk of a finned tail, a fleeting glimpse of dusky scales and scarlet speckles, became suddenly correlated in my mind with the fact that one of my boots was full of water, and my line was swinging high in the air,—the hook gone, the gut leader nipped off short.

It was a small chore to go to the tent for the other pole. One does not expect all luck to be good luck in fishing. "As long as there is light there is hope," I philosophized. To my father's query I replied that I had lost something, and was going back to find it.

From my stone perch I cast the second grasshopper to the place where the first had disappeared. It was undisturbed. The sound of an approaching wagon caught my ear, and a moment later I heard an exchange of friendly greetings. Listening intently, I recognized the voices of a hunting party we had met twice before among the mountains. They were all mighty men of valor with rod and gun, and were on their way to the Ten Sleep country, a veritable happy hunting ground, if reports could be believed.

I heard my father say that I had gone fishing. An impulse to make one last effort seized me, as the night came down. I flung my line into the air at random, and the bait struck the water just below the little cataract. A tug, mighty as the

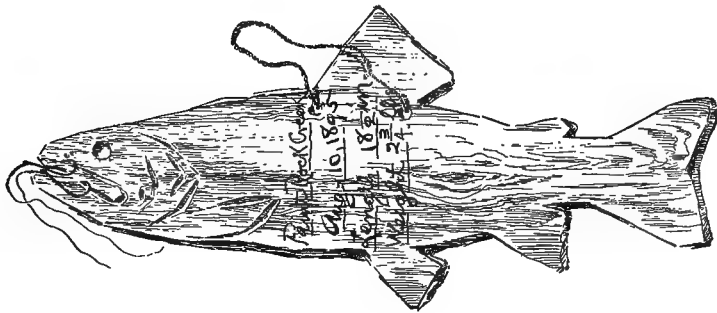
first and fully as prompt, nearly lost me my balance, but it steadied my nerve. One thought, one purpose filled my mind—I must get that fish to shore. Then I felt strangely self-conscious, all at once. The trees on shore began to move in a circle of which I was the center. The crackling of twigs dispelled the illusion, and I saw my father bearing aloft a flaring pine-knot. He was followed by seven lusty fellows, who crept in Indian file along the edge of the stream. "Behold how great a cloud of witnesses!" was the thought that put strength into my good left arm. I lifted with steady nerve and set teeth. With joy I saw my angry captive flash out of the water. Then came an instant of despair. He was off, the bent pole straightening itself with a spring that snatched it out of my hands. Wait! He was free, but his freedom came just too late! The curve on which he rose was complete: he fell forward—right at me!

The mathematician may think that those two curves were alike. But they were not. The up curve was a forlorn hope—the down curve was perfect assurance. I knew my fish would never escape me. By all the laws of dramatic unity and poetic justice, he was mine. For in his gaping mouth I read a startling revelation. He was bringing back those two hooks!

He struck the water in that little basin shut in by the three jutting rocks, and I *sat down upon him!* Calmly, and with dignity, I trust, but without delay. It was the only thing to do. He was in a trap that needed but a lid. I was that lid!

Now I could answer my father's call, for the dazed fish had found a corner, and a groping thumb and finger had found the back of his neck. My repressed feelings broke forth in one long, ambiguous, feminine scream.

There were bigger trout up the cañon, as Uncle Sam had promised. And there was noble sport in catching them according to rule. But my enjoy-



"A LIFE-SIZED, WOODEN EFFIGY OF MY FIRST BROOK TROUT"

ment of trout-fishing reached its zenith in the dusk of that August night when, dripping but triumphant, I went to meet the rescue party on the shore. By my father's torch I read astonishment and admiration on all faces. And the wonder grew when I held up my struggling prize, and they saw in the yawning mouth two hooks, and impaled upon them two grasshoppers, still struggling to get free.

Theoretically, I do not approve of the souvenir habit. Chips from monuments and splinters from historic trees I esteem not. But above my desk

as I write hangs a trophy that I prize. It is a life-sized wooden effigy of my first brook trout, neatly whittled out, and suitably engrossed with faithful statistics. It was Barry, leader of the visiting party, arch fisherman and good fellow, who called the humble lid of a cracker box to serve the higher uses of art. It was he likewise who retired the two fish hooks from active service, and devoted them to a purpose significant, if not very æsthetic.

When the thing was finished to his liking, he presented it to me with a profound bow, and said: "Accept wid me compliments this counterfit presentsintm'nt. It's a clumsy affair, but it tells the facts. That was the biggest an' the naytest catch of the year, so far as I know. I'll warrant ye'll not be fergettin' that night, an' when ye do, this will help ye to remimber the day."

XXXIII

BROOK AND LAGOON

IN the late summer there is no walk so delightfully full of surprises nor so surprisingly full of delights as that one along the bank of Clear Brook. Back in the hills the stream rushes through a narrow channel between walls of rock, or leaps a sheer fifty feet into a mammoth pot-hole. But after hurrying through the town it finds its level in the lowland and "fair dawdles." A path along its bank is packed hard by fishermen and by bare-footed boys lured thither by the opportunity for wading.

Escaping the heat and dust of the sun-dried uplands, what a relief it is to drop suddenly into the cool shade along a wooded stream. Immediately the scales drop from my eyes and I begin to see what is worth while. Tangles of jewel-weed have sprung up wherever a tree has been taken out and a bit of moist soil left untenanted. The new railroad bridge hangs against the sky supported by the treetops so far as I can see from down stream. Every available inch of cleared space about the approaches of the bridge has been taken up by this irresistible plant. It does not grow entirely alone, however. Towering high above it here and there are gaunt plants of angelica, like tall chandeliers. I could see, too,

that the jewel-weed had troubles of its own. Straggling over it, clutching at its most ambitious branches, were tangled ropes of yellow dodder. Twisting and writhing, reaching out its long naked arms to seize some new support, this uncanny, orange-colored parasite seemed to have gained sad supremacy even over the successful jewel-weed. I like better the pretty pink-flowered bindweed. Its luxuriant leafage and twining habit have nothing of the cruel throttling ways of the dodder. The bindweed—pretty wild convolvulus—creeps over the trees, gently covering their bare trunks with shining foliage; or, running out toward the light on a slender branch, it hangs gracefully swaying over the water. Virginia creeper has similar ways and is much lauded for clothing the trunks and branches of dead trees with its draperies of green. When the autumn changes this green to hues of red and brown our praise knows no bounds. I have seen nothing half so splendid over the verandas of houses as these wild, untrained creepers along Clear Brook.

Step carefully now and keep to the beaten path. If you know yourself to be susceptible, you would better turn back or go round some other way. Gather your skirts close about you and make ready to skip nimbly, for here we must run the gauntlet between hundreds of plants of poison ivy. Who, in passing, does not give this plant a rub, metaphorically speaking? Naturalists have done their best to wreak vengeance upon it by branding its triple leaves with the "skull and



FLOWING PEACEFULLY BETWEEN ROWS OF WILLOWS

cross-bones." It can do no better than to keep up its reputation. Has it, then, no virtues? Will no one speak a good word for this plant?

I will.

Stand off and look at it! As a climber does it not compare finely with Virginia creeper? Will you not concede that its young leaves are exquisitely colored and delicate of texture? How well its gray-white berries harmonize with the blue ones of the ampelopsis and the rich transparent red of the bittersweet!

Poison ivy reaches its full glory with the crimsoning sumach in October. Mingling with the brown of burdocks, pitchforks, and other disreputable weeds with which it consorts in the dry bed of a certain brook of my acquaintance, its unmistakable beauty challenged my admiration. Such riot of red and orange and flame color! The wind, one perfect autumn day, played among its leaves, lifting them that I might see them to advantage. It was as if one had set fire to the brook bed. The very next day, when I took the Artist down there to see the wonder, there was nothing left but smoke and ashes. Some one had indeed set fire to the place, and burdocks and ivy had perished together.

"It's just as well," said the Artist. "Some children might have seen and gathered it, and that would have been a pity."

I'm glad I saw it, though; for now I know that even the despised and maligned poison ivy has its moments of beauty.

After passing through the place of the bad ivy, the path along Clear Brook makes a sudden bend toward the left and brings one directly to the bank of the stream. One day I found a boat there, and daringly seating myself in it, I pushed



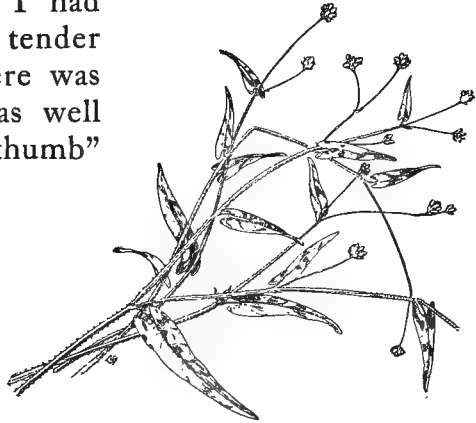
FORGET-ME-NOTS

it off and pulled slowly down stream. The left bank was in deep shade and sloped down close to the water's edge. A wide fringe of forget-me-nots hung over, fairly dipping their sweet blue faces into the water. I drew up close and put my hand in among them to feel their cool leaves. The water was a perfect mirror. No wonder they peered over the edge! I looked at the reflections in the stream and then at the realities on the bank. How faithful was the unbroken surface! I shifted my position. The ripples fled from beneath the boat and lapped against the forget-me-nots. Again there came stillness and smoothness.

