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WASPS, SOCIAL AND SOLITARY

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Introduction

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NOT long since I wrote to a friend, a nature lover, as follows: “The most charming monograph in any department of our natural history that I have read in many a year is on our solitary wasps, by George W. Peckham and his wife, of Wisconsin,—a work so delightful and instructive that it is a great pity it is not published in some popular series of nature books, where it could reach its fit audience, instead of being handicapped as a State publication.” This end has now been brought about, and the book—revised and enlarged with much new material and many new illustrations—placed within easy reach of all nature lovers, to whom it gives me pleasure to commend it. It is a wonderful record of patient, exact, and loving observation, which has all the interest of a romance. It opens up a world of Lilliput right at our feet, wherein the little people amuse and delight us with their curious human foibles and whimsicalities, and surprise us with their intelligence and individuality. Here I had been saying in print that I looked upon insects as perfect automata, and all of the same class as nearly alike as the leaves of the trees or the sands upon the beach. I had not reckoned with the Peckhams and their solitary wasps. The solitary ways of these insects seem to bring out their individual traits, and they differ one from another, more than any other

> wild creatures known to me. It has been thought that man is the only tool-using animal, yet here is one of these wasps, Ammophila, that uses a little pebble to pound down the earth over her nest. She takes the pebble in her mandibles, as you or I would take a stone in our hand, and uses it as a hammer to pound down the soil above the cavity that holds her egg. This is a remarkable fact; so far as I know there is no other animal on this continent that makes any mechanical use of an object or substance foreign to its own body in this way. The act stamps Ammophila as a tool-using animal.

I am free to confess that I have had more delight in reading this book than in reading any other nature book in a long time. Such a queer little people as it reveals to us, so whimsical, so fickle, so fussy, so forgetful, so wise and yet so foolish, such victims of routine and yet so individual, with such apparent foresight and yet such thoughtlessness, finding their way back to the same square inch of earth in the monotonous expanse of a wide plowed field with unfailing accuracy, and then at times finishing their cell and sealing it up without the spider and the egg; hardly any two alike; one nervous and excitable, another calm and unhurried; one careless in her work, another neat and thorough; this one suspicious, that one confiding; one species digging its burrow before it captures its game, others capturing the game and then digging the hole; one wasp hanging its spider up in the fork of a weed to keep it away from the ants while it works at its nest, and then running to it every moment or two to see that it is safe;

another laying the insect on the ground while it digs,—verily a queer little people, with a lot of wild nature about them, and of human nature, too.

JOHN BURROUGHS.

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WASPS
Social and Solitary

Chapter I

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COMMUNAL LIFE

“For where’s the state beneath the firmament
That doth excel the wasps’ for government.”

“What is not good for the swarm is not good for the wasp.”

AS the tendency of mankind to crowd into towns grows stronger the joys of country life and the workings of Nature are more and more excluded from the daily experience of humanity. In a few the primal love of the wild is too strong for suppression, and turning from the hot and noisy streets they find it a refreshment of spirit to meet our little brothers of earth and air in the wider spaces of their own territory.

We were walking through the woods one hot day in the middle of August when our attention was attracted by a stream of yellow-jackets issuing from the ground. They came in such surprising numbers and looked so full of energy that we stopped to watch them, and this was our introduction to the study of these “bold sons of air and heat,” although a perusal of Fabre’s fascinating “Souvenirs Entomologiques” had prepared us to feel a lively interest in them. We were at our summer home near Milwaukee, where meadow and garden, with the wooded island in the lake close by, offered themselves as hunting grounds, while wasps of every kind, the socialistic tribes as well as the

extreme individualists of the solitary species, were waiting to be studied.

The Vespas that had aroused our interest received our first attention, and a nest in the ground proved to be a most convenient arrangement. Experiments that would have been dangerous to life and limb had we tried them with a paper nest hanging in the open, were easy here so long as we kept calm and unflurried. Intent upon their own affairs, and unsuspicious of evil, perhaps because they knew themselves to be armed against aggression, they accepted our presence, at first with indifference; but as we sat there day after day we must have become landmarks to them, and perhaps before the summer was over they considered us really a part of home.

