

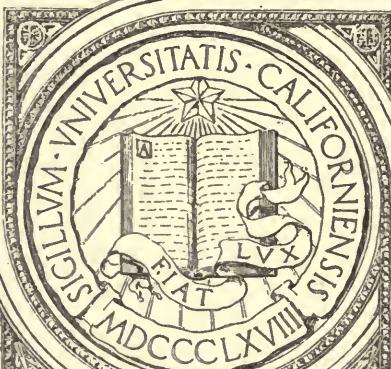
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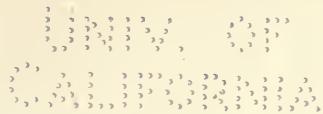
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WILD LIFE IN CALIFORNIA

SOME OF ITS BIRDS, ANIMALS
:: :: AND FLOWERS :: ::





WILD LIFE IN CALIFORNIA

SOME OF ITS BIRDS, ANIMALS AND FLOWERS



By
FRANK A. LEACH

OAKLAND, CALIFORNIA

TRIBUNE PUBLISHING COMPANY
1921

THE TRIBUNE
ANNIVERSARY

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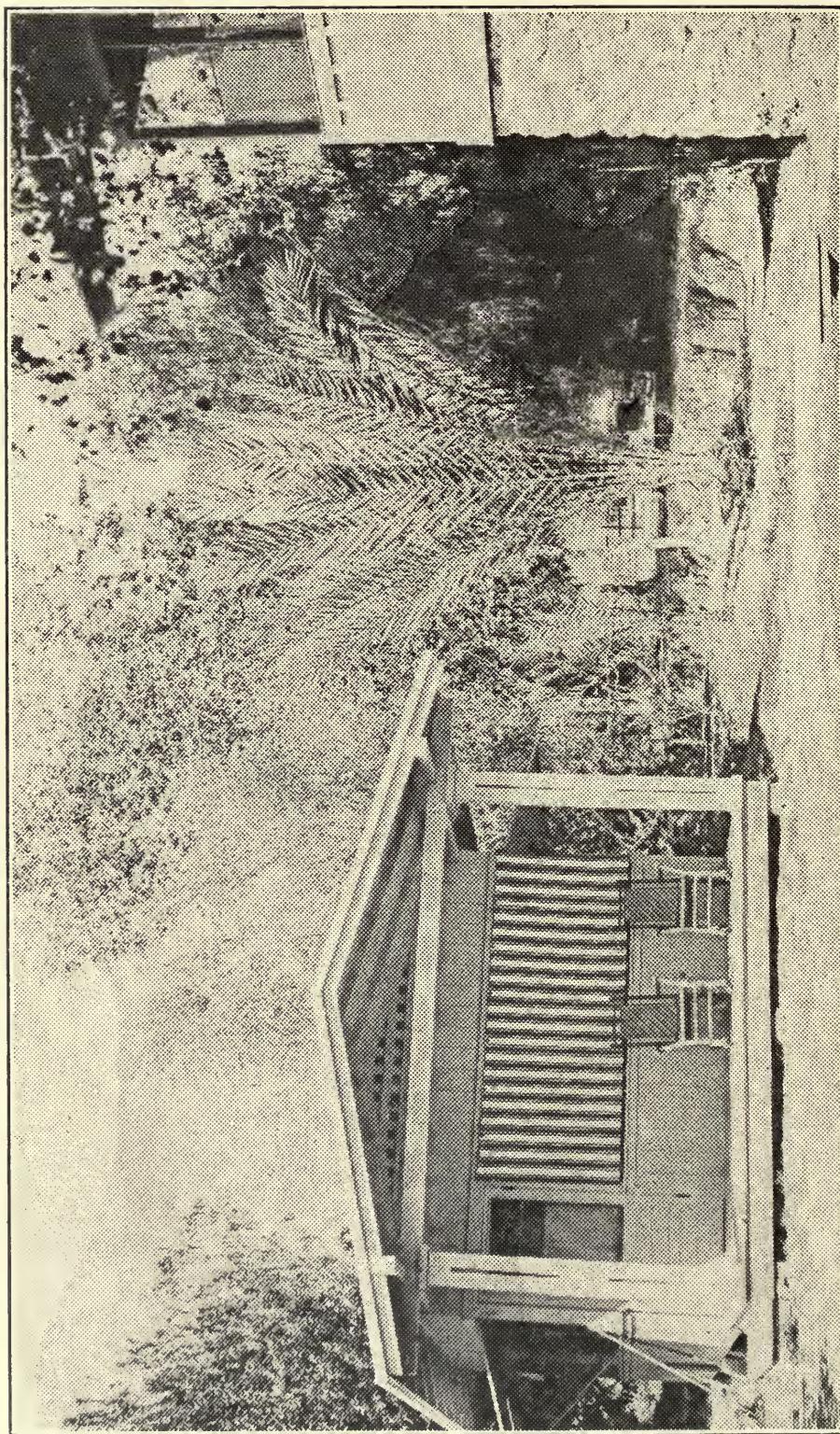
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FOREWORD

The series of Nature Studies contained herein were published first in The Oakland TRIBUNE. When it was learned that Mr. Leach had set down the results of his many years of observations of California's wild life, The TRIBUNE at once requested the privilege of placing them before its readers. The sound judgment of this has been more than confirmed by the testimonials of delight and benefit from the readers.

Mr. Leach has produced something which any naturalist or lover of the open places would be proud to call his own. He has written with charm, simplicity, knowledge and a literary finish which give his studies an uplifting quality, for both old and young folk.

FREDERICK FAULKNER.



THE AUTHOR'S QUARTERS WHILE IN PALM SPRINGS.

Wild Life in California

By FRANK A. LEACH

CHAPTER I

THE DESERT OF SOUTHERN CALIFORNIA Its Wonders. Its Wild Life. Its Beauties and Dangers The Hermit of Palm Canyon

One evening in the middle of March, my son Ed, his wife and little daughter, Virginia, and self left our home in Piedmont for the Sixteenth street depot, Oakland, preliminary to a visit to Palm Springs, Riverside county, in Southern California.

We checked our baggage to Whitewater, the railroad end of the trip, and boarded the train which was to take us to Los Angeles.

After getting located in our reservations and settling with the conductors for the night I thought I would go into the buffet car, smoke and read until bedtime. The car was crowded. The only vacant seat brought me next to a party of politicians who were having one of those "talks" so much enjoyed and so commonly indulged in when two or more kindred souls, who think it their destiny on this earth to make and unmake statesmen, meet with a little time on their hands to spare. They were all men well known in the State by their activities in politics, who would not feel complimented to be styled politicians, for they were not, in the offensive sense of the term. They did not recognize the writer, for which I was thankful, as I was now glad to escape becoming involved in discussions of matters that no longer interested me more than becomes an ordinary citizen. They talked rather loudly. I could not help hearing every word said. I could not move away, for there was no other vacant seat in the car. I tried to read. I did turn over several pages of my book, every one of which I read and reread, but when conversation turned upon men that I knew quite well and others that were intimate friends it was difficult to follow the lines in more than a mechanical way. After finishing my smoke I concluded to go to bed and read where I would not be an unwilling listener to the conversation of others and there would be no one to disturb me. When I went to my car and threw open the curtains to my berth, to my astonishment there was a big fat man apparently sound asleep in the bed. I quietly closed the curtains and went to the porter at the other end of the car and asked for an explanation. He didn't

know anything about it and seemed to care less, but finally said he would call the conductor. This official looked at my ticket and said the berth was mine and that the man had no business there. He called a couple of brakemen and the three men went to the berth, I supposed with the purpose of ejecting the intruder. Whether the job, considering the size of the man, or for some other reason, looked to be too great an undertaking, I did not learn. However it was, in a short time the conductor came to me and asked if I would not take another lower berth, which of course was all the same to me, so I consented. He said some uncomplimentary things about the other fellow, but did not offer any explanation of why he let him remain in the berth, though he said the man knew he had no right there.

I could not help but notice the great influence over the manners and civility of grown people wrought by the actions and speeches of a bright, innocent, sweet little thing like Virginia. The conductors and brakemen, who are generally short, if not gruff, and porters who are stolid, largely made so by constant contact with unreasonable and inconsiderate travelers, were all smiles and ready to surrender everything when in the presence of that dear little girl.

After a stop in Los Angeles we boarded another train which was to convey us to Whitewater, situated about nine miles from Palm Springs. This little town is located on that part of desert lying between the San Bernardino and San Jacinto ranges of mountains in the extreme southerly part of California. This particular part of the desert is that portion of the great Colorado Desert that extends into the State of California. Palm Springs is a little town of about forty or fifty houses, including a school, church, hotels, stores and garages.

Our train took us out through the famous San Gabriel Valley, passing Pomona, Ontario, Colton, Beaumont, Banning and several other towns of lesser importance. For the distance of ten or fifteen miles from Los Angeles the

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land seemed to be under a high state of cultivation or "intensified farming." Beyond to Banning orchards, grain and hayfields predominated in the use of the land adjacent to the railroad, about all of which appeared to be in a fairly prosperous condition.

Leaving Banning we passed into the desert. The desert is not without vegetation. In fact it is covered with shrubs, plants and cactus, with here and there growths of Palo Verde and smoke trees and palms. Probably seventy-five per cent of all is a shrub that grows from two to possibly ten feet in height, called the Creosote Bush or *Larrea Mexicana*. It is an evergreen and at that time was covered with small yellow flowers. It is a resinous shrub and emits something of a creosote, or carbolic acid smell, which we noted while tramping through it, for sometime before we learned from what it emanated. It is said that in certain localities on the desert the branches of the shrub become incrusted with a gum-like substance identical with the shellac imported from the Orient, and that it is used by the Indians for cementing purposes. The leaves and young branches are said to possess medicinal virtues.

The next most common plant is a perennial ordinarily with leaves of the dusty miller gray shade. The plant rarely grows more than eighteen inches high and generally covers a space of from two to three feet in circumference. From this area hundreds of naked green stems are sent up, surmounted with yellow composite flowers of about an inch or more in diameter. The disk or center, as well as the rays, are bright yellow. We saw a few plants where the centers of the flower were dark brown, and in Chino Canyon, 2000 feet above the desert, we found many of these plants where the leaves instead of being gray were green.

There are a few other gray plants, among which is a species of Yerba Santa, with a violet flower. These plants, however, are not as common as the first mentioned.

Next to the yellow flowered gray plant in importance as to quantity is the cactus family. We noted five varieties, all of which were in bloom, giving by far the most beautiful of all the blossoms we saw on the desert. Some of the cactus bore red flowers, some showy pink blossoms, and others yellow.

At Whitewater an auto stage meets passengers, bound for Palm Springs, so at this point we left the train and were soon on the way to the springs. The road in sections was in fine condition. Being State highway it had been paved, but flood waters had damaged and washed it out in places.

Palm Springs is an oasis of the desert, but not naturally so. Thirty years or more ago somebody conceived the idea of creating a town or city on the spot. The land was acquired and surveyed into blocks and streets, with lots of 27½ feet frontage. Water from a neighboring canyon was brought to the site and improvements in the way of buildings and the planting of trees was begun. We were told that the lots were sold rapidly and that one day's sales amounted to over one

hundred and seventy thousand dollars. Probably the reason for locating the proposed city at the spot was due to the presence there of an immense hot spring. Another enthusiastic person located a place about three miles further south where there now is a small grove of palm trees growing, at which he erected a hotel, beautified the grounds and called it the Garden of Eden. He constructed a narrow gauge railroad to connect the Garden of Eden with the Southern Pacific railroad, running the tracks to Palm Springs station on the latter road. Nothing is left of the enterprise now but the grove of palm trees. It failed for the lack of patronage, but that was before the day of automobiles and great increase of population in the southern part of the State.

The immense hot spring just mentioned was curbed and made to supply water for the bathhouse that was erected, and a small hotel was built. Some of the adjoining lands were planted out in vineyard and to fruit, principally citrus, but in a small way. All grew most luxuriantly. For many years there was not sufficient patronage to justify keeping the hotel open. It fell into other hands and now with the beautiful grounds is a private home.

The advent of the touring autos and the greater population in neighboring cities brought about a change. The charm of this beauty spot on the desert with its salubrious winter climate became known to the people of Los Angeles, Pasadena, San Diego and other cities of the south, and now the trouble is to take care of all who wish to visit the place.