I had drifted a little way, and a new reflection came into the mirror. This was a brookside trailer, with leaves like long pointed arrows. It managed to be reflected by trailing its long, recumbent branches over a mat of forget-me-nots, then over the tops of a clump of sedges. Finding no further support, it hung there, plucking at me as I drifted

by. Its plucking had some effect, for I felt its claws and stayed the boat long enough to assure myself that it was none other than "tear-thumb." Its teeth looked just as sharp as ever. This plant always reminds me of the family of rodents because of these reflexed prickles. Long ago the suggestion in its name had proved too much for my imagination and I had tested it against my tender thumb. *It did*; there was no doubt that it was well named, and "tear-thumb" it will ever be to me, no matter what the botanists may call it.

The boat grounded on a muddy bar and swung out into a bay. A path which I had never seen before



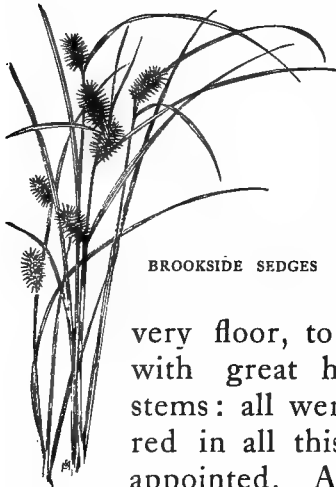
TEAR-THUMB

opened invitingly at the boat's side. My wanderings had always been along the other bank, but here was mystery. How did I dare leave the boat there tied to a tree root? Yet it seemed quite natural in the woods to do unconventional things. The path bore straight away from the water for a rod or more, then bent sharply to the left and soon brought me to the bank of a second stream whose existence I had not even suspected. It was wilder than the first. The bushes on its further side looked unfamiliar. A gray veil hung over them and added to the mystery. I rubbed

my eyes to get the magic out of them and looked intently at the near-by shrubs. They were just ordinary low dogwoods, poplars and ashes, but they were overgrown with wild clematis! Masses of the bearded seeds still clung to the flower-stalks. This explained the gray veil on the opposite bank. I never supposed there was so much of this adorable plant in the whole world! I wondered if I could ever find the place again, for certainly the Artist would want to see it when I told him of my discovery. I walked over the path two or three times to make sure of landmarks, and even moved a stone and a fallen limb to a conspicuously unnatural position in the trunk of a dead tree.

While searching about for a stick to drive into the ground at my boat landing, I found trailing over the rich moist earth many hog-peanut vines. I knew the plant by its hairy stems and triple leaflets. Earlier in the summer when the purplish blossoms attracted my notice, the Botanist had shown me the underground flowers from which the peanuts of this plant develop. "By this time the crop must be ready for the harvest," I thought, and fell to digging carefully, following a thread-like stem which crept away under the leaf-mold. My search was rewarded finally. There was the peanut, a queer little pod containing but one seed. The hog-peanut loves the moist shade and the deep loose soil, and since there were no hogs hereabout to root out these nuts the plant was prosperous.

Putting my peanut seed into my pocket as a trophy, I went back to my boat and took up the oars. Beyond, the stream was beginning to widen into a sort of lagoon. The banks were less shaded and the plants more like those of the open country. There Joe-Pye weed and goldenrod nodded at each other over a mirror, and their reflections nodded in unison. Swamp milkweed in full flower and



BROOKSIDE SEDGES

the deep blue lobelia crowded each other, and their possession of the place was disputed by boneset and monkey-flower. Sedges of all shapes and sizes crowded each other in this wild garden; from the tiny ones no taller than my finger and crouching on the very floor, to the coarse, harsh-leaved ones with great hard balls surmounting their stems: all were there. I looked for a bit of red in all this riot of color, nor was I disappointed. A plant of monarda or Oswego tea had somehow found its way down stream into this colony and added its bright note to the harmonious whole.

I rowed over to a clump of swamp milkweed so near the bank of the stream that its reflection was as distinct as the plant itself. Reaching forth, I drew the strong, firm stems toward me. Once before I had gathered these flowers for a wild bouquet, but now I knew better. They do not take kindly to vases. They have no parlor manners, for

they droop and hang their heads stupidly indoors. How much better they look against a hummock of tall sedges anyhow! I wanted to know why a certain white butterfly should so persistently cling to the flower which hung out over the water. It was odd that it should not flit, since tradition demands it.

No wonder it did not leave the flower! There it hung and even allowed me to take its wings between my fingers. The flower had caught it as with a tiny vise and would not let it go. A faint hum caught my ear. My eye followed the direction from which the sound came and found a velvety bee in the same predicament. Both had been caught by the leg in stepping lightly over the honey-laden cluster between two parts of the complicated flower. Failing to free themselves and the pollen organs of the plant at the same time, they remained as hapless prisoners, unable to fulfil their own destinies or to carry out the designs of the milkweed. I have caught bees in my net before now whose bodies and legs and heads fairly bristled with milkweed "saddle-bags." These at least had done all that could be expected of them. The milkweed which thus sentences a bee or a butterfly to a miserable death in the stocks gains nothing by the act.

My borrowed craft was drifting too near the open water of the lake, for we had almost reached the broad mouth of the creek. Fortunately the current was weak, and I made my way back to the mooring with some haste. I felt a little hesi-

tancy about meeting the owner of the boat and hoped he was still fishing farther up stream. Fortunately I had marked the place, and hastily disembarking I tied the rope to a stump and made good my escape. I'd like to have thanked the man, but he might have been ungracious. It was just as well, perhaps, to be grateful in silence, thanking my stars that I did not meet an irate angler waiting for his boat.

XXXIV

IN OCTOBER

THERE'S no month like October! The magical blue haze of autumn casts a spell over the country landscape. From my house door I can see the woods that form the narrow border of Clear Brook. Dark beckoning hemlocks and whispering white pines invite one to wander. Flaming scarlet maples, like pillars of fire, light the way through the aisles of oaks and chestnuts down to the brookside. Once there the brook will take care of you. One can not go far out of the way following Clear Brook. The air is full of silken threads laced across the path by ballooning spiders. They seem

to belong naturally with the blue sky, the ripening nuts, the ruddy leaves and all the rest of October.

In the edge of the woods stands a precious clump of witch-hazel. As you look up through the naked branches you become conscious of a halo enveloping the tall bush.

Or can it be a reflection from the giant hickory yonder, whose mellow splendor, as with a Midas'



THE WITCH-
HAZEL PRESENTS
MANY SURPRISES

touch, has gilded every weed and shrub in sight? No, the hickory shall claim no share in the making of this subtle essence. The witch-hazel's gold is of its own alchemy and the plant is famed for magic of a subtler type than that of King Midas. One never comes upon this plant in blossom without surprise, pleasure and a sense of mystery. The summer flowers are gone; it is the season of fruits and frost. What wonder, then, is this?

"Has Time grown sleepy at his post
And let the exiled Summer back?
Or is it her regretful ghost,
Or witchcraft of the almanac?"

When Ellen and I were children, we had a neighbor who could "water-witch." Though small in faith, I confess to a decided thrill down my "spine-bone" when the forked twig held tightly in his rigid hands was seen to turn downward time after time as he crossed a certain line. The old man invariably selected the most impossible situations in the barnyard and would then pace solemnly up and down until the witch-hazel fork told him where water was to be found.

"There!" he would announce, eyeing with quiet dignity all skeptics; "I wouldn't be afraid to dig hyur, if I wanted a good spring-fed well."

Father never did dig where he suggested, and the power of his divining rod remained untested. But we children were all impressed, and ever since then we have been devoted to the witch-hazel.

In the fairy tale, forlorn Cinderella was sup-

plied with gowns of silks and laces, jewels rare and priceless pearl necklaces by the witch-hazel tree planted over her mother's grave. Though not the same kind of tree as ours, it evidently bears the same reputation in England. Our witch-hazel possesses a charm quite apart from its reputed powers. Though it befriend no forlorn Cinderellas and discover no hidden treasures, it has well earned its title. There is witchery about its pale golden blossoms, fluttering like tiny ribbons from a fairy's cap. There is nothing to compare it with. It reigns alone in the autumn woods.

Right among the flowers you will find the nut-like fruits. In the very fact that seeds and flowers are present at the same time, there is a touch of the supernatural. These seeds are from last year's flowers. Take a branch of witch-hazel home with you, and you may have as pretty a bit of parlor magic as you could wish. The delicate perfume of the blossoms distracts the attention from the blunt button-like fruits. But before your back is fairly turned they may burst and pepper you with small, shiny black bullets. The dry air of the house causes them to open suddenly and let fly at you. If you turn to look back you may get one in the eye. The seed-pods stand with mouths agape, and you can almost imagine you hear a cackle of elfish laughter. But it was probably a rattle of seeds from another cluster of wide-open capsules. They keep it up until not one is left. One night I was awakened by a strange popping sound that seemed to emanate from downstairs. Next morn-

ing I found the parlor floor covered with witch-hazel seeds. I picked them up and counted twenty.