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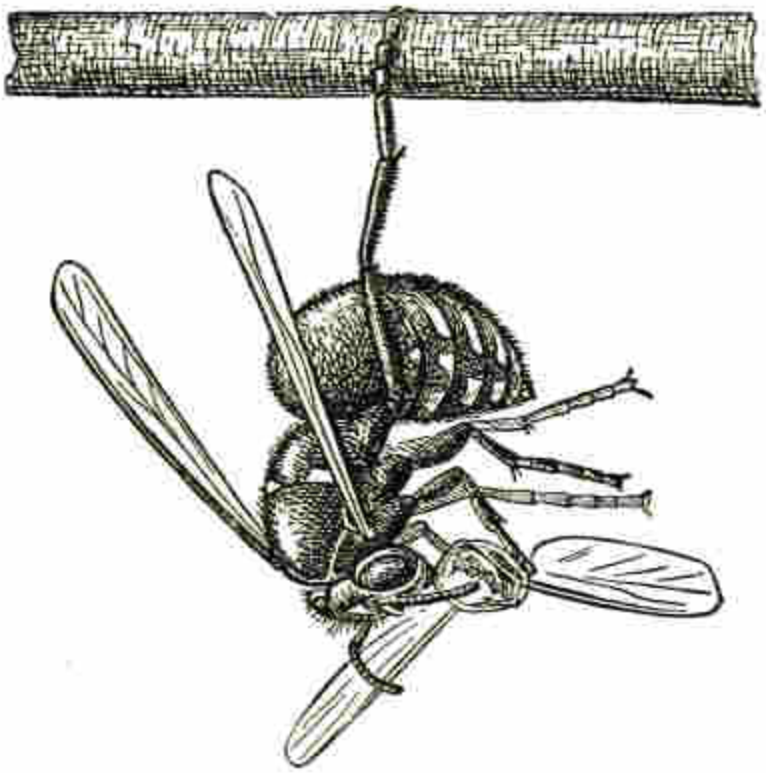

WASP EATING

While poor humanity takes comfort in a mid-day siesta, wasps love the heat of noontide, and with every rise in temperature they fly faster, hum louder, and rejoice more and more in the fullness of life. The entrance to the Vespa nest was but an inch across; and once when they were going in and out in a hurrying throng, jostling each other in their eagerness, we counted the number that passed, one taking the entrances and one the exits. In ten minutes five hundred and ninety-two left the nest and two hundred and forty-seven went in, so that we saw eight hundred and thirty-nine or about eighty to the minute. This must be a strong swarm, wonderful indeed when we thought that it had all come from a single queen mother. We imagined how she had made an early start, digging a hole in the ground, building within it a paper comb with five or six cells around a central column, and laying therein some neuter eggs; how she had then spent a month in attending carefully to the beginnings of things, feeding the young larvæ as they hatched, and watching over them through their childhood and youth; and then how her solicitude was rewarded by the filial devotion with which this first set of workers took upon themselves the labor of excavating, building, and feeding the young, everything indeed except the egg-laying. These queens, surrounded though they are by respectful and attentive subjects, have much the worst of it in our estimation, never going out, and passing their lives in a dull routine. Through the early summer only neuters are produced, but when fall approaches the future generation is provided for by the development of males and females. The activity of the little colony is limited by the season, for as

the days grow colder the males and females leave the nest and mate, and a little later both males and workers lose ambition, become inactive and finally die, while the queens hide away in protected corners to reappear in the spring. The eggs and larvæ, left unfed and uncared for, become a prey to moulds and to hordes of insects, and thus the swarm comes to an end.