The area of land that was reclaimed from the conditions of the desert probably would not greatly exceed fifty acres. The trees that were planted upon the land have reached maturity. The fresh bright green of the citrus trees, the great spread of the thrifty fig trees, the shade of the great cottonwoods, acres of green meadows and green lawns about the hotel and private grounds, would be features of attraction almost anywhere, but here the contrast with the desert is so great that the springs not only appear as a place of beauty, but a delightful haven of rest and retreat.

Excepting the territory just described and some railroad grant possessions, the desert land thereabouts has been made an Indian reservation. A number of Indians have large holdings under cultivation. Within recent years the government has been encouraging them to plant orchards on quite an extensive scale, aiding them in the purchase of trees and bringing water from the adjacent mountain through the establishment of a system of irrigating ditches.

These ditches are rock lined and cemented so as to insure as little loss of water as possible. Several of the Indians are graduates of the well-known school near Riverside. All the Indians we saw appeared to have abandoned the habits and customs of their forefathers. There were no loafers wrapped in blankets or shawls hanging around the

streets or other places where white people congregate, as was common a few years ago. The men now were as fully occupied with business affairs and as active as their white neighbors.

Their wives were at home attending to household duties, and some of the children were in attendance at the public school. And what is more to their credit the school teacher told me that their children were as bright and as quick to learn as the white children.

In describing the location of Palm Springs I should have mentioned the fact that it is situated on the edge or western side of the desert, at the foot of the San Jacinto range of mountains. In fact the shadow of the high San Jacinto peak is thrown over the town comparatively early in the afternoon as the setting sun drops behind the summit. This mountain is nearly eleven thousand feet high, with several neighboring peaks reaching six to eight thousand feet of elevation. Palm Springs has an elevation of about 500 feet above sea level, but the grade of the desert toward the south drops rapidly and at a distance of fifteen miles, or at Indio, the floor of the valley is twenty-two feet below the sea level, and at a distance of fifty-seven miles further on, at Salton, the floor of the valley is over two hundred and sixty feet below.

Like all other mountain ranges, the sides of San Jacinto range overshadowing Palm Springs are gashed with canyons. Some are insignificant, but many are deep and can be followed back into the mountains for miles. Three miles north of the springs is the entrance of Chino Canyon. Six miles south is the entrance of Palm Canyon. Between the last named and the springs are several other canyons, the principal ones being Murray, Andreas and Tahquitz. The latter is located only a mile and a half from the springs. Andreas four miles and Murray five. Tahquitz has a beautiful waterfall made accessible by an easy trail.

The features of interest in Palm Canyon is the growth there of numerous native palm trees known in botanical circles as the Washingtonia filifera. A few of these trees are found in the other canyons previously mentioned, excepting in Tahquitz. They also appear in one other canyon north of Chino, and in several other canyons south of Palm Canyon. They are more numerous on the opposite side of the desert or along the base of the San Bernardino range. The maximum height of the trees is about seventy-five feet, the largest trees have a trunk diameter of about three feet. The huge fan-like leaves thrust from the top of the trees give a pleasing shade. As the trunk ascends in growth the leaves die and hang down, making a thick thatch around the trunk, suggestive of a great petticoat. But it is only occasionally you will find a large tree with its petticoat preserved. Fires, intentional or accidental, have burned them off. Unless the fires burn into the top, or green part, which seldom happens, the trees are uninjured. It is said these trees are peculiar to that section of country ex-

tending from the margins of the northern part of the Colorado desert into Lower California. They are commonly called California fan palms.

We made the hotel, or inn, as it is most commonly called, our headquarters. It is centrally situated in the territory that we wished to cover in our study of nature's productions. So it was from this point we made daily excursions out on the desert and to the various canyons mentioned. Generally we took our lunches with us and would walk from six to fifteen miles. Some of the places, the larger canyons in particular, we visited several times to enable us to observe all of the features of interest, such as the geological formations and recent changes therein, the flora peculiar to the section, and especially some of the desert insect life.

The remarkable vigorous growth of the numerous citrus trees, the strong and healthy appearance of the fig and numerous other fruit, shade and ornamental trees in and about the little town suggested a soil condition of unusual fertility. In the hotel grounds there were growing many beautiful trees of different kinds, among which were a couple of trees near the office bearing grape fruit. These trees were about twenty feet in height and the great size of the fruit hanging from the branches at once attracted the attention of all incoming guests. Some of the largest fruit measured within a fraction of twenty-four inches in circumference, which would give them about eight inches diameter.

We had not been long in the place before we noted that it was teeming with bird life, with numerous songsters. In fact the air was filled with bird music, in which the singing of the linnets and Bullock orioles was the most prominent. The last named was one of the most numerous birds around the springs grounds. As the nesting season was now on we found several pairs of these birds at work constructing the peculiar hanging nests for which they are noted on the under side of the big leaves of the palm trees.

A few moments' walking northerly, easterly or southerly would take a person beyond the lands reclaimed for town purposes, out among the shrubs, cactus and wild flowers of the desert. The floor of the desert consists of what might be roughly called coarse sand, but properly speaking it is composed of the erosions from the granite masses forming the mountains bordering the desert. In the course of time where it receives an abundance of water and some humus, and is worked, it seems to slowly decompose and form soil. It should be rich in some of the elements nutritive to plant life, especially potash. Ordinary sand is composed almost wholly of silicia, which is insoluble and therefore differs from the so-called sand of the desert.

As you approach the mouths of the canyons from the main level of the desert this sand becomes coarser and coarser until finally you begin to encounter boulders, then big broken

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rock masses. Not very long ago, geologically speaking, the valley of the Colorado Desert was submerged and formed an arm of the sea or of the Gulf of California, and while in this condition the comparatively still water of the ocean prevented an extensive distribution of the heavier eroded parts that were brought down into the canyons from the mountain sides, from whence they were sluiced out by the rapidly flowing streams into the ocean waters and deposited according to size and weight. The lightest material was carried the farthest and spread out. The deposition of the erosions in this way gave a fan shape to the deposits and in some cases with a slope of about one foot in ten from the mouth of the canyon to the outer edges of the fan. When the country was elevated above the ocean level once more and the sea had disappeared, the canyon streams soon cut channels down through the loose material of the fan deposits in forcing their way to the desert floor. In some places we found these channels a hundred or more feet in depth. The fans are greater or less in extent in their intrusion upon the desert according to the magnitude of the canyon from which they emerged.

Palm Canyon, which is the most extensive in size and length of all the canyons in the vicinity of Palm Springs, as stated, is situated south of that place, and the entrance to the canyon is six miles from there with an elevation of several hundred feet above the valley. This is the most popular of all the canyons by reason of it being comparatively easy of access, there being a road which enables autoists to run their machines well into the canyon. Besides the natural attractions which embrace the largest groves of palm trees on the west side of the desert, a nature man, or a hermit, makes his abode there. The novelty of his dress, or lack of it, his accomplishments as a musician, his skill in manufacturing souvenirs, his cabin, and the unusual appearance of the man himself, all combine to make him an important addition to the features of Palm Canyon, especially with the tourists visiting the springs.

At some period ages ago through some action of nature the original channel of the canyon appears to have been dammed by a filling of rocks and earth to a depth of more than one hundred feet and greater width from wall to wall. The canyon stream there was diverted in an easterly course to a point two or three hundred yards distant, where it cut a way for itself through the hills, turning north and making a channel that in a quarter mile or so brought the waters back into the old channel some distance below the dam. The only practical way of reaching the upper part of the canyon is by using a trail passing over this dam. The nature man's cabin is located on the level top of the dam alongside the trail. Its location gives him a commanding view, especially down the canyon, nearly a half mile to the terminus of the auto road, from which point all further explorations have to be made on foot. It can

be relied upon that few tourists, if any, start up the trail without the knowledge of the nature man. The trail where it passes over large rock masses, or other points, where the indications of it are slight, is made distinguishable by the nature man having placed small rocks one upon another in spots along the indistinct places.

This nature man is an interesting character. He is still a young man. His long hair and full beard, together with pleasant facial features, makes his photographs look somewhat like the pictures of the Saviour, a fact of which he is very proud. After meeting him a number of times I reached the conclusion that he really enjoys a certain amount of the solitude of mountains and desert but desires the presence of visitors and sight-seers for what coin his music and wares might induce them to part with. The amount of money thus secured cannot be very large, but as his wants are few and simple it is probably sufficient for all his needs. He endeavored to establish rules to govern the conduct of his visitors. These are set forth on a neat and well-written card, prominently placed at the end of the auto road, where all who enter the canyon and the domain of the hermit cannot help seeing them. A reading of the rules will show that the author is not only a man of some education and culture, but also not unreasonable. The following is a copy:

AN APPEAL TO REASON.

Small rocks, piled one upon the other indicate the trail. If U don't need them **someone else may**, therefore leave them as U find them.

In the beginning **all things**, Rocks, Plants, Animals, Man, were called into existence by the **First Great Cause, GOD**, and therefore **all belongs to HIM**, and since U are unable to create U have no right to destroy, not even a snake.

Therefore when U enter this Canyon leave Ur fear and hatred and weapons of murder behind. Say "Peace and Good Will to All." Come! Look! Admire! Enjoy! but don't let Ur joy mean suffering to something else. God loves All. Live and let live! and God will bless U.

HE WHO LOVES ALL THINGS.

He did not seem anxious to hide the fact that a certain amount of his "nature life" is commercialism, pure and simple. He justifies it as being easier than hard work in procuring the necessities of life. He seems to be sincere in his declaration of love for the life he is living. He says he is studying philosophy and religion and expects that when he masters the subject he will be able to fathom the mysteries of life "without the aid of scientific instruments."

Arriving at the cabin upon the occasion of our first visit we found the nature man sitting outside playing on a guitar-like instrument which under his handling gave forth most pleasing and delightful music, finished and artistic. Although aware of our presence he made no sign of recognition of the fact, but went on playing as if his soul and the instrument were in some form of communion not to be interrupted. Nor did we care to interfere. We were willing to listen as long as the spell was upon him to play. Finally he stopped playing and with a smile on his face bid us "Good morning." Our appreciation of his musical efforts pleased him and he proceeded to give us another number or two. The instrument he said he had made to order, but its peculiarities were not original. It was constructed after a form in common use in the Hawaiian Islands. The music is produced by manipulating the strings on the finger board with a small piece of tempered steel held in the left hand, while the strings are vibrated with the fingers of the right hand over the sounding board or the usual place in playing a guitar.

One of the pictures he has for sale is a photograph of himself playing on this instrument. However, as there was some little chill in the morning air at the time of our visit he wore more clothes than when the picture was taken, but not very much—just a shirt.

He told us that he built the cabin himself, cutting all the lumber used, out of the trunks of fallen palms he found in the canyon. Beside being an excellent musician, he was a good mechanic. All the work of the cabin was well done, and as the wood seems to be strong and durable, barring accidents, it should afford a shelter for years to come. I asked him for the names of the flowers I held in my hand. He looked at them for a moment and then replied: "They are all flowers to me; I do not need to label them."

It was plain from his accent of speech that he was a German. He said he had been in the United States ten and a half years, and in that vicinity for a year and a half; that when he first came on the desert he located and built a cabin in Chino Canyon, but as so few people went up there the location afforded a little more solitude than he was looking for. The present site of his cabin supplied other advantages—more sunshine and more air, so he had moved to where we found him.

From the cabin the canyon extends southwardly several miles, but for lack of time we were not able to go, in our explorations of it, beyond a couple of miles. For the greater part of this distance the going was easy, but beyond it appeared to be rough and difficult.