I was about to leave the witch-hazel and follow the course of Clear Brook, when my attention was called to a number of small brown discs suspended among the branches of the shrub. In these I recognized the "nursery" of a spider, and concluded to investigate farther. There were five little packages done up in dull silk wrappings and hung one above another on a slender, almost invisible framework of threads. The spider had evidently not finished her work, as there she was clinging just below the last of the little cases. These cases were the sacs or cocoons that held her eggs, and she did well to suspend them thus out of harm's way. The cables which supported them were heavy and firm, and securely fastened to the branches. They were so placed that the egg-sacs were suspended in mid-air, some distance from any branch. A marauder must be keen of vision and light of foot to find her treasures. In front of



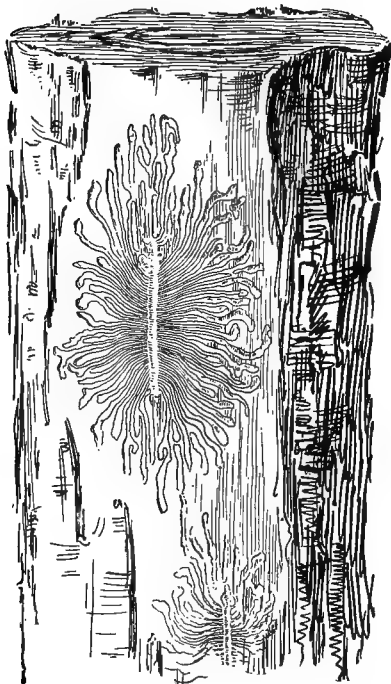
THE WINTER
NURSERY OF THE
LABYRINTH
SPIDER

the tier of cocoons was hung the imperfect orb-web of the labyrinth spider, glistening in the October sunlight.

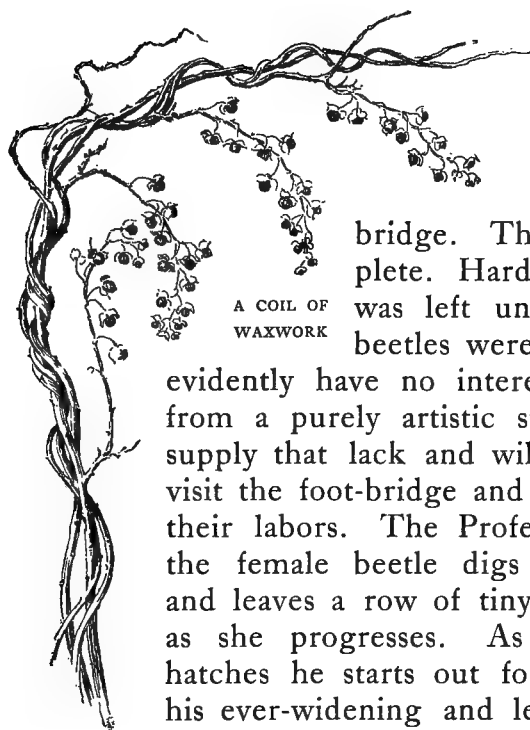
I found several of these nurseries on that trip. The spiders had taken possession of many bare shrubs along the path to the brook. How careful they always were to attach their cables to twigs, and not to the transient leaves!

When I finally reached the small bridge which spans Clear Brook it was nearly time to go home. I had time to stand with my hands on the railing and talk back at the water. Mechanically my

fingers picked away at the small tree trunk which formed the top of the railing. A great sheet of bark peeled off in my hand, and revealed as fine a bit of wood carving as one might see in many a long day. The engraver beetle had been there before me and had evidently reared a numerous and most skilful family. I could only judge of their number by the tunnels they had made, and of their skill by the neatness and regularity with which they followed the pattern set by their master. I



ENGRAVED BY A FAMILY OF BEETLES



A COIL OF
WAXWORK

peeled off all the bark that I could loosen, thinking what a fine thing it was to find an engraved foot-bridge. The work was complete. Hardly an inch of space was left uncarved. But the beetles were not there. They evidently have no interest in their work from a purely artistic standpoint. I will supply that lack and will invite others to visit the foot-bridge and see the results of their labors. The Professor tells me that the female beetle digs the main tunnel and leaves a row of tiny eggs behind her as she progresses. As each young one hatches he starts out for himself, making his ever-widening and lengthening tunnel at right angles to the central one. The creatures are extremely small, even the adults being scarcely a quarter of an inch long.

I went home by another path, which brought me through a pasture and over the most adorable of stump fences. Festoons of orange berries hung from a young tree in the fence-row, and I felt justified in helping myself to a coil of waxwork or false bittersweet. In the warmth of my study, the capsules would reveal their scarlet hearts and give color to our Hallowe'en "doings."

XXXV

CIRCUMSTANTIAL EVIDENCE

INDOORS it was hot and stuffy. Under the influence of furnace heat I was slowly mummifying. I determined to sally forth. It was the eighth of January and a raw sort of day. The ground was covered with snow which had partly melted and then had frozen over again into a thin icy sheet, which broke at every step. Behind our house was an open field, now swept bare by the free north wind. Even the weeds grew sparingly here and showed the effect of much mowing. A flock of crows "riz up" at my approach, though I would gladly have conferred with them. Perhaps they looked on me with suspicion because of the red hood I wore. I'll admit it was an unbecoming headgear and seldom saw the light of day; but I hadn't expected to meet any neighbors.

The snow crust along the road was broken by the foot-marks of only one pedestrian. I tried stepping in his tracks, but found it poor sport. I looked about me for something more stimulating, and found it in the tracks of two crows. One had evidently been walking along in the same direction as myself, and lately. Up on the steep bank was a small black object, just showing above the snow. The crow climbed the steep slope, sinking deep at every step. How he must have felt when he

discovered the black object to be a mere bit of clod! I imagine he looked around to make sure no crow was watching him, then walked unconcernedly down again. I could trace him by the fresh tracks, up and down. The second crow had come from the opposite direction and had gone through exactly the same series of manœuvres. I chuckled at their stupidity.

There had been a flurry of soft snow early in the morning, and most of it was collected along the road. The crow tracks in this soft carpet were even more distinct than any I had noticed before. The impressions of the warts on the various joints of the toes were there and the tapering cuts made by the claws. I followed one track for some distance over the soft snow till it suddenly stopped. For a moment I was at a loss to know how my crow could get away and leave no track. Then I found out. On either side of the trail near its end were great marks, as if the claw of some large animal had scratched the snow. A little farther on were more scratches. They had been made by the stiff quills of the crow's wings as he took flight. I began to like crows.

I bent my steps toward the first of a series of small brooks which found their way through this field, all bound for the same level, the flats below the town. In autumn I had gathered the fragrant mint just where the road crosses the first stream, and in a vague way I wondered if it were still growing as fresh as in October. On my last visit in November I could find no traces of the skunk

cabbage and veratrum which had made themselves so conspicuous in early summer. If they were beginning to show their heads now in January I needed to know about it.

Again the crows flew up in a protesting body from the bank long before I was near enough to see why they had gathered at the brook's side. They flapped away, reviling me loudly at every flap for my intrusion. "A crow is a noisy, simple old bird," I thought, but I didn't talk back to them. My opinion of them rose again before an hour had passed, and I wished they would come back where I could beg their pardon.

Arriving at the brook's rim, I was astonished to find the snow on both banks tramped as by thousands of little feet. The tracks were evidently made by crows. There were perhaps a dozen or twenty in the party I had disturbed, but the banks of the stream for several rods looked as if an army of four-toed soldiers had come there to drink. I don't believe a score of crows made all those tracks. Perhaps there had been an open-air meeting or a county convention—crow politicians must be a thirsty lot!

I crossed the brook and climbed a fence to a bit of high ground. I stood still and surveyed the prospect from my tiny hilltop. In the distance in front, the snow-covered slopes of a long hill climbed away toward the south. I watched a road wander painfully up this hill and was glad I could stay near home. From behind me came the soft sighs of the white pines. But I had not come out

to generalize or to "think thoughts," but to see what was going on.

Ah, there at my feet was a hole in the ground, its doorway worn smooth by who knows what kind of little feet! If the creature would only just show itself I should have a story to tell. It wouldn't do to sit down and watch, so I stood. The snow was deep and cold and I couldn't wait, but looked about for a more promising lead. I had some trouble making my way among the young thorn trees, the brier bushes and weeds. A well-grown burdock found me, and requested me to carry a bundle into the next field for it. This I flatly refused to do, emphasizing my refusal by snatching the prickly mass from my skirt and flinging it far from me. The burdock seemed quite as well satisfied, for it made no complaint of my discourtesy.

Surely some foraging crows had visited that slope before me, for their tracks were fresh and clear in the snow. The crust was too thin to bear up even a crow. I followed one which had

evidently retired alone to the very top of the knoll. There he seemed to have stopped and, after dancing a few steps, had gone down again in another direction. I could see just where he had made the



"THE CAPS TORN OFF, THE CONTENTS
RIFLED"

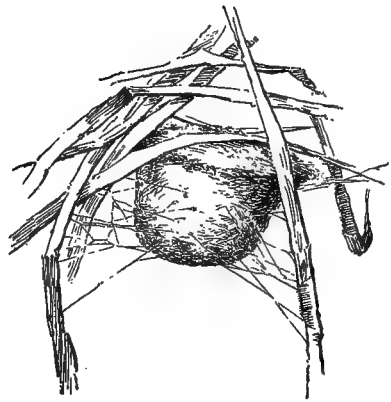
turn, and wondered if he had had any special errand up there. I was about concluding that the ways of crows were past finding out, when my eye caught sight of a small object lying on the snow near the place where the crow had stood still. It was a bit of woven silk about half an inch across, and round. It looked like part of some cocoon, and I mentally accused the crow of insect-hunting. But where's the rest of this cocoon? He would not care to eat anything so tough. It was not hard to find. From a crevice in the snow no bigger than the crow's bill, I fished out the rest of the cocoon and identified it as the egg-sac of an orb-weaving spider. I fitted the pieces together and convicted the crow without further evidence. Not an egg remained in the sac. A few, just to make me certain, clung to a stray thread of silk, but the sac was empty.