We had once made some not very successful attempts to find out whether spiders had a sense of color; and seeing that the conditions were much more favorable with our present subjects, we thought it would be a good plan to test their knowledge of the spectrum. Providing six sheets of stiff paper two feet square, colored respectively red, blue, green, pink, and two shades of yellow, and cutting a circular hole four and one half inches in diameter in the centre of each, we began our experiments by placing the red paper over the nest so that the entrance was clearly exposed. The outgoing wasps dashed upward without noticing it, but great was the confusion among the homecomers. Thrown out of their reckoning, they clamored about us in ever increasing swarms. Like Homer's wasps,

"All rise in arms and with a general cry
Assert their domes and buzzing progeny,"

and a crisis (for us) was approaching, when one, a pioneer of thought, determined to go into the hole, which did not look like the right hole, although it was where the right hole ought to be; and so potent is example that one by one the others followed. Three hours later they had become accustomed to the change, and went in and out as usual.

They had noticed the paper; that was plain enough, but did they notice the redness? To test this, we left things as they were for two days, and then substituted blue paper for the red. Again the confusion, the swarming of fervent legions, the noisy expostulations, the descent of one after another; but this time they settled down to their ordinary routine in a little more than two hours. On the following day we removed the blue paper, leaving the grass around the nest exposed; and this proved a new source of mystification, but not so serious as the others. At the end of an hour twenty-five or thirty were still buzzing about, needing the guidance of the blue paper to get inside, and entering at once when it was replaced. As we tried new colors from day to day a few of the wasps became entirely reconciled to our interference, and paid no attention to the changes, while the others grew more or less accustomed to the idea of mutability, and were but little disturbed, although they still showed their consciousness of each alteration by making a few circles before going in. We once placed some dark red nasturtiums on light yellow paper near the nest, and found that more than one third of the homecoming wasps flew to them and hovered over them before entering. When light yellow nasturtiums, nearly matching the paper in color, were substituted, only one out of thirty-six noticed them; and as the odor was as strong in one case as the other, it would seem that the color was the attracting force.

Our final color experiment was to let the blue paper remain for a day or two, giving time for all the wasps to become familiar with it, and then to leave it on the ground a foot and a half away, while replacing it with yellow. This

gave a false nest surrounded by the color that they had been associating with the entrance, and a true nest surrounded by a new color. In the next ten minutes two hundred and seventy wasps came home, and every one of them went to the false nest. Many circled above it, others entered the hole in the paper, and some began to excavate, and made quite a depression in the ground; but gradually they found their way home. Three hours later seventy-six wasps entered the false nest in five minutes, and at evening they were still visiting it in goodly numbers; but on the next day we saw only two that were deceived.

On successive days we substituted red for yellow, green for red, and so on, always with similar results, although the wasps became more and more accustomed to the vicissitudes of their life, and after a time seemed to look for the hole itself without relying upon the color to guide them. They found their nest under a color new to them much more readily than when the paper was taken entirely away and the ground left exposed. Once when the green paper was around their nest, and the wind blew it over the hole so that they could not enter, at least one hundred collected, many of them settling in the false nest; when we lifted the green paper, leaving the hole free, only three or four entered, but when we put it back in place they rushed in six or seven at a time. It was plainly the color that directed them.

This was a nearly rainless summer,—a condition extremely favorable to wasp development. Nests multiplied and grew until the whole country-side complained, and no wonder, for houses were full of them, and at mealtimes they gathered at the table with the members of the family. How

did they know when dinner was ready? It could not have been by the sight, unfamiliar to them, of cooked food; was it, then, through the sense of smell?

Many were the questions that we asked in vain of our Vespas, but here was one that they could readily be made to answer. We rolled up two bundles, one of nothing but gauze, and another, like it in appearance, but containing some warm chicken bones; these were laid to one side of the nest, the color of the gauze matching that of the paper on which it was placed. The wasps in returning to the nest, even though loaded with food, could not resist the appetizing odor, and settled thickly upon the bone bundle, trying their best to penetrate within, while the empty gauze was unnoticed. As the bones grew cold and dry they attracted less attention, but two days later they were occasionally visited.

Having killed two wasps that had alighted on the ground, by striking them with a folded paper, we took them up and placed one of them at a distance, so that it was entirely hidden in the grass. Five settled above it, and after they had carried it away the place was visited by several others, while the spot upon which we had killed them drew to it nine wasps within fifteen minutes. Thus they seemed very keen of scent where animal matter was concerned; but the powerful oils of peppermint and wintergreen, although noticed, aroused little attention, perhaps because they indicated nothing of interest to them.