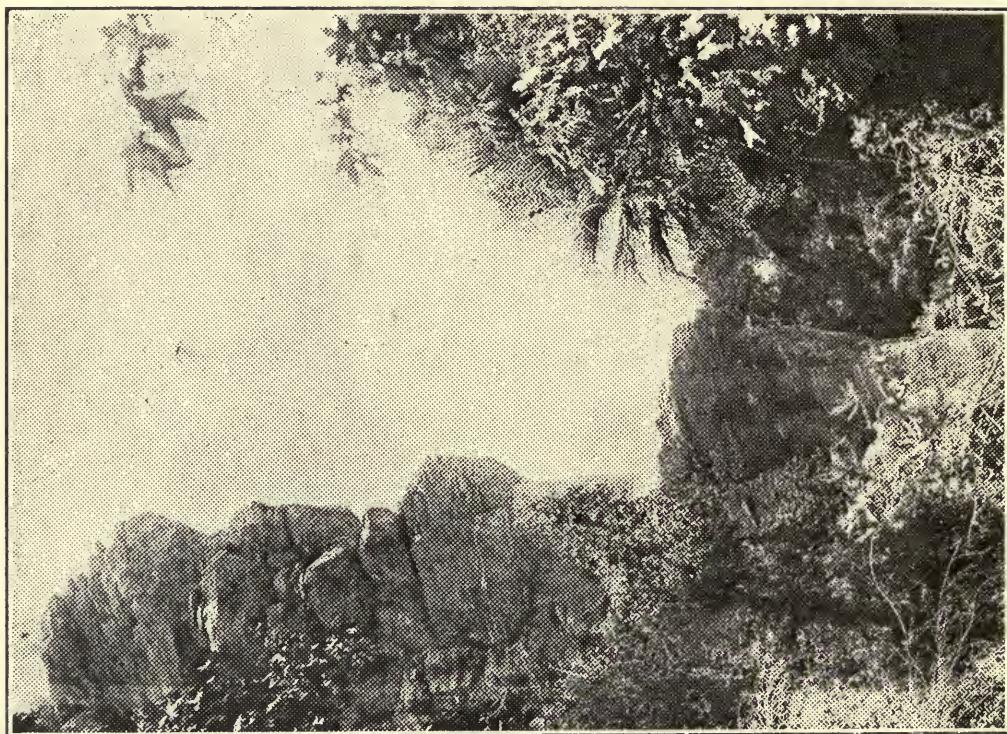
It was on this trip where we saw our first Phainopepla, a handsome crested male bird, a little smaller than a male blackbird and like which, wore a coat of iridescent black but with white patches on its wings. This bird is peculiar to the southern part of the State, where it is quite common in some sections. It does not have much of a song but its notes

are not unmusical. The female is of rather a dull black and leaves it all for her mate to make a show. We also noted a pair of Yellow warblers, a Mocking bird and a King bird, sometimes called Bee Martin, which has a more severe name in the bird books, *Tyrannus vociferans*. Strange it is that while this bird will attack and drive away birds much larger than itself, even crows, it will flee from the attacks of humming birds. They are rather noisy birds and anything but musical. We also saw several Audobon warblers flitting around among the trees bordering the canyon stream. They are pretty birds with their slatey, black, white and yellow colors, but always in such a hurry that it is difficult to get a satisfactory view of one.

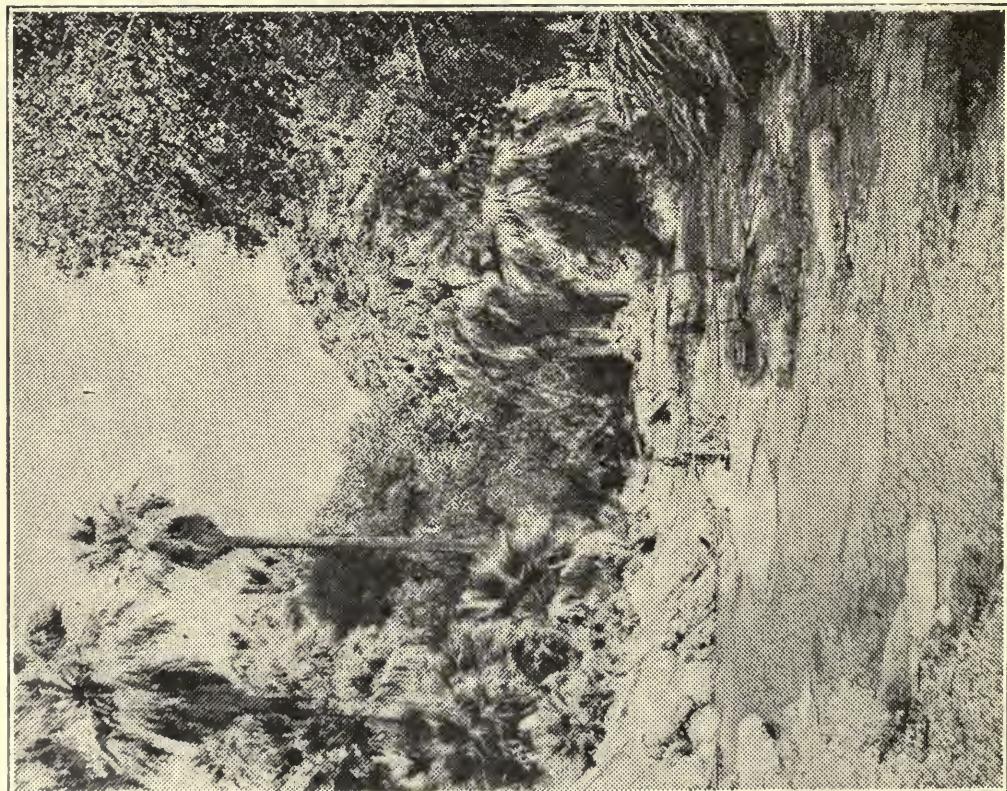
The palm trees grow in the bottom of the canyon and we found them scattered along as far as we went, and were told they continued to be a feature of the canyon for nearly its entire length. Nearly all the trees we saw had their petticoats burned off and the trunks were blackened by the fires. However, the tops looked thrifty and therefore the trees had suffered no injury.

We found some wild hollyhock with a delicate pink shade and others of plain white; there was no difference otherwise from the plant with the scarlet blossoms found elsewhere on the desert. Another attractive flower noted was the vervenia, *Phacelia distans*. The plant grows from one to two feet high. The leaves and stems are hairy. The blossom stems carry a mass of small violet colored flowers. We saw but few flowers common to the northern part of the State, not more than four or five varieties, of which the white forget-me-not, the larkspur, the evening primrose are all that I can recall, unless I should include one little, sickly, half-developed "blue dick" or "cluster lily," or *Brodiaea capitata*.

Palm Canyon was made the scene of operations of a large moving picture company from Los Angeles during our stay at the springs. The advent of this company, with its actors, photographers, superintendents, assistant superintendents, mechanics and laborers to the number of a hundred or more people accompanied by horses and camels and an immense amount of paraphernalia, was something like a circus coming to a country town. The commotion caused in our little burg could not have been greater if it had been a circus. The purpose of the company was to take advantage of the natural scenery with the tropical character given to it by the groves of palm trees as a setting for an act or two in a play being prepared for exhibition in movie theaters. A well-known actress and some actors not so well known, together with the nature man, appeared in the scenes. Owing to imperfect arrangements for transportation quite a number of the men, women and children taking part in the production were left at the canyon to get back to the springs the best way they could. Some of them were still in their grotesque costumes scattered along the desert on foot, making their way home-



ANDREAS CANYON.



IN PALM CANYON.

ward when we saw them near nightfall. It was quite late in the night before the last of the stragglers were found and brought into town.

It is in this canyon that the exceedingly rare beetle, *Dinapate Wrighti*, is found. It is one of the largest of the Coleoptera occurring in the United States. The mature insect measures from an inch and a half to two and a quarter inches in length. It belongs to the Bostrichidae family. It has been found so seldom that very few collectors have taken it and but very little is known of its life history. My son succeeded in collecting several specimens and also found that the female beetle deposits her eggs in the wood of the native palm tree, where the larvae hatch and live until they develop into mature beetles. The holes in the palm wood from which the beetles emerge are about three-quarters of an inch in diameter and look as if bored with an auger. Ed brought home a piece of the wood which he thought contained some larvae and placed it in the warm attic of our house in Piedmont, and in the fall of that year had the satisfaction of obtaining several mature beetles that emerged from the log. Hubbard styled this beetle the "Dodo" of Coleoptera, referring to its large and ungainly form and the fact that the species is bordering on extinction.

While out on a short trip of observation one evening we met Dr. J. C. Bradley of the faculty of Cornell University, on his way to set a night trap in a favorable place for the collection of insects. The doctor being one of the most prominent entomologists of the Eastern states, besides a most genial companion, we were delighted to meet him. He arrived at the springs the day before for the purpose of spending two or three days here collecting. The result of our meeting was an arrangement for a joint trip on the following day to the next canyons north of Palm Canyon.

As planned, after breakfast, in company with Dr. Bradley, we started out on an all-day trip to Murray and Andreas Canyons. We engaged an automobile to take us out a distance of nearly four miles on the main road to where the trail to the last-named canyon began. Arriving at this point we dismissed the machine and proceeded on our tramp. We entered the canyon and went up between its rocky walls for a distance of about three-quarters of a mile. Our main purpose, of course, was the collection of insects and plants of interest. The Doctor paid particular attention to the wild bees and caught specimens of a number of species. Ed made quite a collection of beetles, some of which were rare and others that were new to him. We came across a number of those attractive birds, the Phainopeplas. They were not very shy, which gave us opportunity to become better acquainted with them.

I met with a plant, the first and only one I had seen on the desert, the yellow bladder-pod, *Isomeris Arborea*, that belongs to the Capparidaceae family. Though quite common in some localities, the only other place where

I had seen the plant was on Catalina Island. It bears clusters of rather pretty yellow but ill-smelling flowers, but is more interesting by reason of the peculiar way it forms its bladder-shaped seed pod on the top of its style instead of at its base, as is usual with other flowers. Wild apricot bushes were quite numerous, but very few wild flowers were in evidence. Ed found a couple of seedling palm trees which he dug up without injury to the little rootlets, with the intention of transplanting them in the soil of Alameda county.

After our return to the mouth of the canyon, where there is a grove of the native palm trees, by which runs a large stream of beautiful clear, cold water, we had our lunch. We passed a half-hour or more in eating and conversation and then started for Murray Canyon, the entrance of which was about a mile away to the south. Here we found another good-sized stream of water, with more palms growing along the banks. The canyon is somewhat smaller than Andreas and the walls of the entrance are not so high and rugged.

By 3 p. m. we were ready for the walk home, five miles away. We had experienced a most enjoyable day and were fuller of knowledge of the strange things the desert section possessed. We met some picnic and camping parties in Andreas Canyon, the members of which seemed to be enjoying the novelty of the place as well as the beauties and grandeur of the canyon.

While working slowly along the upper part, a lady passing me said: "Are you hunting bugs, too? I just passed a man below here who said he was trying to catch beetles. How interesting." "Yes," I replied, "and if you go a little farther you will see another man engaged in a similar occupation, hunting for wild bees."

"How interesting!" she declaimed, and passed on.

On the way home, while we had stopped to examine an ant hill or nest, we were witnesses to a combat between a small spider (the body of which was not larger than a duck shot) and a member of this particular ant colony. As the fight was in progress when we discovered it, of course we had no way of determining how long it had been going on or how it began. The ant, which was less than a quarter of an inch long, was persistent and aggressive, while the spider seemed more artful and active. Finally the latter jumped at the ant and then back like a flash, in which act it apparently dealt a knockout blow or bite, for the "model of frugality and industry" was seen to be stunned. Its antennae quivered and body swayed on its legs that were apparently giving away from the effects of the spider's poisoned blow. In less than ten seconds the ant was "down and out." In that swift and fatal movement the spider not only inflicted the sting, or more properly the bite, that decided the battle, but wrapped a thread of its web around the ant, entangling it so that when we lifted the dead ant with a pair of pinchers the spider was raised from the ground as well.

Dr. Bradley called our attention to the fact that the nest was that of the Honey ant, **Myrmecocystus Melliger**. A peculiar feature of this species is that it makes provision for food to carry it through the season when its peculiar food is unobtainable. It gathers a honey-like substance presumably from flowers which is fed to and then stored in the abdomen of one form of the workers designed by nature for the purpose. When filled the abdomen is inflated to the size and shape of a cherry stone. After being gorged with the nectar the live storage vats cling to the roof of their home underground until later in the year when food is scarce and it becomes necessary for the other members of the colony to resort to the storage ant for subsistence, which they disgorge to their fellows through their mouths.

The Doctor also pointed out eight or ten different species of ants along the road, one of which was peculiar to this part of the world; and besides, showed us another, a Myrmicidae, extremely rare, which we found in Andreas Canyon.

We came across four or five birds, members of the thrush family. They looked like our russet-backs, but the color seemed darker and the spots on the breast more pronounced. They might have aided us in identification by rendering a note or two, but they preferred to remain silent, so we were compelled to continue on our journey without determining their exact place in avifauna of California. My pedometer recorded nine miles walking for the trip.