"Now where did you find that sac of eggs, friend crow?" I inquired. "Is your eye so trained that you see such dainties on every bush, or does your instinct guide you? If it's instinct, then I'd recommend the spider to get an instinct which teaches her how to hide her cocoon more safely. I've a notion to play Sherlock Holmes and see if I can find you out."

I examined the hole in which the larger part of the cocoon was found, and made up my mind that it was made by the crow in tearing open the sac. I believe he found the eggs where the spider left them and carried his prize package off to rifle it alone.

The next thing was to follow more solitary crow tracks and, though some of them led back and were lost in other paths, I managed to get together a half-dozen empty sacs and caps to match. This was encouraging, and the circumstantial evidence made out a strong case against the crow. Finally I determined to discover where the crows had found these egg-sacs, which were apparently very plentiful along here. How convenient to find one's victuals and drink so near together!

Selecting the track of a crow who seemed to have some individuality, as he did not tread any beaten path, I followed it for some distance. Once I almost lost it, but found it again by studying a peculiarity in the footmark. This crow had evidently lost a piece of one of his toes. We brought up short at the foot of a small clump of raspberry bushes. The canes were covered with that soft bloom which makes them so charming in the winter time. But to follow the crow. Several canes grew close together; the snow crust at their base had been broken and the dry grass uncovered. I held my breath with excitement and dug the snow lightly away with a stick. There in the grass, stitched fast with many a silken thread, I found



A SPIDER'S TREASURE — A CROW'S
PRIZE PACKAGE

what no crow had yet molested. Three perfect cocoons, so cunningly made and so beautiful that I mentally resolved to restore them to their place after I had taken them away for the Artist. In shape they resembled nothing more than a chocolate cream. In color they were grayish white, tinged with pale brown. Dainty things they were, and filled with innumerable pale yellow eggs, the spider's priceless treasure.

I bore them home and told my tale of the brook and its visitors, the sloping bank, the crow and the spider's eggs. The jury admired the delicate color and graceful form of the egg-sac and gave a unanimous verdict of guilty, but recommended that mercy be shown the offending crows.

XXXVI

A WINTER WALK

IN spite of the fact that it was midwinter and the roads were drifted, I determined to take advantage of a sunshiny day, rare in January, and visit some of my summer haunts. It is hard to confine one's walk to indifferently cleared sidewalks and conventional paths when one feels that there are things going on out in the real world. The path leading to "Liberty Vale" was sure to be cleared, and once in the open road beyond I would not mind the snow. I listened to no objections, but started up the campus hill, with my face toward the woods along Fall Brook.

The first thing that attracted my notice was a brown and black "woolly bear," which slowly crawled along the edge of the sidewalk. I was surprised and concerned. What business had he to be going about in that fashion? Did not all the traditions of his family demand that he spin a cocoon as soon as cold weather comes on and retire from active life? Here he was, however, and no book can ever make me believe that "caterpillars" sleep all winter. This one was awake, although he curled himself up in my hand and "played 'possum." I wrapped him loosely in a note slip, twisted the ends, and put him into my hat. Just what he will do I have plans for finding

out. I shall keep him in a cool, dark place, in a box of earth and dead leaves, until he does something.

Then I saw an oriole's nest flapping loosely against a bough in a high tree-top, and I fell a-thinking of the summer, and forgot it was January until some noisy tree-sparrows playing "Here we go round the barberry bush" woke me up. I had passed that elm tree forty times last July and August and had seen the orioles whirling in and out, but their secret place was well hidden by kindly summer. There are three nests in that same tree. They could hardly serve as homes another year, even if anybody wanted them. The wind has switched them to shreds and tags.

My room-mate and I had promised each other that neither would ever go alone along the really dangerous paths on the sides of the gorges. To-day I was strongly tempted but finally contented myself by gazing down at the ice-bound stream and at the huge icicles lining its steep, rocky sides. They hung so cold and blue, and gleaming in the sunlight. The Jack Frost of my nursery book had just such icicles for whiskers. A week later when they were in the height of their beauty the Artist found a safe path down to the flat rocks at the bottom and took a winter picture.

But it was too cold to stand long admiring the icicles. Further up where the banks are sloping, I could follow a path down to the water's edge. The sights would be tamer, I knew, but my desire to be nearer the water was too strong to resist.

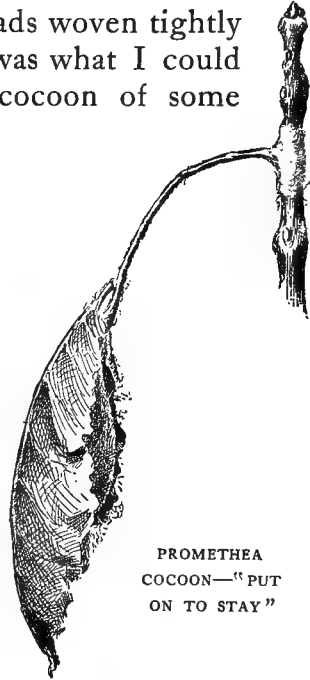


WINTER

I have always had a failing for wet places. I was probably restrained in my youth from wading and paddling. If I can find a spring or brook, a pond, or even a plain, homely mud-puddle to poke about in, I am more than content. The life in the water is the life I turn to for my solid satisfaction. I must confess that I had no idea of finding anything alive along the frozen edge of Fall Brook, at a place where the stream widens into a pond and receives the surplus water from a cold spring and a tributary brook. But what do these round holes in the snow mean? Surely "skunk cabbage" is not having a "spring opening" in January? But so it is. There are the strong brownish purple hoods just lifting their peaks above the water. Up further on the bank the snow was melted in little cup-shaped hollows around each blossom. Did you ever experience the odor of this vegetable? You can't remember? Oh, yes, you could if you had ever smelled it. *Perhaps* you can resist the temptation to put your hand down and rub its smooth sides. *Probably* you cannot. You will certainly want to smell it again, just to see if it smells as bad as it did last year. Yes, it is the same old smell, perhaps a little worse than ever before. In spite of its unsavory name and reputation, the plant delights me. Its bravery cheers me, and its vigor quickens my pulse. I can ignore the rest.

As I strayed further down the bank of the stream, I came upon some wild cherry trees, standing bare and dark against a background of blue sky. Why did most of the leaves fall and only a

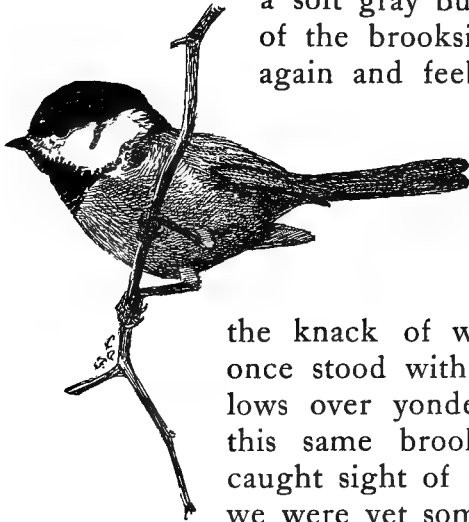
few curl up and stay on the tree? I tried to pull off the only one I could reach, but it would not come. The branch sprung mockingly upward when I let go. After another effort I succeeded in getting a twig on which there were three leaves. They were, indeed, put on to stay, but not by the tree. They seemed to be sewed on or fastened on by means of fine threads woven tightly together. Inside of each leaf was what I could not help recognizing as the cocoon of some insect. What will come out of these cocoons? When they come out I will tell, not before. They have gone to bear that furry caterpillar company until such time as suits them for further development. On the same tree were masses of tent-caterpillar eggs, well protected from cold and rain by their coat of varnish. How easy it is to see them after one has seen them once! They seem to stand out clearly, and we wonder that they ever escape our notice. I shall leave them on the tree and visit them again during the first warm spell of April. I found these same things on our apple tree in the dooryard and made bold to remove them bodily from their chosen place. Their tents are not handsome ornaments for the lawn, and the neighborly way in which they



PROMETHEA
COCOON—"PUT
ON TO STAY"

linger about the doorstep in early summer is not at all to my taste.

By the time I reached the Cathedral Pines I must needs turn back. The wind was cold and the sunshine had grown thin and watery. I fancied I heard a chickadee, and noticed there was a soft gray bunch moving in one of the brookside trees. I looked again and feebly tried to call the



"THE CHICKADEE EYED
US CURIOUSLY"

bird. It seemed absurd for me to try to imitate the tiny creature; I was a million times his size. One who has

the knack of whistling bird notes once stood with me under the willows over yonder on the back of this same brook. His quick eye caught sight of the chickadee while we were yet some distance off. He began by whistling an *s* through his teeth in close imitation of the bird's

conversational chirp. The friendly little fellow answered with a brisk "chickadee-de-dee." We stood motionless, the tops of our heads but a few feet below the tree's lowest branches. The whistler then began to call in the soft, plaintive "fee-bee" which is the special spring note of the chickadee, but is not forgotten even in winter. The bird's reply was but a shade more delicate and refined than the whistle. His behavior was

most flattering. He not only recognized the note, but signified his willingness to continue the conversation by perching on a lower limb. He eyed us curiously, while I fairly held my breath, and the whistler kept up the flow of talk. The bird flirted his long, slender tail, showed his black velvety head and stock collar and answered with a more prolonged chicadee-de-de-dee.

"Fee-bee!" whistled my companion, and the bird suddenly whisked away into the tree-top without a word.

"Evidently I said the wrong thing that time," said the whistler, as we took our leave.

"Chickadee-dee," the bird called after us cheerily, as he went about his business and we about ours. He had evidently forgiven the error and was ready to take us back into his confidence.