Our experiments on hearing met with negative results. The wasps seemed insensible to any noise we could make or that we could produce by whistles of various degrees of

shrillness. This of course does not show that they cannot hear, and any one who has been unfortunate enough to disturb them in the neighborhood of their nest will remember how their angry buzzing seemed to serve as a battle cry to gather all the members of the clan for the attack.

Our Vespas began to work an hour or two after sunrise, and did not stop until dusk. One cloudy evening when darkness fell early they continued to return to the nest, being able to fly to the right spot without any hesitation, although our vision did not permit us to see the opening without going down on our knees and looking closely. At last it grew perfectly dark, and we stuffed a handkerchief into the hole, with the result that seventy-five, coming home without a ray of light to guide them, were shut out, and were found clustered about the spot on the following morning.

We wanted to estimate the amount of labor done by a worker in a day, and so, rising one morning at the first bird call, we went out into the freshness of dawn, and for an hour had the world to ourselves; but a little before five a few straggling wasps that had stayed out all night began to bring in loads, and by half past seven they were fairly under way. From half past four until twelve we counted all that passed, 4534 going out and 3362 coming home; and with all this activity there seemed to be no pleasure excursions, for each one carried food when returning, and took out a pellet of earth when leaving. We once raised a little garden from the pellets that were dropped on our porch table where we kept a bowl of water. Wasps are great drinkers, and when

they find such a provision they come frequently to refresh themselves, dropping their loads as they alight. This habit of holding on to their loads until they settle down may perhaps make them a factor in extending the boundaries of plant distribution, both under ordinary conditions and when, as must often happen with little creatures flying so high, they are blown to long distances from home.ill11

PAPER NEST WITH SIDE REMOVED TO SHOW CONSTRUCTION OF COMBS

Having kept close track not only of the numbers, but of the hours, each count being made to cover five minutes, we were able to calculate that an average trip occupied forty-three minutes. When we met these wasps in the garden they never seemed to be hurrying, and had the air of amusing themselves; but they must be faithful workers to accomplish so much. The curious fact has been established that when food is very plentiful the workers begin to lay male eggs, thus taking from the queen a part of her burden and leaving her free to produce neuters and females. The nest that we were watching was found, at the end of the season, to contain 4661 wasps in various stages of

development, and others that we opened had from two to four thousand. This is nothing to the social wasps of China, where a single household is made up of from fifteen to twenty thousand members; but China is a thickly populated country, and perhaps with wasps as with human beings several families live in a single domicile.

Outside of their wonderful social instincts our wasps are found wanting in the higher gifts of emotion and intellect. When we killed a number of them and placed them near the nest, their nearest relatives wasted no time in mourning, nor yet in revenge, but calmly cut up the bodies and fed them to the ever hungry young ones. If we placed some rich and tempting morsels at a distance, two or three would discover them, and would go back and forth all day without telling the others about it, as ants would have done under like circumstances. When we obstructed the opening to their nest by lightly laying blades of grass across, the day passed without its occurring to the wasps to lift them away, although they suffered the greatest inconvenience in getting in and out, crawling laboriously through, and in some instances giving up the task and flying away.

Vespa maculata, building on trees and fences, has practically the same habits as the ground wasp, germanica, the internal structure of the nest following the same plan, while the outer wall is of a papery substance like that of the combs, made from the scrapings of weather-beaten wood. The genus Polistes builds combs similar to that of Vespa, under porches or in any sheltered place, and does not inclose them. All these wasps, when adult, enjoy fruit and flowers as well as animal food; but only this last is used for

the young, and many a caterpillar creeping along with sinister design is snatched by them to be chewed into a pulpy mass, and then fed to the larvæ. No calculation has been made of the value of these wasps in agriculture, and one of the things that farmers have yet to learn is to encourage their presence in orchards and gardens.