On a previous occasion Ed and I visited the entrance to Andreas Canyon while on our way back from Palm Canyon. We did not have time to explore the canyon for any distance but satisfied ourselves with looking around the little meadow of an acre or so in size, which is dotted with a clump of palms with their petticoats unburned; also with alders and cottonwood trees. In one place the palms and other trees were so thick that the sun's rays could not penetrate the branches and leaves and interfere with the perpetual shade made by the thick growth. At one time the canyon was a popular camping place for people who wished to visit the desert, but recently government agents have ordered campers away. From the canyon to the inn the distance was a little over four miles. It was while walking this stretch that we came across the first wild apricot trees. The fruit and leaves are much like those of the cultivated tree, but both are considerably smaller. We were informed that the government is making some tests at the experimental station at Indio with the wild tree to see if it or its roots cannot be utilized to some advantage to our fruit growers.

After getting off the fan of the canyon, we found a road leading into Palm Springs. The walking of course was easier, but we were also glad to get away from having to dodge the choya cactus, which was growing in greater quantity over the section we had traveled than we had experienced elsewhere. It grows from three to six feet tall, the main

stalks being about three inches in diameter; these stalks throw out contorted branches and sub-branches without order or system. The thing is covered with barbed-spines from top to bottom which it parts with on the slightest provocation. Some people think that the plant shoots its spines at passersby, which absurdity I was almost willing to endorse for a time. When once in your flesh it takes strength and a pair of tweezers to extract the thorn.

Along the road we found some datura plants in bloom, a plant that is very common in the San Joaquin valley. It has a beautiful large flower, but is so plentiful that it is classed with the weeds by some people. We found more than ordinary interest in these flowers, discovering that they were harboring some interesting beetles.

On the 26th day of March the sky was slightly overcast and the day much cooler, but very agreeable for those at the Springs. We could see, though, that out on the desert, eight or ten miles away, the wind was blowing hard, and the air was filled with dust and sand, almost obscuring the view of the San Bernardino range of mountains that border the easterly side of the desert.

While watching the cloud of dust being driven from the northwestern end of the desert with a speed that implied an unusual wind mileage, I noted that the disturbance did not seem to extend beyond the great sand dunes in the middle of the desert. For some distance south of these great mountains of sand the air was practically clear. Here was a possible clew accounting for the presence of the dunes, which had heretofore been something of a puzzle to my mind in trying to find a reason for their occurrence at that particular spot. It appeared to me that it was probable that the heated air of the desert rising admitted a rush of cold air through the gap in the mountains at the northwestern end of the desert to take its place. The hotter the weather the more rapid the rarification and less resistance to the cold air pressing in from the ocean side. The cold air would travel over the desert until it became heated and thus made to lose its onward force and become like the rest of the desert air. Then its horizontal movement changed to an upward direction. Its capacity to carry sand and heavy dust gradually ended with the change of its temperature and upward movement. These dunes are located about forty miles from the gap or northwestern end of the desert. Apparently then the ocean, or cold, winds are modified by degrees to the same temperature and condition of the general atmosphere of the desert while passing over this distance, therefore losing their dirt-carrying capacity at the end of the forty miles. This change taking place practically at the same spot for ages, there is now piled up a great mass of sand 2000 or more feet high and several miles long—a huge monument to one of the forces of nature—the wind.

The change in temperature of the entering cold winds is effected slowly as it passes over the desert. This fact is indicated by the form

of the dust cloud. When first seen it is shallow, rising but a few feet above the desert plane, but as it progresses into the desert it rises on an incline until it reaches a height of thousands of feet, where further projection of it ends, and beyond which the atmosphere is free of dust. This theory was reached while trying to find an explanation for the fact that we at Palm Springs and thereabouts were enjoying the pleasures of an exceedingly quiet, clear and clean atmosphere while a sand-storm prevailed a few miles away on the desert.

In one of my morning walks I met with four people in different places whose occupations gave strong evidence of the popularity of this section with lovers of nature. One was a young lady from the Eastern states, who was making oil sketches of bits of the desert with rugged mountain back grounds; another was Carl Eytel, an artist, who has passed much of his life here and in similar sections of Southern California, who was engaged in reproducing on canvas some local landscape features in which the native palm was conspicuous; another was a lady gathering wild flowers to be pressed and preserved to show as novelties of the desert. The last was a Californian who was sketching a picturesque spot in water colors. No doubt but there were others unseen by me engaged in similar occupations or in making a study of the insects, birds or flowers.

As might be expected, Palm Springs was not without real estate agents. As you enter the town signs announcing date and other fruit lands for sale are conspicuous. Up to the time of our visit no date trees, so far as I could learn, had been planted in that immediate locality. From experiments made in growing dates in other desert sections there was reason to believe that the date palm will grow thriflily and bear abundant fruit in that section. We met a gentleman living in Palm Springs who was then and had been for some months past giving his time and attention to a date orchard located at Indio, which is about fifteen miles from Palm Springs. He had become interested in the cultivation of this fruit some few years before and had had an orchard down in the extreme southern part of the state, but he found the climate there unsuitable to the maturing of the fruit. The cool, damp breezes that came off the Gulf of California mildewed the dates at the ripening season. He concluded that the climatic conditions at Indio were superior; in fact, more like that of the home of the fruit; therefore he determined to remove the orchard containing about 400 trees to Indio. This was two years and one-half ago. In carrying out this very remarkable undertaking the trees were carefully dug up and crated, hauled five miles to a railroad station, and from thence were shipped by rail to Indio. Some of the larger trees weighed two tons each. Of course he had a very large freight bill to pay, to say nothing of the cost of digging up and replanting. Remarkable to record, he lost very few trees in the transplanting and none of those that died

were large trees. The loss was confined entirely to the small trees. He said the trees were then in bloom and gave every evidence of being located in a congenial situation with profitable results.

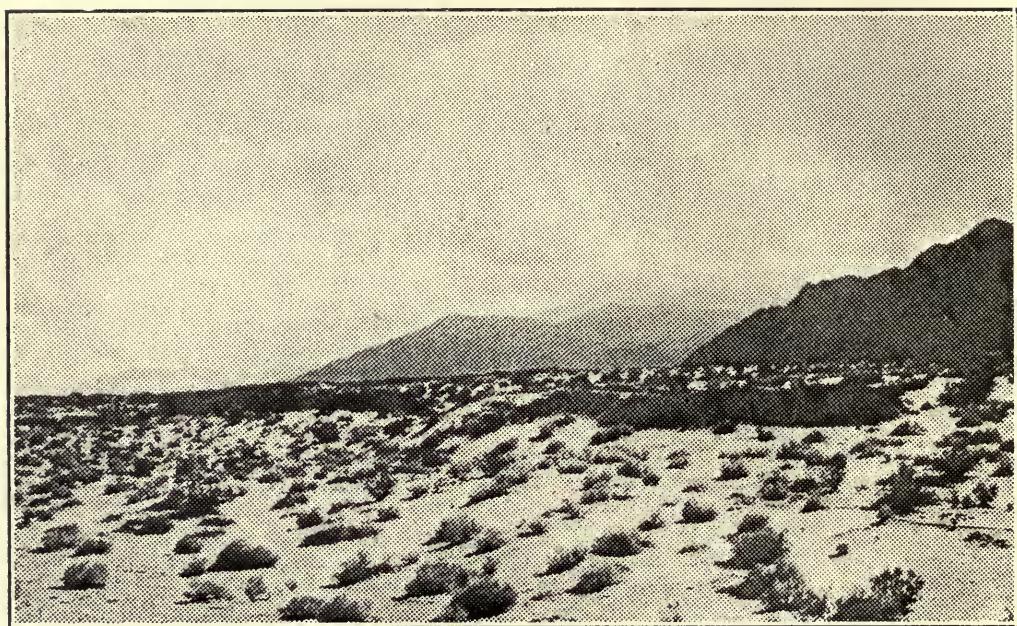
One forenoon while walking along an irrigation ditch we discovered a pair of giant water bugs known as Belostoma of the specie *Serphus dilatatus*. The entire back of the male was covered with the eggs of his mate, which she had placed and cemented there, a habit which the females of this specie are addicted to. He was thus made the caretaker of about ninety eggs, which were rather more elongated than globular and about two millimeters in diameter. Judging from its actions compared with those of the female, I concluded that it was not taking life, under the conditions imposed, with any great degree of ease and comfort.

Upon my return to Piedmont three weeks later I took Mr. Serphus out of the small box where I had been keeping him between moist wads of paper. He appeared none the worse for his close imprisonment, but I noticed that the eggs had elongated or grown lengthwise by half a millimeter. I put him in a glass jar partially filled with water. It was unnecessary to put a cover over the top of the jar, as it seemed impossible for him to use his wings plastered down as they appeared with eggs.

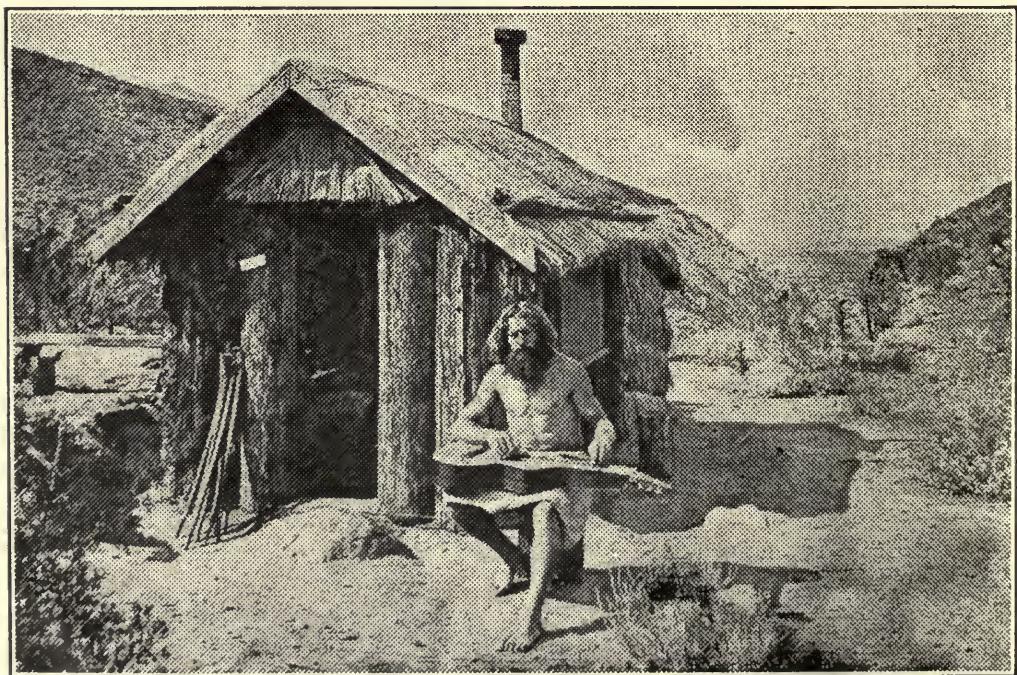
I also put a large flat cork in the jar for a float that the bug might have a place on which to get out of the water if so disposed. This he used a great part of the time by which to lift the tip of his abdomen above the water. I presume he did this for the purpose of obtaining air; for, like some other forms of insect life, he probably secured his needed supply through the stomata or breathing places there.

Three days later I noted that some of the eggs had elongated to about four millimeters or to about double the length of when I first saw them. That day eight or ten eggs hatched and as many little baby Serphus were soon swimming around in the jar. They were like the parent in shape and in a few hours they acquired a length of about eight with a breadth of about four millimeters. Burdened as he was, like Sinbad the Sailor, it must have been a happy day for the father. The young bugs when they first emerge are practically colorless but become yellowish a little later, then soon take on a rather dark brown color and become quite lively. Their eyes, two little black dots, as well as the beak, were quite conspicuous.

I took the parent bug out of the jar to examine the unhatched eggs and found about a dozen in advanced stages of hatching. In the earliest stage the top of the egg breaks open and a transparent jelly-like mass protrudes. This is the head part and bears three black specks which become the eyes and beak of the mature bug. The emergence from the egg cases is a very slow process. I could see but little progress in the course of an hour's observation. The body seemed almost shapeless and lifeless until the emergence was com-



THE DESERT, NEAR PALM SPRINGS.



THE PALM CANYON NATURE MAN.

plete and the insect freed from the case. Soon after it would swim off actively and dart around as if in enjoyment of the newly-found life.

Within two or three hours after I discovered the hatching had begun I observed three of the babies were lying dead on the bottom of the jar.

In the next twenty-four hours about a dozen more young Serphus made their appearance in the jar, but soon after there were eleven dead on the bottom of the jar. I put an earth worm in the jar and very soon several of the oldest babies were feeding on it.