I reached home tired, but happy and hungry. In making up my account with nature for that day I have:

DR.

One and one-half hour's time.
Energy for a mile walk.
Muddy shoes to be cleaned.

CR.

One "woolly bear."
One oriole's nest (out of reach).
Barberry bush and red berries.
Flock tree-sparrows.
Skunk cabbage, touch and smell.
Three cocoons to watch.
Icicles in the gorge.
Tent caterpillars' eggs (not in my own trees).

All these things were extras. The air and the blue sky, that peculiar blue which we have after

a snowstorm sometimes; the exercise; the clearing out of cobwebs from my brain, and the routing of goblins which love to lurk in cobwebby places,—these were the real objects of this winter walk. I shall never again allow myself to be mewed up between walls of brick and mortar for any length of time. The arching tree-tops are temples which call to worship. Their voices and the murmur of the ice-rimmed stream mingle like soft music from a far-off organ. I will go often, and be lifted out of the humdrum of every-day existence. The outdoor world is full of life in winter. To know this life one needs only to be open-eyed and open-hearted; the spirit of winter is ever ready to guide, to cheer and to bless.

XXXVII

SKUNK CABBAGE

THE bees are not the only flower-lovers who have discovered the skunk cabbage and delight to pay it respectful visits long before other flowers are awake. Every year I make a pilgrimage to the nearest colony. Even in January I have broken the ice around the hoods and counted dozens of them. They do not mind the weather. Ice-cold baths seem to weaken neither the constitution nor the odor of this lusty bog plant. I well remember the first time I heard a bee buzzing inside the hood of a skunk cabbage flower. Do you know that sound? Then you have something yet to live for. It is worth a long hunt and a cold wait.

Prowling along the underbrush on a slope above Cold Spring one day in early February, I became aware that some one else was crunching about in the snow which covered my favorite "cabbage patch." The person, dressed like myself in short skirt and heavy boots, was intent on some odd business. I could only make out that she was bending down and thrusting her hand into the snow. I went nearer, emboldened by natural curiosity, and discovered that she held in her hand some small instrument which gleamed in the sunlight. My "interest in her strange behavior" was not to be conquered, so I accosted her, in

the hope that she was harmless and might let me into the secret.

She started at my "Good morning," but didn't look guilty, though I felt sure she had been prying into other people's business. I saw that in her hand she held a thermometer, and as she returned my greeting she thrust it down into an opening in the snow. "May I look?" I asked, suiting the action to the word without giving her time to deny me. The opening in the snow had not been made by her hand, as I supposed. It was rounded smoothly, and down at the bottom I could distinctly see the top of a skunk cabbage hood.

How came these air holes? What did the thermometer mean? I looked inquiringly at my new acquaintance. She showed me that some of the openings were small, others as much as eight inches across. In no case was the hood of the plant on a level with the surface of the ground. In the smaller ones the cavity was larger at the bottom than at the top, the snow walls forming an arch over the plant.

While we were talking the thermometer had been busy taking the temperature of one of the skunk cabbage plants. She gently drew it forth and with a quick eye read its record, which she jotted down in her note-book against the date. She then let me look at her notes. We found that the temperature of the plant was in many cases considerably above that of the atmosphere. The largest difference between the two was 4°

Centigrade. When I saw that the thermometer spoke in an unknown tongue, my respect for the young woman rose still higher, and I almost dared ask her to tell me how to reduce it to the Fahrenheit scale.

"I thought when I first noticed those holes in the snow that the skunk cabbages must be at work and generating enough heat to melt the snow around them," she said. "Now I'm sure of it. I've visited this place every day for a week, and my record shows that the plant not only keeps from freezing, but is able to melt out a breathing hole for itself besides."

I like hardy folk—people who can generate their own fires and do work in spite of everything. Skunk cabbage is just such a sturdy citizen. It has many good points. Even its odor is not offensive, strictly speaking; it is rather defensive. You must not meddle with busy people who have important things to do, or you may get an unpleasant rebuff. I really enjoy a little of the skunk cabbage odor—its high, aromatic, piercing quality is not unsuited to so determined a character. The trouble comes when you get too much of it—like too much of any other good thing.

Among the many hearty appreciations of this interesting plant that I have read, there is one feature which I do not recall ever to have seen mentioned. I refer to the aspect of the whole plant when uprooted in September. I happened to notice this last fall, when a farmer neighbor

brought from his wood-lot a load of muck for my flower-bed. Some strange dragon-like creatures lay upon the surface of the muck. With their flat bodies, short stiff heads, and great clustered roots, composed of fleshy fibers, they suggested I know not what monster of pre-historic times.

I willingly let others sing the praises of its colors in early spring—the variety and rare beauty of the hood markings. Others may celebrate in fairer phrases the tropical luxuriance of its foliage, when, amid the burst of spring, this plant waxeth mightily. Many, too, have remarked how in

summer the bright green of skunk cabbage gives the only sign of lusty growth amid the desolation of the swamp, as if it were appointed to express the best that is to be gotten out of a dismal environment. Let them note these phases of a



"SKUNK CABBAGE IS A STURDY CITIZEN"

many-sided creature's life-story. For myself, one thing at a time is enough. It is the hardiness of the skunk cabbage that appeals most to me. Deny it who may, the skunk cabbage is the first flower of the year, long in advance of all the others. Does it not well typify American pluck and enterprise?



THE ALDER FRINGE IN EARLY SPRING

XXXVIII

ALONG THE BROOK IN MARCH

THE banks of Clear Brook are steep. In some places the loose earth and shale have caved off, leaving great irregular heaps of rubbish on the stream bed below, and bare, precipitous walls above. On the right hand side of the stream, midway between the water line and sky line, is a path. You must be sure-footed if you would follow its lead. Now mounting to near the top of the bank, where you may catch glimpses of neighboring chimney pots, now dropping suddenly into the bed of some tributary stream, its course is a series of surprises. Each change of direction or level brings you within range of a fresh picture.

In March, when the snow was all melted from the south side of things, this path was ever a joy and a revelation to me. If I looked downward, I saw the mass of struggling, seething, chocolate-colored water, quite unlike our summer memory of Clear Brook. Above, against the cloud-swept sky, the pale gray-green of the poplars was barely visible. Mentally resolving to have a closer look at these trees on my way home, I swung heavily down the path and found myself on the slippery side of a heretofore unknown brooklet. Not until I had reached the bottom and crossed on the inadequate bridge of driftwood and icy stones, did

I venture to look back over the way I had come, or to consider the why and wherefore of this new acquaintance. It was a complete and finished brook,—waterfall, current, and shelving banks,—all were there. For a while I marveled, and even considered the possibility of climbing a slippery bank in search for the source of this new-made stream. The way looked too difficult and my own path too alluring, and I decided to save this for another trip. Imagine my feelings when, a few days later, I found out that my wonderful new discovery was identical with the angry little torrent which rushed from under a huge snow-bank back of my neighbor's house!

Leaving the brook to its own devices I followed my chosen path. It led me past a squalid, springy place on the hillside. From below I could see nothing but a forest of tall horsetail where last May had been a solid mass of skunk cabbage. The horsetail had been there too, but had been overshadowed by the rank growth of the broad-leaved plant. Since late summer the "scouring rush" had reasserted itself, and for what I could see now reigned supreme. On closer investigation I found the spaces between the slender rushes crowded full of skunk cabbage hoods. They were in all sorts of attitudes, some with their long pointed hoods drawn down over their heads, completely closing the opening. Others, with heads thrown back, were wide open, the rounded flower cluster plainly disclosed. Tightly wrapped bundles of green leaves were just be-

ginning to prick their way up through the thin layer of leaf-mold which covered the soggy earth.

Returning to my path I picked my way along 'twixt earth and sky for some distance. The ledge above me was dripping with moisture and even beginning to form icicles, for the shade was heavy here and the day was growing old. Clinging to the rocks were rosettes of saxifrage. They huddled together as if to keep warm, and there was promise of a great crop of flowers. A busy squirrel ran along the limb of a ragged yellow birch. What was he about? The limb was wet where he stood and the squirrel seemed to stop and taste the damp bark. He looked across at me fearlessly, then put his nose to the dripping bark. I stood quite still and watched him. For several minutes he kept this up. I could almost hear him smack his lips and say "sap tas'es mighty fresh an' sweet dis mo'nin', won't y'u have some? Reckon I mus' need a tonic, dese spring days; stored up nuts tas'e mighty dry an' floury when de sap's a-runnin' free an' de buds a swellin'." Now, I don't say it was sap he found there, nor that he was sipping up the moisture, but that's what he seemed to be doing.

Just then a shadow dodged across my vision. It could not be a dead leaf tossed by the wind, for there was no wind to toss it. Was it then a butterfly? Impossible, so early. Yet it came again, this time settling on a tree trunk but a few rods distant. Yes, it was a butterfly! Its dark wings were scarcely visible against the bark, but I could see

that it was a Mourning Cloak. What else could it be, out so early?