Some species are said to sting the drones and larvæ to death at the close of the season, but this habit is not followed by V. germanica and V. maculata. Since there is no store of provision to be economized through the winter the only object of such conduct would be the merciful one of ending their sufferings at once instead of letting them perish by slow starvation, and we find no evidence for such elevated ideas. What makes for the welfare of the species they thoroughly attend to, but beyond that point they do not go.

The socialism of wasps is in a less evolved state than that of bees and ants, and yet there is in it sufficient sacrifice of self to the common good to excite the respectful wonder of human beings, whose relations to each other and to the state have such different standards.

Chapter II

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AMMOPHILA AND HER CATERPILLARS

BEFORE we had worked long on our Vespa family we were beguiled by tempting opportunities into running after the solitary wasps. The solitaries, so far as species are concerned, are immensely more numerous than the socials; but they have only two sexes, and the males and females usually see but little of each other after the mating is over, although we occasionally find them living happily together until the end of the season. In the early summer they begin to emerge from the nest in which the eggs were laid the year before. Solitary indeed they come into the world, the generation that gave them birth having perished in the fall. For a time their career is one of unmixed pleasure, and yet, free and unguided though they are, basking in the sunshine, feeding on the flowers, or sleeping at night under some sheltering leaf, they are hourly acquiring experience, so that when the cares of life descend upon them they are no longer creatures of mere instinct. With these sobering cares an almost absurdly heavy sense of responsibility for future generations transforms the hitherto happy-go-lucky females into grown-up wasps with serious views on marketing and infant foods. Each one makes a separate nest and provisions it by her own labor; and in many cases a new nest is made for each egg. There is no coöperation among them; although in certain genera, as Aphilanthops and Bembex, a number of individuals build close together, forming a colony. The nests may be made of mud, and attached for shelter under leaves, rocks, or eaves of buildings, or may be

burrows hollowed out in the ground, in trees or in the stems of plants. The adult wasp lives upon fruit or nectar, but the young grub or larva must have animal food; and here the parent wasp shows a rigid conservatism, each species providing the sort of food that has been approved by its family for generations, one taking flies, another bugs, and another beetles, caterpillars, grasshoppers, crickets, locusts, spiders, cockroaches, aphides, or other creatures, as the case may be.

When the egg-laying time arrives the female secures her prey, which she either kills or paralyzes, places it in the nest, lays the egg upon it, and then, in most cases, closes the hole and takes no further interest in it, going on to make new nests from day to day. In some genera the female maintains a longer connection with her offspring, not bringing all the provision at once, but returning to feed the larva as it grows, and leaving the nest permanently only when the grub has spun its cocoon. The males never acquire this interest, so admirable for the development of character, and aid little, if at all, in the care of the family. The egg develops in from one to three days into a footless, maggot-like creature which feeds upon the store provided for it, increasing rapidly in size, and entering the pupal stage in from three days to two weeks. In the cocoon it passes through its final metamorphosis, emerging as a perfect insect, perhaps in two or three weeks, or, in many cases, after the winter months have passed and summer has come again.

Most graceful and attractive of all the wasps—“*taille effilée, tournure svelte*,” as Fabre describes them, the

Ammophiles, of all the inhabitants of the garden, hold the first place in our affections. Not so beautiful as the blue Pelopæus, nor so industrious as the little red-girdled Trypoxylon, their intelligence, their distinct individuality, and their obliging tolerance of our society make them an unfailing source of interest. They are, moreover, the most remarkable of all genera in their stinging habits, being supposed to use the nicest surgical skill in paralyzing their caterpillars; and few things have given us deeper pleasure than our success in following the activities and penetrating the secrets of their lives. In our garden we have two species of Ammophila, urnaria Cresson, and gracilis Cresson, both of them being very slender-bodied wasps of about an inch in length, gracilis all black, and urnaria with a red band around the front end of the abdomen. A. polita and A. vulgaris, which look much like urnaria, are common in the sandy fields west and south of Milwaukee.