By the end of the third day the hatchings had increased so much I could not count them, but the fatalities were increasing as well. Watching the actions of the young bugs closely for an hour or so disclosed the cause of the death of many, if not all, of the lifeless forms in the jar. I saw one of the largest or first hatched catch one of the younger ones and sink its beak into the body of the unfortunate and proceed to feed upon it. Later I saw one of the older ones seize upon a baby just emerging from the egg case and swim off with it. It was also on this day that the tissue holding the empty egg cases as well as the cases with the unborn sloughed off the back of the parent. After this event no more eggs hatched.

I endeavored to supply the young bugs with worms and insects, but they preferred to feed upon each other, so the number daily grew less and by the end of the week the last and strongest of the young family were dead. Though I was not a witness, I have reason to believe these became the victims of the appetite of the parent.

Tahquitz Canyon, next north of Andreas Canyon, being only a couple of miles from the Springs, was visited by us on several occasions. No palm trees are growing there, but it has many other kind of trees, shrubs and flowers, as well as the beautiful waterfall. I do not know which trip interested me most, but our first visit was on a beautiful morning. The delightful atmosphere, with the clear sky overhead, the many singing birds, the genial air and carpet of showy flowers under our feet wherever we stepped, aroused one's enthusiasm and brought forth mutual expressions of delight and pleasure. One flower that grows in beds not unlike that of the cultivated garden was a wild verbena. In fact, the flower itself is very much like the garden verbena. It has a beautiful shade of lilac and one never tires looking at a bed of them. A flowering shrub that attracted our attention was the **Parosela California**. I could find no common name for it. It was conspicuous on account of the contrast of its little dark blue pea-shaped blossoms with the pale gray foliage. We also noted three specie of the Onagraceae, or Evening Primrose family. Another oddity to us was a pale pink Evening Primrose.

Along the creek that flows from the canyon alders and cottonwoods grow quite profusely, but, as stated, no palms have found a place there. From the mouth of the canyon the trail to the falls is cut into the mountain side.

It was a little rough but on an easy grade. A half-mile walk from the portal brought us to the falls. At this time of the years the falls present a pretty picture, consisting of a sheet of water eight or ten feet wide with a sheer drop of about 65 feet. The large pool formed at the base of the falls looked like an ideal spot for trout, but we were told there were no fish in the stream.

On the return home we came across some pretty bluish purple flowers on a plant about a foot in height. The bell-shaped corolla was over an inch in length with exserted stamens and pistil. We identified the flower as the wild Canterbury bells.

Around the grounds of the Inn and other parts of the town visitors will find not a few things to interest them in the gardens in the way of strange trees and flowers and wild birds. In the vicinity of the big hot spring and bath-house, around which are numerous large trees, many kinds of birds are to be seen. Even the English sparrow had found a congenial home there. In addition we also noted a number of Blackbirds, Robins, Swallows, Black Phoebeys, Orioles and some California Towhees. These latter birds differed from our northern Towhees in that the lores and ear coverts were quite dark. Our Towhees are not so marked.

About a half-mile from town one morning we came across a little "seven by nine" cabin on the desert close to the mountain base, which was housing Carl Eytel, the artist spoken of in another place. In this cozy and comfortable little domicile he has produced much work in art. He has furnished illustrations for Smeaton Chase's books, as well as executed many paintings and sketches. He is credited with being an excellent authority on all subjects relating to the desert. He accommodated me with the botanical name of a plant which I found growing near his place. It was the plant commonly known as the Devil's Claws, being given this name because of the peculiar character of the seed pod when matured and dried. This pod has two slender, curled horns which are six to eight inches long and as tough as rawhide. The points being sharp, they are not a pleasant thing to get tangled around your ankles, which seems to be their only purpose; at least that is what one is inclined to think when he meets with such misfortune. The plant grows to a height of 18 inches or more, with strong but rather recumbent branches. Its leaves are broad ovate in form and the flowers quite large and attractive. **Martynia** is the botanical name by which the plant is known.

On the table in a lounging place at the inn was a flower pot standing in a large brass urn which was directly under a gas jet that was always lighted at night. We had not been seated very long near the table one evening when I noticed Ed peering into the urn. He had heard a fluttering noise there and was inspecting the thing to discover the cause. Lifting out the pot of flowers, he found an immense moth had been imprisoned in the urn. But there was something else there that pleased him more, about a dozen large scara-

WILD LIFE IN CALIFORNIA

baeidae beetles of two kinds, *Ligyrus* and *Polyphylia*. These were two species that he had been hoping to collect, therefore the unexpected find afforded him no small amount of satisfaction. During the remainder of the evening Ed kept up a watch for other beetles that might be attracted by the bright lights burning outside, and was rewarded by the collection of several specimens; besides, he caught a couple of monster moths which when flying looked as large as small birds.

In making notes of what we saw on one of our tramps to Tahquitz we recorded sixteen different kinds of birds, to-wit: Audobon Warbler, Bullock Oriole, Wilson Snipe, Dove, Meadow Lark, Robin, Western House Wren, Say Phoeby, Yellow Warbler, Junco, California Goldfinch, House Finch or Linnet, White-crowned Sparrow, Humming Bird, Little Green Heron and Western Gnat-catcher. With the exception perhaps of the last, all of these birds are common in our part of the state and consequently were not new to us. The Gnat-catcher is to be found north, but is not so much in evidence there as the others named. It is quite a small bird, no larger than a California Goldfinch. It has quite a musical song which the male bird persistently keeps up throughout the day during the nesting season.

We had a dozen or more different flowers, some of which I was able to classify. A conspicuous flower was one called by the natives *Belleperona*. It grows on a small shrub and has clusters of honeysuckle-shaped scarlet blossoms. It answers to the description of the *Pentstemon cordifolius*, by Margaret Armstrong. Another beautiful flower was the scarlet Mallow, a species of wild hollyhock. A plant attracted our attention, not so much on account of its minute simple flower as for the peculiarity of its flowering stem and branches, which were swollen between the nodes or joints, with the larger part of the swelling toward the top. At first we thought the enlargement was due to injury or the presence of an insect, but an examination soon disproved that, and, moreover, all plants of the kind were in the same condition. It was nothing more than one of nature's provisions for the welfare of the plant. It is known as the *Eriogonum inflatum*, or bottle plant. The radical leaves which form a rosette around the base of the plant are very pretty, looking something like the handsome foliage of hot-house Begonias. We found a single plant of the thistle poppy, *Argemone hispida*. It grows between two and three feet high and bears a number of beautiful white flowers not unlike in size and appearance to those of the Matilija poppy. The stems and even the leaves are covered with the sharpest kind of thistle points. At a distance the plant has an attractive appearance, but the "stickers" defy one to take the flowers by any ordinary process. In truth, I think the majority of the perennials as well as many of the annual plants of the desert are armed with thorns and "stickers," and one is soon impressed with the advisability of closely examining the character of all plants there before entering into too familiar relations with them.

A plant that is also a feature of the desert flora at this time of the year is the Yerba Santa, *Eriodictyon tomentosum*. It is different from the Yerba Santa, *Eriodictyon Californicum*, growing in the northern section of the state. The leaves, while of the same shape and texture, are covered with a gray, velvet-like pubescence. This dressing gives the plant a handsome appearance, and it is especially attractive when in bloom. The flowers, of lilac color shading to purple and white, are a little over a half-inch long. The clusters of these flowers, with the gray, velvet buds and leaves with the peculiar gray foliage, is an exhibition of one of nature's most pleasing color schemes.

Another remarkable plant belonging to the pea family, just beginning to show color in its flower buds, was called to our attention. This is a shrub peculiar to the desert known as *Parosela Emoryi*. Its flower is dark purple, the foliage grayish green. The flowers are quite small, pea blossom shape, gathered in a head not unlike the clover. A strange and interesting feature of the plant is that by bruising the stems or flower head upon the hands or other objects a profuse and deep orange color is produced. The discovery of this property in the plant led some people to think it might be valuable for the production of a dye, and some experimental work to develop it was attempted, but with what success I could not learn.

Referring to the English Snipe mentioned among the birds seen on the trip to Tahquitz, I might add that they were flushed while passing a moist bit of ground made so by leakage from a nearby irrigation ditch. Ordinarily these birds are very shy and after being flushed alight only at a place that gives them immediate cover, but these snipe flew off for a short distance, then back, coming to the open ground within a few feet of where I was standing, where they remained long enough for satisfactory observation. Their long bills and eyes set so far back in their heads that they appear out of place give the birds a very odd appearance.

During the latter part of our stay, when the weather became more summer-like, some male wasps belonging to the Elis family put in an appearance. They looked very much like the slim-bodied "warmtailed insect" so common in the country districts of the north, but these wasps had no stings, consequently could be handled with impunity. However, if I should have captured a female of the species, I would have been made aware that the power to inflict a sting was not altogether absent in the species, but this difference is true with all kinds of wasps. It is only the females that are armed with the stinging weapon, which is absent in all males whether bees or wasps. With the Elises it is the males that are gadding about while the females remain at home. But with our common wasps, the *Polistes* and *Yellow Jackets*, it is the lady wasps that make themselves so conspicuous, and the gentlemen, where there are any, remain at home and are seldom seen.

As to the common wasp, the *Polistes*, which is represented during the spring and summer

almost wholly by the female sex, which does all the work of house-building, feeding and caring for the babies, we are told by observers that the male kind, which does no work, is not brought into existence until the last of the season in the latest broods, and then only that the race may be perpetuated.

A couple of young female wasps of the *Polistes* tribe visited the eaves of my cottage, inspecting all the corners and other available places for a location for a nest. At that time I thought they represented the possible foundation of two colonies, but I was in error, as will be seen later. The following morning I found one wasp employed in starting a nest. The first work consisted of constructing the "stem" by which the nest of cells are suspended. That evening I saw but one wasp there, which evidently had suspended operations for the day. About one-half of the stem had been constructed. On the second day I visited the scene of operations quite frequently and never found more than one wasp there and at no time was it away when I called. By night the stem had been lengthened about the required distance, when by the position and quietness of the wasp I concluded she had quit work as on the evening previous. The next day I made frequent observations and found that before night the base for the cells had been started. At no time did I find the wasp absent, and I began to wonder where the paper-like material came from with which she was constructing the domicile. By noon of the next day the base had been enlarged and the beginning of three cells were clearly outlined. I marveled still more. Apparently the wasp had never left the spot since she began the structure which now contained as much material as would make an object several times larger than the wasp. Where did the building material come from? At noontime I found the answer. While watching the lady busily employed on the new home, another wasp suddenly flew in and took a position near the nest, remaining perfectly still. The wasp at work continued her operations for a few seconds and then flew away, when the newcomer immediately stepped upon the job and proceeded with the labor of increasing the cells. By night the bases of five cells were completed, but only one wasp remained with the work over night. By these actions it was inferred that two wasps at least were working in relays. The absentee was gathering material for the nest.

From observations made in watching a representative of the same species the year previous in Mendocino county, I found that egg-laying was begun as soon as the base of the cells reached the cup shape; therefore, as the cells of this new nest were beginning to assume that form I began to watch for the appearance of eggs. The base of the sixth cell was completed and a start made on the seventh by the end of the following twenty-four hours, but no eggs had been deposited. On the fourth day of their operations the wasps had the seventh cell base finished. The cells were arranged so that one was in the center and the other six were around it.