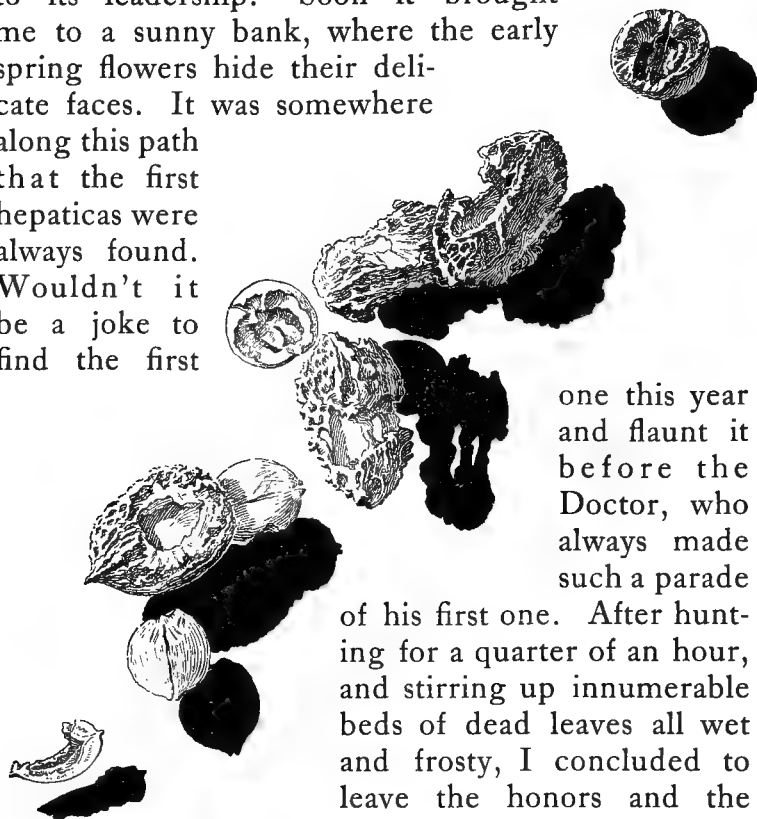
My first knowledge of this hibernating butterfly came years ago when my father and uncle went in winter to cut our supply of stove wood in the "timber" bordering our little stream. One day while eating lunch around a snapping fire they saw a strange sight. Lured from its hiding place by the warmth of the first day of our regular February thaw, a Mourning Cloak had fluttered forth. Daintily it alighted on the top of a fresh stump and seemed to find something there to its taste. My father was always full of stories after a day away from us and this of the winter butterfly was one of our favorites. We begged to go next day and see this wonder, but the next day was cloudy and threatening. Though Uncle Joseph put some drops of sweetened water on the stump, no butterfly came to sip them.

In later years I had watched the development of this butterfly from a spiny black caterpillar dotted with coral red, feeding ravenously on leaves of elm, through the short chrysalis stage to the coming of the butterfly. I had grown quite familiar with its coat of maroon velvet faced with straw-color, and ornamented with splashes of shining blue. But never before had I encountered one in March on this brookside path. I watched. It stood perfectly still on the tree trunk. Going nearer I could see that the bark of the tree was black with sap which fairly streamed from a row of holes in the trunk, at a level with the top of my head. The holes

seemed freshly made and these were the only ones on the tree. The bark of an evergreen near by was fairly riddled with similar holes—as far up as the eye could reach were these rows of little holes, made, as I had already learned, by the downy woodpecker during his many winters here. I saw one at work along this path one year in January. A very industrious creature he seems, busily picking off flakes of bark in the hope of finding some larvæ hidden beneath it. His soft gray sides were set off by the jaunty red of his head feathers. He seems very self-sufficient as he braces himself against the tree trunk, literally sitting on his stiff tail, while his beak is busy. Since March is too early for the real sap-sucker to stop here, these flowing wells on the beech tree must have been made by the little downy woodpecker. I doubt if he made them in insect hunting this time; I dare say he likes a drink of fresh sap now and then.

From just below the path I watched the Mourning Cloak. I could see the arching proboscis as it was lifted daintily now and then over the rough bark. The hungry creature was fairly "up to its elbows" in the sweet flood. I crept nearer to get a better view, giving small heed to my footing. Crash! When I picked myself up out of a clump of deceptive bushes the butterfly was sailing afar off. I had to content myself with a close examination of the woodpecker's work. It had drilled six or eight holes in the tree, in a regular row, as if it had started to girdle the trunk. The sap welled out and I wished for more butterflies and squirrels

to come and quench their thirst. "Perhaps they will if I move on," was my thought, as I scrambled back up the slope to the path and gave myself again to its leadership. Soon it brought me to a sunny bank, where the early spring flowers hide their delicate faces. It was somewhere along this path that the first hepaticas were always found. Wouldn't it be a joke to find the first



FOUND ROLLING DOWN THE BANK

one this year and flaunt it before the Doctor, who always made such a parade of his first one. After hunting for a quarter of an hour, and stirring up innumerable beds of dead leaves all wet and frosty, I concluded to leave the honors and the further discomforts of the first hepatica to the Doctor and to devote myself to making other discoveries. Besides, I had some treasures of my own to take home. Scratching among some promising looking hepatica leaves all lined with purple, I loosened a

half dozen nuts which rolled away down the bank. Thinking their behavior rather suspicious, and willing to be diverted from my fruitless search, I followed. Picking them up, I read their story at a glance. A squirrel is certainly a dainty eater. Every nook and crevice of the butternut was as clean as possible. I could not have done so well with a nut-pick or even with a hat pin. The hard rough sides of the nuts were eaten off and the sweet oily kernels deftly extracted. Some had ragged holes in both sides; in others the woody partition between the halves of the nut had been gnawed away and the "goody" taken out. Filling my pocket with the shells and rejoicing in the thrill they gave me when my hand from force of habit sought comfort in those depths, I followed the path to the top of the hill, where it dipped into an unknown tangle of underbrush, leaving me in the open road in sight of my own dwelling. It was as if I had been politely bowed out!

Accepting my dismissal gracefully, I hastened home to show my treasures to the Doctor and to gloat over my right of discovery. Imagine my feelings when he greeted me triumphantly and presented me with "the first hepatica of the year"!

I was about to show my treasures when that exasperating man drew forth from one of his cavernous pockets a handful of gnawed nut-shells exactly like mine! But he had to confess that he had not seen a Mourning Cloak, nor any woodpecker's holes, no skunk cabbage and horse-tail, nor had he discovered a new brook.

XXXIX

SOLDIER, SOLDIER!

"WHERE there's so much smoke there's sure to be some fire," is a very ancient adage, and has been known to serve as valuable circumstantial evidence. Fire without smoke would be even more dangerous than with it, for the smoke gives the warning. No wonder war promoters sought diligently until they discovered smokeless powder to make their trade more iniquitous than before. Smoke without fire seems unnecessary, a warning without the accompanying danger. But there are many things in heaven and earth as yet unheard of by those who lead lives far from the haunts of the water brooks. There may be occasions when a warning is sufficient. It was certainly so with me when I first encountered in his stony citadel the bombardier beetle. His dwelling place was not made to order; he simply occupied a crevice behind one of the many stones which scatter the bed of Fall Brook. Long since the stream itself had retreated to a narrow channel in the middle of its bed, leaving a broad space on either side paved with cleanly washed limestone. Where the bank rose steep to the roots of the overhanging trees lay a tumbled mass of water-worn stones, some too large to be lifted, others no bigger than my fist. I had just lifted one about the size of a

loaf of bread, when piff! a tiny cloud of blue smoke rose from the damp hollow where the stone had lain. Surprised, confused, discomposed, I looked about for the cause. The smoke cleared away almost as quickly as it came, and nothing was there to explain its coming.

Quickly I turned over another stone, never believing that the experience would be repeated. Nor was it, just then. Convinced that I had been mistaken, I continued my search for young grasshoppers. It was early spring and I was bent on capturing the first hoppers for my cage. My search was immediately rewarded and in my anxiety to catch and transfer to my box this lively creature, I forgot the "smoke without fire."

One grasshopper was not enough for my purposes and I turned to a pile of stones a few feet away. I lifted one, bending down quickly to let nothing slip my eye. Paff! right in my face this time came the smoke, and something quick darted away behind the neighboring stone. I followed, stone after stone rattling down on to the pavement below. No more smoke and nothing but a long-



A PUFF OF SMOKE

legged beetle clad in dark blue armor with a yellow breast-plate. I could not help likening him to a military man, his aim had been so perfect. But his behavior had not been very valiant, for after firing one shot he had run away as fast as his legs could carry him. "He who fights and runs away will live to fight another day," I said as I let him go. I admired his discretion rather than his valor, for he had evidently intended to frighten me with his blank cartridge and to escape before the smoke cleared away.

The next one was more soldierly. Either he had a greater supply of ammunition or he used it more sparingly, but he certainly bombarded me three times while I pursued him. With the first puff of smoke I was surprised to hear a distinct pop like a miniature pistol shot. The smoke was ill-smelling, too. I watched him scurry away and returned to my grasshoppers. But I found myself repeating one of the Professor's favorite quotations from Dickens "A rum thing is nature!"