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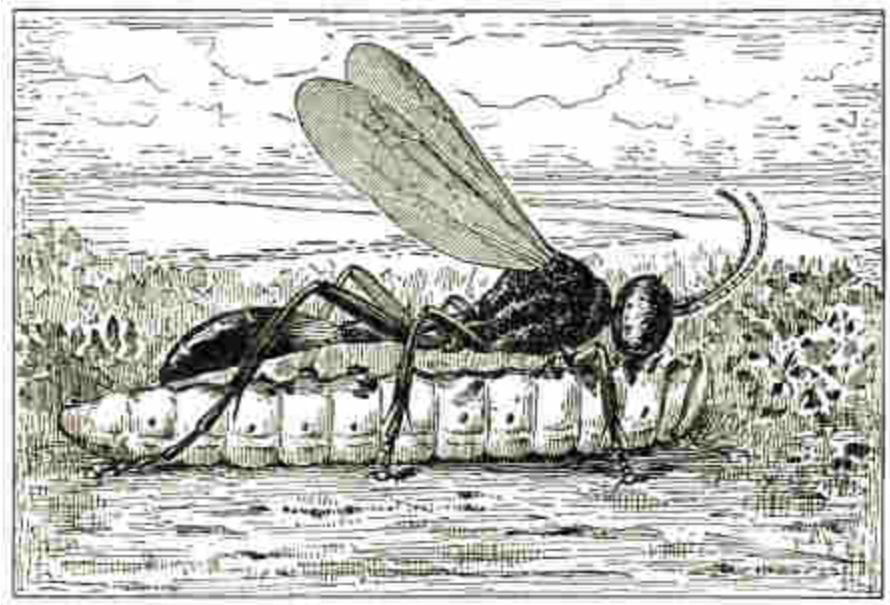

AMMOPHILA URNARIA CARRYING CATERPILLAR TO NEST

During the earlier part of the summer we had often seen these wasps feeding upon the nectar of flowers, especially upon that of the sorrel, of which they are particularly fond; but at that time we gave them but passing notice. One bright morning, however, we came upon an urnaria that was so evidently hunting, and hunting in earnest, that we gave up everything else to follow her. The ground was covered, more or less thickly, with patches of purslain, and it was under these weeds that our Ammophila was eagerly searching for her prey. After thoroughly investigating one plant she would pass to another, running three or four steps and then bounding as though she were made of thistledown and were too light to remain upon the ground. We followed her easily, and as she was in full view nearly all of the time we had every hope of witnessing the capture; but in this we were destined to disappointment. We had been in attendance on her for about a quarter of an hour when, after disappearing for a few moments under the thick purslain leaves, she came out with a green caterpillar. We had missed the wonderful sight of the paralyzer at work; but we had no time to bemoan our loss, for she was making off at so rapid a pace that we were well occupied in keeping up with her. She hurried along with the same motion as before, unembarrassed by the weight of her victim. For sixty feet she kept to open ground, passing between two rows of bushes; but at the end of this division of the garden, she plunged, very much to our dismay, into a field of standing corn. Here we had great difficulty in following her, since, far from keeping to her former orderly course, she zigzagged among the plants in the most bewildering fashion, although

keeping a general direction of northeast. It seemed quite impossible that she could know where she was going. The corn rose to a height of six feet all around us; the ground was uniform in appearance, and, to our eyes, each group of cornstalks was just like every other group, and yet, without pause or hesitation, the little creature passed quickly along, as we might through the familiar streets of our native town.

At last she paused and laid her burden down. Ah! the power that has led her is not a blind, mechanically perfect instinct, for she has traveled a little too far. She must go back one row into the open space that she has already crossed, although not just at this point. Nothing like a nest is visible to us; the surface of the ground looks all alike, and it is with exclamations of wonder that we see our little guide lift two pellets of earth which have served as a covering to a small opening running down into the ground.

The way being thus prepared, she hurries back with her wings quivering and her whole manner betokening joyful triumph at the completion of her task. We, in the mean time, have become as much excited over the matter as she is herself. She picks up the caterpillar, brings it to the mouth of the burrow, and lays it down. Then, backing in herself, she catches it in her mandibles and drags it out of sight, leaving us full of admiration and delight.