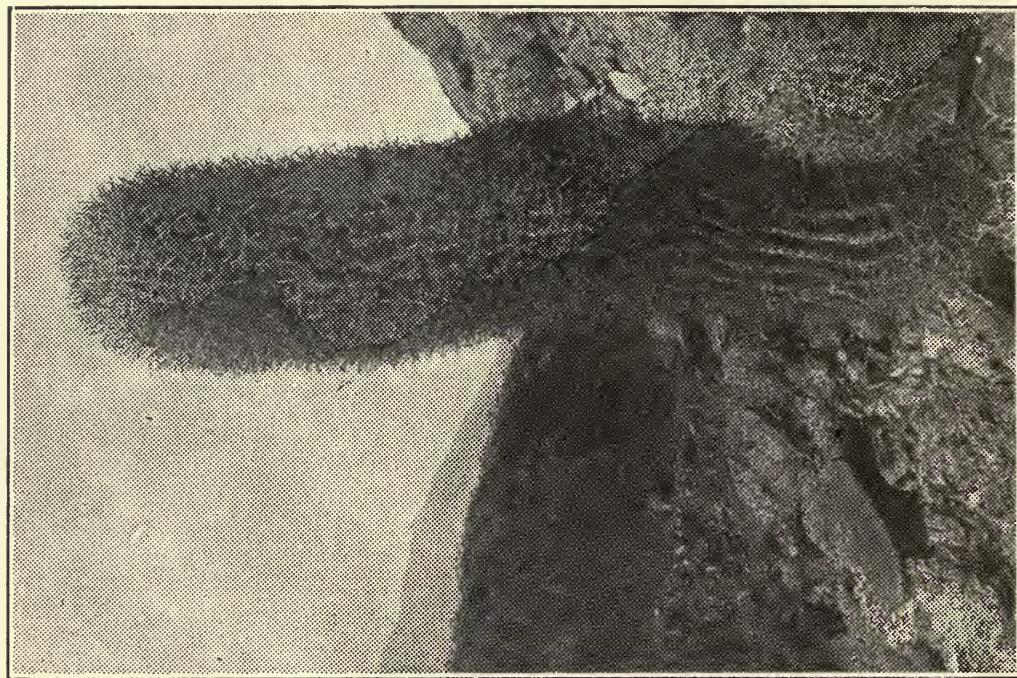
On the fifth day the wasps did not seem to be very busy, and so far as I could see made no addition to their home, but that night both wasps remained on the nest. The first thing the next morning I did was to see what my vespa friends were doing. Both wasps seemed active, but I could not determine the nature of their activities. No more cells had been started, neither did they seem to be raising the height of the six mentioned yesterday. Finally, I concluded they were preparing to lay eggs in the cell bases. The shadows were such that I could not see whether eggs had been deposited or not. After breakfast the light was more favorable and I discovered an egg to be seen in each of the cells, fastened or glued to the bottom or a little to one side. The mother wasps seemed to be quite proud or solicitous over the event and were nervously walking over and peering into the cups holding the precious morsels. I could not be positive as to the exact time of the laying of the eggs, but the event possibly accounts for the peculiar actions of the wasps in suspending building operations the day before. Neither could I tell whether one wasp laid all the eggs or shared the responsibility with the other wasp.

Later in the day the base of an additional or eighth cell was started, but neither of the wasps showed the industry and close attention to their labors they manifested during the earlier stages of their undertaking. They were both absent for considerable lengths of time.

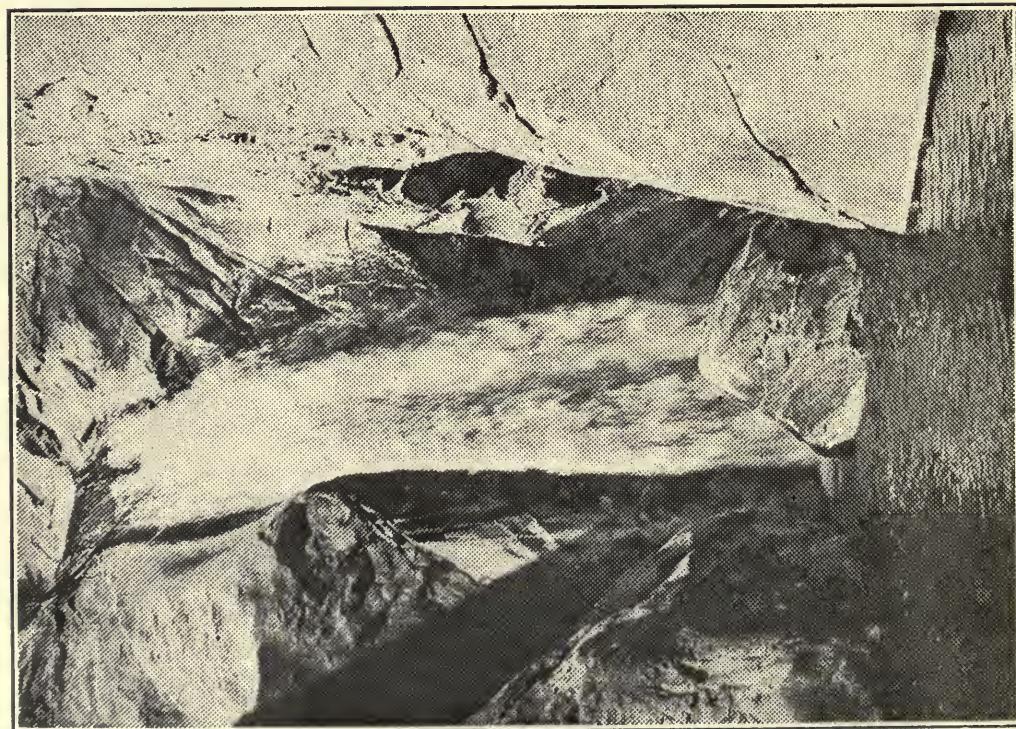
The following morning I visited my wasps for the last time, as it was the day of my departure for home. They appeared to have suspended work of adding cell bases and were wholly engaged in increasing the length of the first seven cells. Perhaps it was their purpose to complete the cells for the embryo wasps before starting the apartments for another brood, but more probable that this latter work was left for the employment of the young wasps when they should emerge from the cells now being completed. I regretted I could not take the nest and builders with me and continue to watch the progress and growth of the family.

Ed and I spent the greater part of one afternoon on the desert making a special effort to capture some giant carpenter bees, insects that are larger than the largest bumble bee. The female is jet black without a mark of any other color, while the male is orange yellow. They fly with almost the speed of a bullet and unusually loud noise. We saw one female and three male bees but made no capture. These bees are called carpenter bees from the fact that they bore or excavate holes in dry wood for their nests. The holes are round, about five-eighths of an inch in diameter, and are sometimes found 12 inches in depth. The bees do the boring with their strong mandibles.

The next day we were more successful, for we succeeded in capturing two specimens of the blacks, but did not see one of the yellow, or male, bees, which we were so desirous of obtaining. While we were trying to catch the bees a man from a camping party located



BARREL CACTUS NEAR PALM SPRINGS.



WATERFALL, TAHOOTZ CANYON, NEAR PALM SPRINGS

nearby approached us holding a glass jar in his hand. He said: "You folks seem to be interested in bugs and such like, maybe you would like to have this thing," at the same time presenting the jar to us. Upon looking into it we found an enormous scorpion, which appeared as if it would measure over six inches in length. It was light in color, very much as if it had been bleached out, quite unlike the specie in the north in this respect. We received the gift with thanks and the monster was added to the curiosities of our collection in Piedmont.

Of all the canyons mentioned in the introduction of this chapter, Chino is the last of these interesting places to be described. It was visited by us several times, but as the notes of the first trip are more complete that record is used in the following description:

Friday, April 20—This was the day we fixed for the trip to Chino Canyon. As there was no road for an automobile, it was either go on horseback or walk. The point in the canyon we intended to reach was five and a half miles from the inn. We chose to walk rather than be bothered with horses, besides there was much to see while walking which would be inconvenient to examine if we were on horseback. By half past seven we had our breakfast and were off on the journey, taking a lunch with us for it was to be an all-day excursion. For the first couple of miles we did not follow any trail, preferring the untraveled section, for what greater novelty it might present to us. Not very long after leaving the hotel we discovered there was an increase in the grade which grew steeper as we entered the mouth of the canyon. At this point we were well up on "the fan," struggling around great boulders and dodging cactus and other spine-laden bushes. It was growing warm so we concluded it would be advisable to find the trail and consequently easier traveling. We picked it up without much trouble but there would have been some difficulty in following it if it had not been marked by the little piles of rocks as had been done in Palm canyon to indicate the trail there. There is so little travel to Chino by people on foot that long stretches of the trail were unmarked by footprints, and in places the wind and rain had obliterated it. Under foot the going was easier but the day was growing warmer, and our course led us steadily up, up. There was a pipeline down the canyon along which the trail zig-zagged. The pressure breaks scattered along supplied us with all the water we wanted to drink, otherwise I think we would have been quite thirsty before reaching the end of the journey.

We saw more new flowers on our way, one of which I at first thought belonged to the cruciferae, as its cluster of little half-inch white four-petaled blossoms were somewhat after the form of the mustard blossom, but a closer inspection showed it to be a member of the Evening Primrose family, a *Chylisma*, var. *calavacfirmis*. So far as I could learn from the natives it bore no common name, although it was a pretty flower with maroon

dots at the base of the petals, yellow stamens and green stigma which invariably laid over to one side of the flower as if to avoid too close association with the neighboring anthers.

An odd flower that attracted our attention I found later was called the bladder-bush. It grew on thorny bushes three or four feet high. The little, bag-shaped, magenta colored flowers are born along a stem and rather loosely placed. After they wither the calyxes enlarge and form bags larger than the flowers and take the place of the blossoms. As the calyxes are composed of a tissue-like substance of a bright color, the blossom stems appear as though they were bearing two kinds of flowers of different colors.

I found well up in the canyon a couple of white flowers which had every appearance of being members of the Pink family.

Among all the strange flowers it was a pleasure to meet an old acquaintance, a *Mimulus*. It was the variety *Brevipes*. Another flower which we found in bloom was the Indian paint brush. It is not exactly like the flower of that name growing in our part of the country, but near enough to claim a close relationship.

The birds noticed on this trip and not seen on any of our other excursions were blue birds, mountain quail, song sparrows, a hawk, and a little bird probably a warbler that we could not identify. White-crowned sparrows were numerous, but unlike the birds of this species around Piedmont, they did not sing. These birds were also constant visitors in and about the hotel grounds, showing but little fear.

The sun's rays beating down upon us in the breezeless canyon caused us to remove our coats and unbutton our collars, but as we trudged along, this curious plant, that strange flower, a fleeting beetle here and there, caused us to forget the discomforts of the heat and to think only of the pleasures of the trip.

The "fan" of Chino extends back into the canyon for a distance of fully three miles from the portal and nearly as far in the opposite direction from that point. The objective point of our trip was the upper end of the "fan," where through some choking of the canyon, probably during the period of submergence, a fairly level section of land formed embracing five or ten acres. It was now covered with a fine growth of large trees and shrubs, besides there were two or three large patches of meadow with green sod, all making a cheerful and restful spot.

We reached this oasis about half past eleven. My pedometer had recorded something over six miles. We estimated that more than a half mile of this distance was due to our divergences from the trail in examination of shrubs, plants, flowers and chasing beetles.

We found the site of the Nature Man's former home or cabin that he built when he first came to the desert and which he abandoned because it afforded more solitude than he needed. However, the site was all that was left of it; there were only ashes and the indestructible parts remaining. It had been

WILD LIFE IN CALIFORNIA

occupied by another nature man who in some accidental way set it on fire the Sunday before our visit. The site was in a group of native palm trees, the only trees of the kind in the canyon.

Less than fifty feet away was a large spring of hot water slightly charged with sulphur. An excavation had been made about ten by fifteen feet in dimension and two or three feet in depth for bathing purposes. The water was not only pleasant to drink but was remarkably soft. Rubbing your hands in it yielded a sensation as if you had used soap. There were several other springs producing an abundant supply of fine cold water. Altogether the surroundings were such that we wished we had blankets and some food that we might camp there for a while.

We were surprised when we looked back through the canyon down upon the valley below with the San Bernardino mountains beyond, to find we had reached an elevation of much greater height than we had anticipated. We both concluded that we must be up as much as two thousand feet above the floor of the valley. We afterward learned that the elevation was 2600 feet.

Finding a nice cool place by the side of a spring, shaded by the overhanging branches of a huge cottonwood, we sat down to lunch. During the meal we were joined by another party of trampers, a lady from the Inn with a guide, "Dutch Frank," a well-known prospector and mountaineer of the desert country. Upon conversation I found the lady to be a lover of nature and outdoor life, who had visited almost every section of our state from Oregon to the extreme south. After lunch the lady declared her purpose to extend her tramp still farther up the canyon. She also told the guide that he could remain in camp and take a rest.

Ed and I spent some time exploring the grounds and incidentally looking for coleoptera. We were quite successful in collecting specimens of several species, among which were a couple of very large "clickers," some ground beetles, some Buprestids, as well as a few Phloeodes, a strange looking bug belonging to the Tenebrionidae family. Feeling that a rest would freshen me up for the walk back I lay down on the ground in a shady place. Ed, however, continued his work collecting. "Dutch Frank" was also laid out under the shade of a tree and was soon fast asleep. The lady trumper came back from her trip in the course of an hour or so. After a little rest she and the guide started back for Palm Springs. However, Ed and I concluded as the walk back was all down hill and the distance a little less than six miles, that we could cover it in two hours' time, therefore we could remain to enjoy the beauties of the spot at least an hour longer and still reach the inn by 6 p. m. Another advantage of a later start was escaping some of the heat of the day.