A BANK WHITE WITH TRILLIUMS

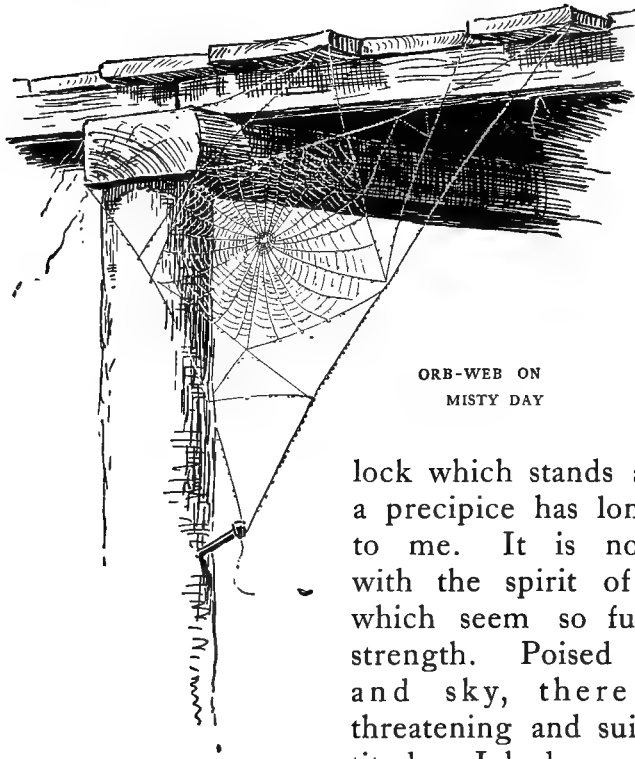
XL

A RAINY DAY

Do you ever go out in the rain? Dressed for it, there is nothing more delightful. I leave my umbrella behind with other conventional trappings, for I like to feel the warm drops on my face and shoulders. A certain wise man says: "One's happiness is largely a matter of clothes." The wise man could not have spoken more truly if he had had a bonnet of tulle and feathers and a trailing gown of "melting" organdie to take care of. What he says is indeed true when it rains.

I was tired of waiting for April to give me a half day of uninterrupted sunshine. Yesterday's rain had been impetuous—dashing in torrents against the windows. The streams flowed yellow. The puddles in the garden walks danced and dimpled as the big drops, coming straight down, struck their faces. I smiled in spite of myself, and registered a vow to go out next day no matter if the weather prophets did say "continued cloudiness and showers." When the morning came the sky was leaden and a heavy white mist hung in the valley. The weather man was right. But I had vowed my vow, and left the house in a "shocking" hat and struck across lots to where the wooded banks of the "Little Indian" would give me shelter, and where there would be no

one to criticise my headgear. The trees were still bare for the most part. A few poplars had shaken out their soft gray tassels, and the willows shone as if newly polished. Unconsciously I put



ORB-WEB ON
MISTY DAY

my hand to my pocket, but finding that I had come away without my knife, I concluded that it was a little early for willow whistles.

A certain dead hemlock which stands at the brink of a precipice has long been a trial to me. It is not in keeping with the spirit of these woods, which seem so full of life and strength. Poised between earth and sky, there is something threatening and suicidal in its attitude. I had never expected to see anything beautiful in its stark, ungraceful limbs. But to-day, in the fine mist, it was fairly encrusted with jewels. Each black branch was wound with pearl strings. Never again will the dead hemlock be ugly to me, though this be the only time I ever see it in such a charming rainy day dress.

This transforming power of dew and mist is wonderful. We once found a strikingly beautiful example of it in one of the angles of our foot-bridge. We had watched a large orb-weaver spin her web there in the evening and had admired her skill. The web was one of the largest I ever saw. Its great guy-lines stretching between the timbers of the bridge were at least a yard in length. One dewy morning we inspected the corner and found that tiny drops had gathered on the threads and transformed them into strings of pearls fit to adorn a fairy. The elastic cross lines felt the weight of the water and hung in graceful loops. The web had seemed perfect before, but now it was even more exquisite in our eyes. We could see, however, that the spider would have to wait for dry weather before her web would be of any use to her as a snare.

There are many forest paths along the Little Indian. It would be hard to choose between them. I followed the first one I came to and in a few moments it brought me to a garden of violets. There were blue ones of several kinds and white ones. The ground was so thickly covered with them that I could with difficulty make my way through without stepping on them. They grew tall and vigorous, the flowers nodding on stems sometimes as much as six inches long. A little farther on I came



WHITE VIOLETS

to a bank which was white with trilliums. At a little distance they looked like new fallen snow, but I knew that the rain of yesterday had melted the last snow-bank.

It began to rain gently and the soft pattering on the dead leaves and forest plants was music to

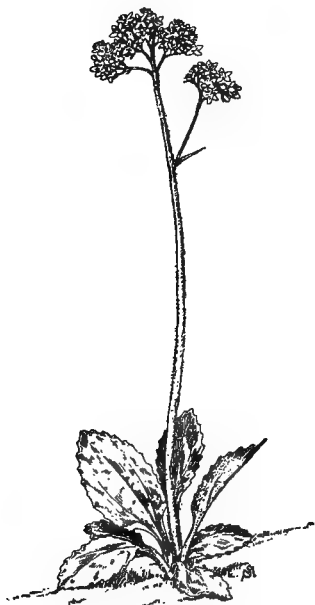


BLUE VIOLETS

my ears. It was in tune with the violets and the trilliums. Together they joined harmoniously in the "natural song of earth." I put my hand down to feel the cool and moist leaves. A hundred fern fronds seemed to reach up and caress my fingers. They were so young, so downy, so delicately pale and refined looking! They have such a modest droop, as if they would not intrude. Who ever had enough of ferns?

From the exquisite maidenhair to the lowly ever-green Christmas fern which any one may have, they are dear to all. They are always the right thing in the right place. But they are best in their native woods, with other woods-folk.

Reaching the bed of the stream at last, I found that the rocks on the bank, though washed by the floods in March, had managed to hold fast to many plants of saxifrage. All winter I had watched the rosettes and hoped to be first to find a flower stalk. But they had shot upwards with the first warm shower and were already in blossom. All up and down the rocky sides of the gorge, wherever a thin sheet of soil could be found to cling to, there was the saxifrage, by hundreds and almost by thousands.



SAXIFRAGE



YOUNG FERNS

It was not yet time to go home, and I concluded to pay a visit to the pond above the dam. It must be nearly "frog time," if one could judge by the choruses of the last few nights. We once visited a swamp in the evening just to hear the orchestra. Of all the batrachian songs I like the basso profundo of the bullfrog best. It begins rather faintly, with a few trial notes. Then, gathering volume, it soon wakes the echoes, *zoom*,

zoom, zoom, zoom! Resonant, booming, manful, it is well worth going miles to hear.

Every spring I go somewhere to look for frogs' and toads' eggs. The latter are in strings of soft, half-transparent jelly and often float on the surface of the pond or cling among the stems of water plants. A frog's egg, when new-laid, looks like a small black bead. Each egg is surrounded by its own envelope of transparent jelly. Great numbers are found together, embedded in this same gelatinous substance. The mass is often supported in the water by being attached to some weed stem or submerged branch of a tree. The young are abandoned by their parents at this stage of their existence. As the sun warms the water the eggs feel its quickening force and development begins. In the course of a week or two the tiny tadpoles squirm free from their envelopes and swim away into the pond. They are now true aquatic animals and, if removed, would die as quickly as one of us would if forced to exchange places with them. Unlike their progenitors, they prefer a vegetable diet and nibble away contentedly upon whatever soft decaying leaves they find in their wanderings. A whole pond to circle about in must seem a mighty big world to a polliwog newly hatched from a thimbleful of jelly. What adventures, what hairbreadth escapes, what boon companions he meets with!

The polliwog has no family ties. He wots nothing of brothers and sisters. All polliwogs look alike to him. The tadpole has no bringing up. He

goes to no school save that of daily experience. To-day a fish may teach him how to dodge or his own grandfather give him a lesson in deep diving, but in both cases it is to escape making a meal for his teachers that he dodges or dives. The main business of the day is eating—or being eaten. If he escapes the latter for six weeks or two months, the common frog finds himself possessed of two hind legs—later of two front ones. The bullfrog develops more slowly. His broad flat tail, so valuable in early youth, stays on and on, until it is a wonder that he does not in the pride of his young froghood take measures to dispose of it. But for this badge of youth, could he not leap away with others of his kindred to hunt insects on grassy banks, or sun himself "with arms akimbo" on quiet lily-pads?

It is just as well that they must wait, for inside their shiny wet coats changes are going on which will fit them for the higher sphere. Lungs for air-breathing are fast replacing the gills which did duty in the tadpole stage. The young frog frequently pokes his nose out of the water as his lungs grow more lung-like, to try them. The mouth, too, must widen and the eyes grow larger and more bulging. When all is complete, the tail will no longer stand in the way.

Did you ever watch wearily for a tadpole's tail to drop off? The children of to-day are familiar with the gradual absorption of the tail and can even tell the story of how the "white blood corpuscles carry away the material which had formed the tail

little by little to build up other parts of the body." Frogs do not shed their tails; neither do they rain down, the daily press and the "oldest inhabitant" to the contrary notwithstanding. They all pass through the gradual development from the egg to the adult. The bullfrog remains a tadpole for at least two years, while some of the smaller frogs reach the adult state in one summer. Much is yet to be discovered concerning their habits and development.

When I reached the pond above the dam not a sound was to be heard. I stood motionless for a few moments, but it was damp and I could not wait for the music. As I neared the reedy margin a telltale *Ku-chug!* told me that the frogs were there, though they evidently regarded my approach with suspicion. The muddy edge was alive with little black polliwogs. How like animated commas they were, their absurd little tails in constant motion. I could not resist the temptation to splash the water, just to see how excited they would be. The water was muddy and the light was growing dim, and not one mass of eggs could I discover. It was late and something told me it was supper time. I left the polliwogs to their own devices and made my way homeward. My rainy day experiences had brought me many things to think about.

XLI

THE BROOK'S TOOLS AND ITS WORK

"TELL me," I said to the visiting Geologist, "how our brooks and gorges came to be."

"That is simple," said he, and straightway began to talk about glacial epochs and erosion and levels.

We were sitting in the Professor's library before the open fire, while outside a very deluge of rain was falling. I always liked the Geologist. Although physically he looked down on ordinary individuals from a lofty height, he did not try to "tower it" over us intellectually. He talked to me even as to an equal, and I appreciated the compliment, though I did not always understand what he said.