How clear and accurate must be the observing powers of these wonderful little creatures! Every patch of ground must, for them, have its own character; a pebble here, a larger stone there, a trifling tuft of grass—these must be their landmarks. And the wonder of it is that their interest in each nest is so temporary. A burrow is dug, provisioned and

closed up, all in two or three days, and then another is made in a new place with everything to learn over again.

From this time on to the first of September our garden was full of these wasps, and they never lost their fascination for us; although, owing to a decided difference between their taste and ours as to what constituted pleasant weather, all our knowledge of them was gained by the sweat of our brows. When we wished to utilize the cool hours of the morning or of the late afternoon in studying them, or thought to take advantage of a cloud which cast a grateful shade over the sun at noonday, where were our Ammophiles? Out of sight entirely, or at best only to be seen idling about on the flowers of the onion or sorrel. At such a time they seemed to have no mission in life and no idea of duty. But when the air was clear and bright and the mercury rose higher and higher, all was changed. Their favorite working hours were from eleven in the morning to three in the afternoon, and when they did work they threw their whole souls into it. It was well that it was so, for they certainly needed all the enthusiasm and perseverance that they could muster for such wearisome and disappointing labor. Hour after hour was passed in search, and often there was nothing to show at the end of it. Urnaria hunted on bare ground, on the purslain, and most of all on the bean-plants. These were examined carefully, the wasp going up and down the stems and looking under every leaf; but the search was so frequently unsuccessful that in estimating their work we are inclined to think that they can scarcely average one caterpillar a day.

In this species, as in every one that we have studied, we have found a most interesting variation among the different individuals, not only in methods, but in character and intellect. While one was beguiled from her hunting by every sorrel blossom she passed, another stuck to her work with indefatigable perseverance. While one stung her caterpillar so carelessly and made her nest in so shiftless a way that her young could survive only through some lucky chance, another devoted herself to these duties not only with conscientious thoroughness, but with an apparent craving after artistic perfection that was touching to see.

The method employed by the Ammophiles in stinging their prey is more complex than that of any other predatory wasp. The larvæ with which they provision their nests are made up of thirteen segments, and each of these has its own nervous centre or ganglion. Hence if the caterpillar is to be reduced to a state of immobility, or to a state so nearly approaching immobility that the egg may be safely laid upon it, a single sting, such as is given by some of the Pompilidæ to their captured spiders, will be scarcely sufficient. All this we knew from Fabre's "Souvenirs," and yet we were not at all prepared to believe that any plain American wasp could supply us with such a thrilling performance as that of the Gallic hirsuta, which he so dramatically describes. We were, however, most anxious to be present at the all-important moment that we might see for ourselves just how and where urnaria stings her victim.

For a whole week of scorching summer weather we lived in the bean patch, scorning fatigue. We quoted to each other the example of Fabre's daughter Claire, who followed

Odynerus with unfaltering zeal until a sunstroke laid her low. We attended scores of wasps as they hunted; we ran, we threw ourselves upon the ground, we scrambled along on our hands and knees in our desperate endeavors to keep them in view, sometimes with our eyes upon the wasps themselves and sometimes pursuing their shadows, which, like those of coming events, were cast before; and yet they escaped us. After we had kept one in sight for an hour or more, some sudden flight would carry her far away, and all our labor was lost.

At last, however, our day came. We were doing a little hunting on our own account, hoping to find some larvæ which we could drop in view of the wasps and thus lead them to display their powers, when we saw an urnaria fly up from the ground to the underside of a bean leaf and knock down a small green caterpillar. Breathless with an excitement which will be understood by those who have tasted the joy of such a moment, we hung over the actors in our little drama. The ground was bare, we were close by and could see every motion distinctly. Nothing more perfect could have been desired.

The wasp attacked at once, but was rudely repulsed, the caterpillar rolling and unrolling itself rapidly and with the most violent contortions of the whole body. Again and again its adversary descended, but failed to gain a hold. The caterpillar, in its struggles, flung itself here and there over the ground, and had there been any grass or other covering near by it might have reached a place of partial safety; but there was no shelter within reach, and at the fifth attack the wasp succeeded in alighting over it, near the anterior end,