After a rest and a bath in the hot spring the watch showed it was time for us to leave the attractive spot. It was with some reluctance that we started off. The canyon floor at this point is a half mile wide and about one

mile at the portal. The walls of the mountains on both sides are very steep and rise several thousand feet above the bottom of the canyon. The peaks where the canyon heads are still higher and were covered with snow. With the aid of our glasses we could see that some kind of trees of the conifer or pine family were growing in and about the snow section.

While waiting for the time to start we heard a thundering and crashing noise as though a great rock was falling down the mountain side. It must have been a very large mass that became detached judging from the noise it made as well as that caused by the falling of other pieces displaced by it. The occurrence seemed to have taken place quite near but we could see nothing of it, not even the dust that accompanies a displacement of that kind. In all probability the movement took place in some of the side canyons out of the possibility of our vision.

The walk down the canyon was pleasanter than the tramp up. It required less effort and the heat was not so great. When we reached the mouth of the canyon, consultation of the watch showed we were making the time scheduled for the trip. When we turned the mountain point forming the south side of the portal to the canyon we passed into the shade of the great mountain mass which made it still pleasanter for us, besides we were soon rid of dodging the big boulders, and worse, the cactus. However, we did not wholly escape punishment of too close contact with the latter. I bumped into a choya and received several barbed spines in my leg above the knee, which later required the use of a pair of tweezers and considerable pulling to remove.

Down on the sands of the flat when not far from the Springs, we saw some kind of small animal or reptile about five or six inches long, with a tail of about the same length, of a grayish-white color, pass like a flash across a little open space or ground. It went so fast we were unable to determine what it was or even what it was like. Noting the clump of brush it entered we prodded it out to get only another glimpse of the mysterious thing. It seemed to be able to run faster than a bird could fly. We chased it around from bush to bush until it finally escaped, without our being able to obtain any idea as to its form or general character. Whenever it came in view all that was recorded on our minds was a grayish-white streak on the desert sand. Reporting the incident to Dr. Coffman at the hotel, he said in all probability that what we saw was the desert white rat, a troublesome rodent in that section. It invades the households and besides consuming eatables it carries off any small movable articles that it comes across, things that cannot be of any possible use or benefit to it. Another peculiarity of the animal is that when it commits a theft it leaves an article brought from somewhere else, as much as to say "a fair exchange is no robbery."

We entered the hotel grounds on our return at exactly 6 p. m., having been two hours

and five minutes in covering the distance of five and seven-eighths miles recorded by the pedometer, or just half the time it took us to go up. Altogether we had walked between thirteen and fourteen miles. A plunge in the hot baths made us forget the fatigues of the day and put us in good humor for the evening meal.

One morning subsequent to the trip just described we concluded to take a short tramp out along the base of the mountain spur back of town where we found an irrigation ditch which heretofore had been dry, but this morning we noticed that it was running full of muddy water. As our object on this trip was more for the purpose of collecting beetles than anything else, the flood in the ditch had greater interest to us than it otherwise would. The idea at once was suggested that the running of the water into the ditches that had been dry so long would overtake and drown many beetles that had been attracted to the cracks and crevices of the waterway as places of refuge. A careful watch of the surface of the running stream soon showed our deduction to have been correct. In a few moments we scooped from the surface of the water two or three specimens of *Diplotaxis*, then a more rare *Sericia*. This was indeed good luck. Instead of having to chase around on the hot sands of the desert among rocks, thorny shrubs and the vicious *choya*, to obtain samples of the beetle life of the strange land, a combination of circumstances was bringing them from a large area of the country and laying them down as it were at our feet.

We selected a shaded and otherwise comfortable spot on the bank of the ditch and proceeded to fish out of the water the different kinds of coleoptera as they came floating down the stream. In the hour and a half we spent in the occupation we gathered 124 specimens, which was much more than we would, in all probability, have captured in an entire day's devotion to the purpose. Beside the collection consisted almost wholly of species entirely different from any we had collected on the trip.

As on all of our other trips we found some new flowers, among which was a very pretty member of the pentstemon group, another of the mint family, which, by the way, is well represented in the desert flora; also the flower of the desert shrub, *Krameria Grayi*, commonly called the crimson beak; and a small representative of the Phacelias. The Daturas were out in full bloom and we found that the beautiful large blossoms were harboring an odd species of the weevil family.

I was awakened on the beautiful morning of Sunday, March 31, at a quarter to six by the sweet music of an Easter anthem, rendered by a chorus of about twenty voices. The sun was just beginning to show its rays above the eastern horizon of the desert, and in the quiet of the early morning hour the singing was not only impressive but also delightful to the ear. It seems that it is the custom of the permanent residents of Palm Springs to assemble at Lookout Point, an elevation on the spur of the mountain range that pushes its

way into the town limits, at sunrise on Easter Sunday and hold devotional services for the occasion. A large wooden cross and a flag-pole with the national colors flying, marks the spot. The elevation is about 100 feet above the surrounding country, and is reached by an easy zig-zag trail cut through the rocks.

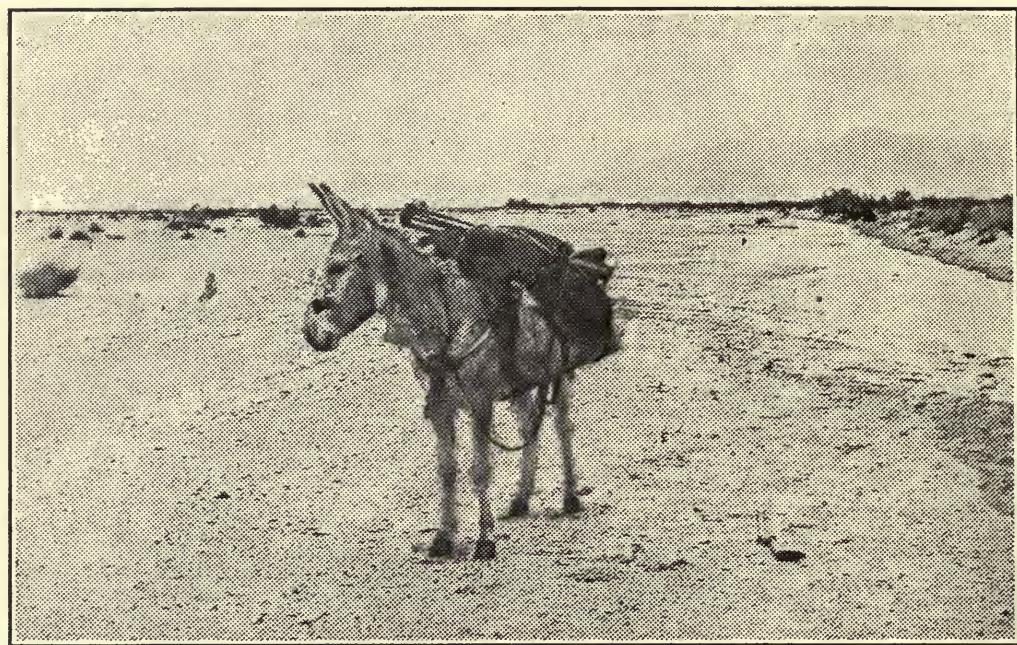
Being interested in seeing the working of a machine used in clearing desert land we walked to where one was in operation. Although less than a mile from the inn where there was scarcely a breeze, here we found a strong wind blowing. Dust from the newly-disturbed ground was beginning to fly, a circumstance that suggested a gale further out in the desert, such as might be expected after a heated spell described in the theory outlined in discussing the subject on a previous page. A glance to the eastward showed that an unusual disturbance of the air was in progress. A cloud of dust filled the sky, shutting out all view of the opposite side of the desert, and the rapidity with which it moved showed there was a tremendous force behind it.

When back within the town limits we found no more than agreeable breeze prevailing, just enough to improve the shade of the trees and make them most delightful places of retreat. The warmth of the sun was such as to make it imperative for comfort's sake, to wear the least amount of clothes compatible with propriety. Yet within six miles of us overcoats and wraps were necessary to comfort.

At the Springs the evening of this day was most delightful. The windows of the dining room were all open, the ladies were in thin dresses and men in their summer suits, little thinking of the terrific sandstorm that prevailed on the desert less than six miles away.

After supper and bidding adieu to the family and friends, I boarded the auto stage in my start of the return trip home with the lady chauffeur at the wheel. There were two other passengers, an Indian and a lady. Soon after starting the driver advised me to remove my glasses and to look out for my hat, for "in a few minutes we will be in the storm" that had been in progress all day. As stated, I had noted the disturbance in our morning walk, but I was wholly unmindful of its power and what its effects were upon things animate and inanimate that came within the range of its force. I had read of serious results and dangers to human life that sometimes accompany desert sandstorms, but to personally experience the fierce character of one of these terrors was something I had never anticipated, and to be suddenly thrust, without warning, into the very vortex of one of the severest was not only surprising but even startling.

I have no knowledge of the speed of the wind on this occasion, but it must have been very high, judging from the carrying force it exhibited. The air was filled with flying sand, grit and dust and moving with such speed that the particles stung the flesh wherever exposed, most painfully. I could readily understand how an exposure to it for a brief time would wound the flesh and cause the blood to flow.



THE "DESERT CANARY," NEAR PALM SPRINGS.



SAN JACINTO RANGE, FACING THE DESERT.

The roar of the rushing wind was so great it fairly drowned all sound of the noisy auto truck which was slowly bucking its way through the flying grit, under the guidance of the brave little woman at the wheel. How she managed to keep the road or make headway against the terrific force of wind, I could not understand. A short time before we reached the point of full exposure to the force of the gale, we noticed an auto running ahead of us suddenly stop and turn around and go back toward Palm Springs. Now we knew why this was done. Further on an auto top would have been no more than a plaything to the forces there displaying their giant and merciless strength.

I crouched down in the bottom of the truck with bent head, holding my hat down with both hands. What the others were doing to protect themselves, I could not see. It was useless to try to talk. I remember watching miniature whirlwinds of sand and grit swirling around and over the sheet-iron floor of the truck, wondering what the outcome of the wild ride would be. Sometimes when an extra heavy gust of wind would strike us with terrific force it was very suggestive of the possibility of being wrecked like a ship in a gale at sea.

The streams of sand and heavier particles of rock substances that came flying through the mountain pass in tremendous gusts were as if nature had contrived a sand blast on gigantic scale with which she designed to remodel the surface of the earth. We were approaching the mouth of this awful blast, defined on the southerly side by a high point of the mountain range that marked the turn into the pass. So far we had not encountered the full unbroken force of the swift-moving sand and wind. Occasionally I ventured to peek over the side of the car or over the back of the front seat to note our progress, but it was always with some punishment. I now saw we were near to the point mentioned. It did not seem possible for the machine to be driven beyond it, so fierce were the gusts of wind and so dense were the clouds of flying sand. Our little lady driver boldly drove the car on, but when we dove into the awful blast the shock was so great that either she was fearful of going on or the truck was stopped by the force of the gale. However it was, she backed the machine into a less exposed place. Just then an auto came flying with the gale from around the point. The occupant was the husband of our driver. He proposed that we passengers get into his machine and he would take us to the station, but when his wife called attention to the fact that although coming with the wind the top of his machine was already wrecked, he exchanged places with her. After taking the driver's seat he waited until there was a lull in the blast and then drove on, and we crouched down, seeking the best protection we could find. How he managed to keep his seat, control and direct the car was marvelous. The only protection he had was a pair of goggles and the windshield of the machine. Although the throttle of the ma-

chine was wide open during all the trip, there were times when the force of the gale would slow us down to almost a walking pace, and the car staggered so I was fearful of disaster, if not a forced return to Palm Springs. The latter was a proposition that I certainly would have approved. However, the man triumphed and finally landed us at the station, where the effects of the gale were not so severely felt, though even here, when I stepped out from the shelter of the building, a gust of wind carried me backward four or five feet. In conversation with our last driver he declared that his wife could not have made the last part of the trip. He said that sand-storms were not uncommon here, but this one was the worst he had experienced. Beyond the sand and dirt in my eyes, ears, hair, beard and clothing, I was none the worse for the experience. Now that it was over with I was rather pleased that I had the opportunity of experiencing a real desert sand-storm, but one is enough and I will take care to avoid any more in the future.