When he was through, I inquired, "Then did the water itself actually make the gorge in which it flows, and not the glacier?"

I had a suspicion that this was really what he had been telling me all along, but I wanted it put in a simpler way.

Very patiently he began again.

"As the glacier melted under the influence of the sun and the rain there was much water to be disposed of. This water could not well stand still, for the hillsides were too sloping. It simply obeyed the law of gravitation and followed the path of least resistance. This path was not often

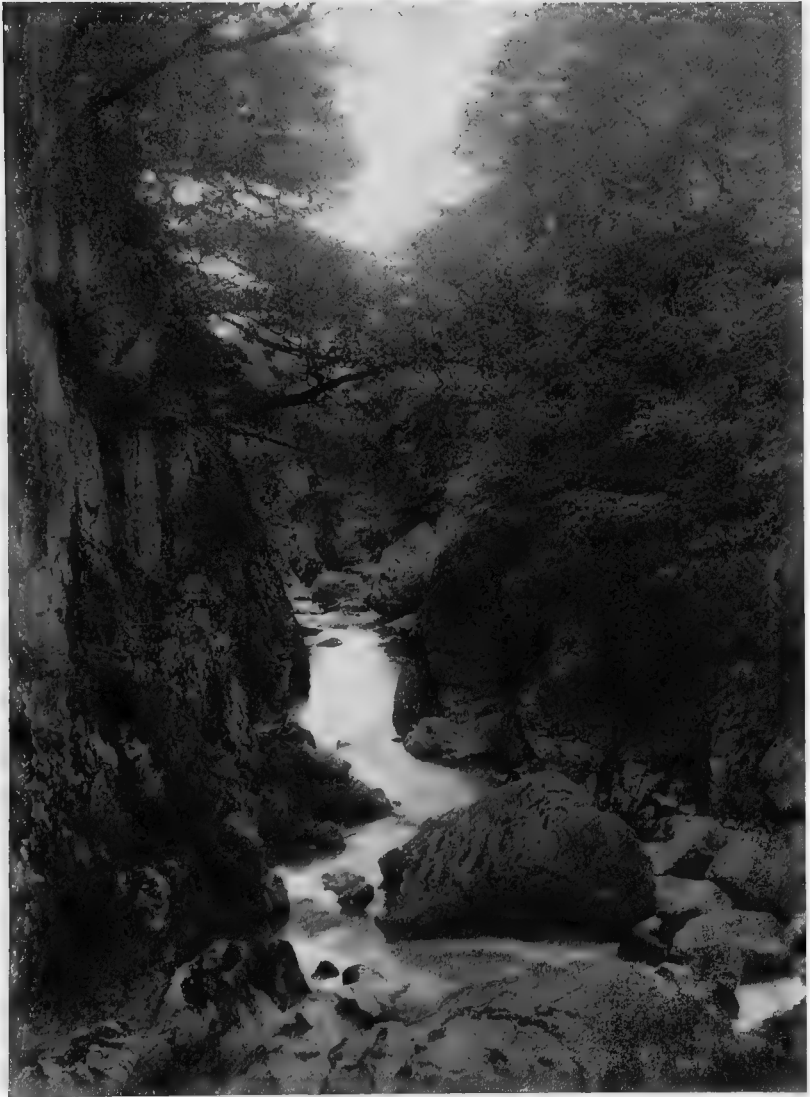
straight, though it was likely to be narrow. When the water came to a very steep slope, it went faster and faster. If, at the foot of the slope, there happened to be a perpendicular ledge, the water leaped through the air and reached the ground below, only to seek out again the steepest path down the next hill and to speed on its way."

"That explains the brook itself," I said, "and the waterfalls and the rapids. But the gorges?"

"Not so fast! It has taken those brooks some thirty thousand years to make the gorges, although they are comparatively modern institutions, geologically speaking."

I was fairly stunned by the thought that anything could be so ancient. Brooks seem to have such a youthful way with them, too. I was ready to listen in silence and let the Geologist take his time.

"As the water continued on its way down hill," he went on, "seeking ever the lowest level, it grew in volume with every rain and every drop of melted glacier. Moving along over the hills and valleys, the glacier had gathered much rubbish; stones, gravel, etc. These it gave up as it melted and the brook received many of them. Whenever the stream had to pass over a nearly level area, it was impossible to carry all this burden further. So some of the stones were left behind on the flat places. Some of the smaller ones and the gravel and sand went on with the brook. These stones had sharp edges where they had been broken by the glacier. As the brook



STONY BROOK'S TOOLS

carried them down they dug into the soil over which they passed, gradually making the channel deeper. Each stone did a little, and altogether it made a great deal of digging. The stones, too, began to be more rounded. They were scoured clean by the sand which the water carried along. After a heavy rain the stream would be so much bigger that it could carry more stones and dig the channel still deeper. The stones and the sand were its tools then and in all the thousands of years since. Just as a carpenter uses his sandpaper, and the cook her sapolio, so the brook uses the sand and pebbles and boulders. The great difference between the carpenter, the cook and the stream is that the latter never lays down its tools. From sunrise to sunrise, year in, year out, century after century it works. No wonder its tools are kept bright, though well worn!

"Now when the spring floods come we see the surface of the soil loosened and perhaps carried by the small stream off into the larger one. Thus the permanent stream is provided with fresh tools as the old ones wear out, and an increased power to carry them. The stream even institutes landslides on its own account. Haven't you noticed how the constant action of the flowing water has 'eaten in' under the sides of our gorges? When the weight borne up by this overhanging bank becomes greater than it can bear unsupported, it falls, bearing with it into the stream's bed all its load of trees, stones, leaf-mold and wild flowers. I have seen streams which I thought rather over-

did this matter during the flood season. They sometimes suffer for it later by being choked by rubbish of their own depositing! When this happens they waste a great deal of time digging new channels. Fall Brook tried to put one through my dooryard once!"

The rain outside had hardly ceased when I left the Geologist by the fireside and started home. As I crossed the big bridge below the pounding waterfall, I was musing upon the power of Fall Brook and at what it had accomplished during the thirty thousand years it had been at work. The water even now was the color of *café au lait*. This must have been because of the clay it was carrying. Though I could see no large stones in the fall itself, I could detect a considerable rolling about of the well rounded ones at the bottom. Where the full force of the cataract had beaten for ages a deep basin had been cut in the rocky bottom. I had not expected so soon to see such perfect illustrations of the Geologist's story.

As I passed along to the open field I found our little brook, a mere ditch in ordinary weather, fiercely rushing along. Its water, too, was a dirty yellow, and I could feel the pebbles grate against my arm as I thrust it into the swiftest current. Yesterday the lush grass grew high on the sloping sides and even in the very channel of this tiny streamlet. To-day it lay prone on the earth, while a flood of muddy water bore it down. I followed this heretofore unheeded stream across the open and level meadow to see what it had done with

previous loads of clay and pebbles. I found that when the water reached a stretch of level ground it had laid down part of its heavy load. Deposits of rough sand and finer clay were left upon the weeds and low vines in the stream bed. The grass was matted and held down by sticky yellow mud. At this rate it cannot be many years till that low bit of ground is filled by the soil washed off the fields above and transported by the brook. What will the farmer back on the hill say to such wholesale robbery? If he is a philosopher, he may conclude that probably a part of his land was brought down and deposited in the first place by some large river in just such a way. Or he may set the brook to turning his cornsheller, thus forcing payment for the stolen goods.

The next time I saw the Geologist I plied him with questions.

"Down at Stony Brook," I said, "there is a place where the water goes through a deep, narrow channel between the banks of very hard looking rock. I can see how the water might have ground out the channel wider and deeper when once it got into the rock, but how did it get started in the first place? Why didn't it go round instead of through?"

"Well," replied the thoughtful scientist, "maybe there was a crack in the rock and the water had to go that way because it was the shortest way down. 'The shortest way down' is what the stream is looking for. Obstacles may turn it aside for a time, but eventually it finds its level. Per-

haps the shortest way led over the top of this rock of which you speak and perhaps there was no rift through which it could creep. Then with its stone hammers and chisels and sandpaper it began to enlarge and deepen its channel. It is still working at it.

"By the way," he continued, "did you notice the 'pot-holes' along there in Stony Brook?"

"Pot-holes?" I inquired.

"Yes, that's what we call them. Sometimes a stone gets lodged where the current does not push it along, but just jogs it in passing. Every jog grinds off a little bit of stone and a few fine grains of the bed rock. Day by day this goes on until even when the current is stronger it cannot dislodge the rounded stone, which grows smaller every year as the smooth little basin in which it rolls about grows larger. This takes a long while, but finally the stone becomes a mere pebble and the grinding ceases, and there is a 'pot-hole' for wondering eyes to gaze at. The big basins at the foot of our waterfalls are made in a similar way and bear this name."

"I shall never be satisfied until I find a real 'pot-hole,'" I exclaimed, quite fascinated with the idea. Since then I have found them, but I have never yet found the stone actually at work forming the basin.

A brook is a river in miniature. It has its source, its tributaries, its struggles and its little triumphs. It is self-made, but dependent. Rivers

make their mighty deltas, brooks their tiny ones. Rivers overflow their banks like Father Nile, and the hearts of the people are made glad or sad according to their different points of view; rivers plunge over precipices like Yosemite and Niagara and rage through rocky chasms, as does the Colorado. So do our smaller streams in their smaller fashion. Their origin, their methods, their yearly round of moil and toil, their alternations of flood and ebb are very similar. Their tools, though different in size, are of the same pattern. Strive as they may from day to day their work is never done.



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