As there was no waiting-room at the station, which consisted of some sheds for freight and a building which housed the agent and his family and supplied a little office room about five by eight for railroad business, we passengers were permitted to go into the little office for shelter to remain until the trains that were to take on our journeys came along.

When we left Palm Springs our information was that the train was three hours late, and the stage driver delayed the departure from the inn for a corresponding time, so we would not have to wait at the station. When we arrived, however, we found that the train itself was making slow headway against the storm and was losing more time and would not be there for at least an hour. Later on the agent told us the train had not yet arrived at Indio, and that it would take over an hour under the conditions to reach Whitewater after leaving the other place. To shorten a long story of hopes and disappointments it is only necessary to say that the train did not pull into Whitewater until twenty-five minutes to 11 o'clock, a little over six hours behind time. We made haste to get aboard and the train was soon under way, headed into the storm of wind which still prevailed, but had abated somewhat in its fierceness.

As expected, when we reached the summit of the pass, where the moisture-laden atmosphere drawn from the ocean district met with the cold temperature of the mountain tops, there was a heavy precipitation of rain, causing a refreshing change in the atmosphere.

Upon finding the conductor of the train, I was informed that the car in which I had my Pullman reservation to Oakland would go no further than Los Angeles, as the train was too late to make connections with the train leaving that city for Oakland at 11:30. All that could be done was to give me a berth where I could sleep until 7 a. m., then I would have to make my way north as best I could.

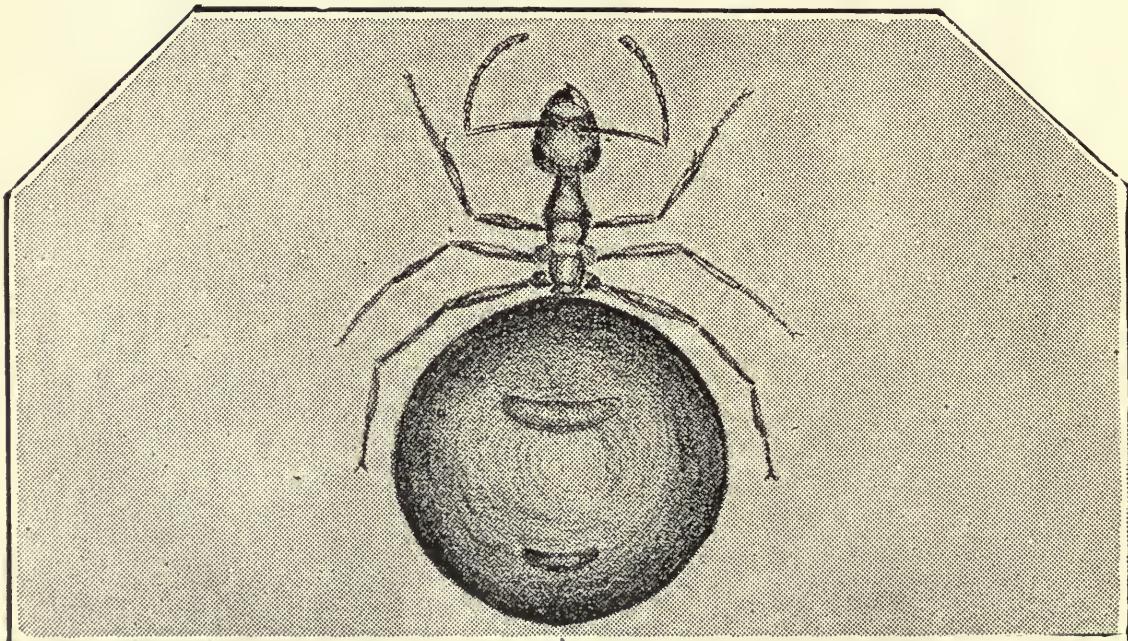
WILD LIFE IN CALIFORNIA

I accepted the situation and had a fair night's rest, and early in the morning went into the depot at Los Angeles and attempted to get my ticket validated for the train leaving for home at 8 a. m. by way of the coast. After considerable discussion of the request among the railroad officials, I was told that I would have to go by the valley route. As there was a train for Fresno starting at 7:50 a. m., I decided to leave by it and lay over at Fresno and take the midnight train there for home.

At first I was inclined to be vexed by the decision of the railroad officials, but after the train started I realized that many years had passed since I had gone through the section of the state between Los Angeles and Fresno by daylight, and now I was going to see what changes had taken place and the progress made in developing the country in all that time. I provided a book to read if the travelling became uninteresting, but at the end of my journey I found I had read but a few pages, and these were scanned at the stations

where there was some delay and the train was not moving. Nearly every mile of the way had its interesting feature, but what surprised me greatest was the discovery that a vast amount more of the territory had been brought under cultivation than I had thought probable or even possible. Even up in the Tehachapi Pass, 4000 feet above sea level, hundreds of acres of land embraced in a little valley there had been planted in orchards and in other ways was being made to produce the necessities and luxuries of life.

In conclusion I may add that I arrived at Oakland in good shape, well satisfied and pleased with the southern trip. Yet when I looked upon the green hills back of Oakland, Piedmont and Berkeley, dotted with groves of trees mantled with bright, new, fresh foliage, I could not help thinking that in all my travels I had not seen a landscape more pleasing or a country more inviting to one who loves to get into close communication with nature.



HONEY ANT, AS IT APPEARS WHEN INFLATED WITH HONEY,
STORED FOR FUTURE USE.

CHAPTER II

THE HATED INVADER

Habits of the Argentine Ant a Menace to Pacific Coast Homes

When these household pests, the Argentine ants, *Iridomyrmex humilis*, have established a line of travel from their nest to some place where they have discovered food to their liking, it is interesting to watch them going back and forth. In all probability the ants returning to the nest are conveying food for their larvae and also for the nurses, or such individuals of the colony that remain in the nest to take care of the numerous infant ants. However, this species of ant is so minute it is impossible to determine without the aid of suitable magnifying instruments and other agencies whether the ants are carrying food or not.

Having discovered a place in our basement where the ants had established a line of travel to the apartments above, using the smooth surface of the tongue and grooved board wall for the roadway, I was afforded an opportunity for close observation of the movements of the ants to great advantage and with no discomforts.

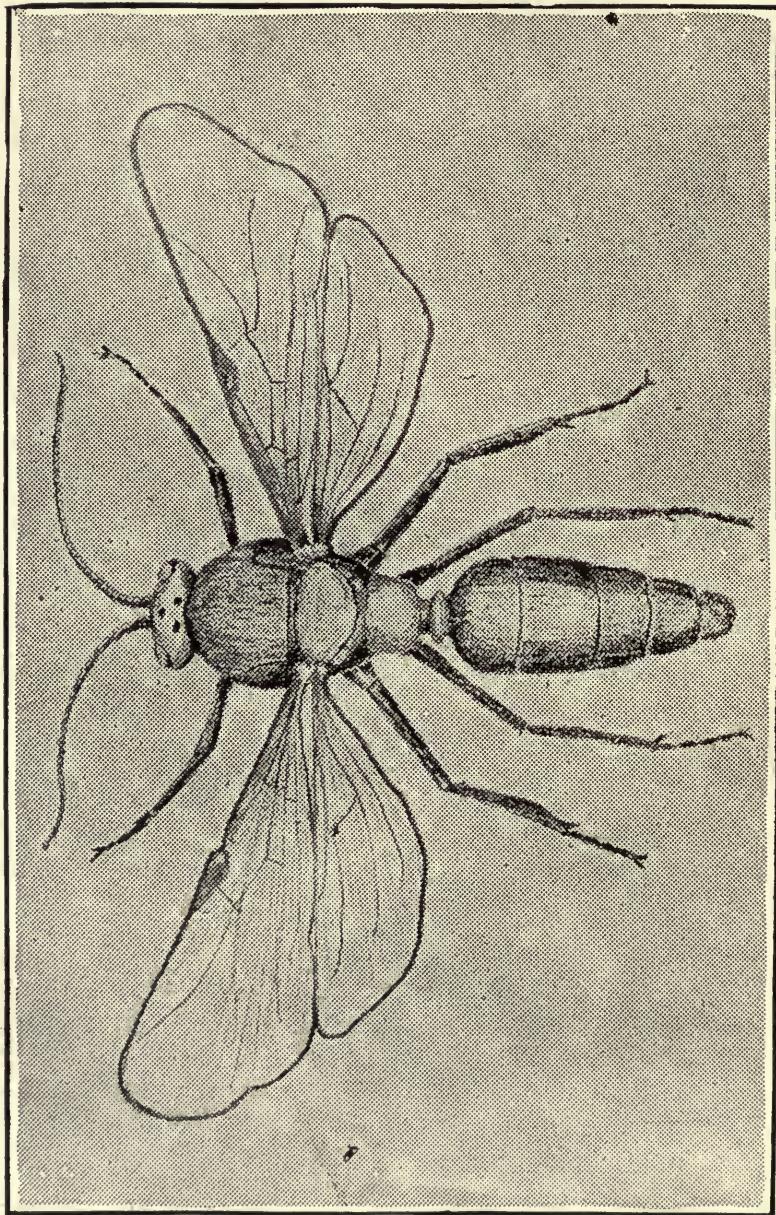
After watching the ants and studying their actions for several days, and making some experiments to test their sense of smell and location, I was ready to concede as true, excepting in the case of some wasps, the claim of certain eminent entomologists who have given years to the study of these insects that the ant family possess the greatest intelligence of all insects.

While traveling in either direction, up or down, I noticed that both of the antennae or "feelers" of the ants were continuously active and were used not altogether unlike a blind man hurriedly feeling his way with a cane in each hand. It is a mooted question as to how well some species of ants can see, but it is conceded by the best authorities that some are practically blind. Whether the *Iridomyrmex* can see or not I was unable to determine, but from the way they used their antennae and results obtained its kind seemed to be in little need of eyesight.

The roadway or space occupied by the column of ants on the wall did not exceed three-eighths of an inch in width at any place between the ceiling and the floor, the points where they emerged and disappeared, in the going and coming; and a remarkable thing about this roadway was that so far as the ants were concerned, it was as well defined as any highway in the State of California, although so far as I could see there was absolutely nothing to mark its boundaries. However, by the manner in which the ants ran along constantly tapping the board with their antennae, hunting their way and turning back into the "beaten track"

whenever in their haste they happened to step off of the course, it was presumed that the roadway was recognizable through the sense of smell, and what tended to confirm this theory was the sinuous character of the trail. While from the top to the bottom it was confined to a single board and in no place was it straight for more than a few inches, it swung on long angles from margin to margin of the board. These crooks and turns of their roadway were followed by every ant, without variation, going up or coming down, for the weeks they were under observation.

As a test of the accuracy of the conclusion I rubbed a place on the wall about an inch wide across the roadway with a fresh piece of Spearmint chewing gum, thinking if the ants were guided on their way through sensing the odor of their own tracks, they would be confused when they reached the spot, depending as I did upon the probability that the pungent odor of the gum would obliterate the ant odor. I chose a time for applying the gum when there were but comparatively few ants working and where there was quite a break in their column. Now let us see what happened. When the first ants to approach the spot reached a point within three-quarters of an inch of the gum-scented place they hesitated in their march and exhibited other signs showing that they recognized that something had happened to their roadway. It was as if they had come to a waterway where their bridge had been unexpectedly carried away. The ants ran along the bank, their antennae working excitedly. Back and forth they went, until notwithstanding the pungent smell of Spearmint they seemed to discover the narrow course that connected their roadway and slowly over it they passed. If the ants were actuated by sense of direction only it seems to me that they would have crossed the obstruction at various points; but not so, the crossing was made without exception at the break in the trail. However, the place was not found and used without confusion and study of the situation on the part of the insects. The effect of the obstruction was the same upon the ants on either side. All were held up here on their course whether it was up or down the wall. The obstruction was operative for an hour or more, though after the first quarter it was not so effective. Even after the first five minutes some of the ants began to cross, showing less hesitation and confusion. While a few others ants for more than two hours after were disturbed and confused to some extent by the lingering scent of the Spearmint.



THE MALE FORM OF THE ARGENTINE ANT.

In watching the actions of the ants at the crossing and noting the variations of conduct in individuals, how timid, excited and hesitating some were, while others showed decidedly opposite traits I was impressed with the thought of how human-like these characteristics were.

When the traveling of the ants was fully resumed and the disturbing odor of the gum no longer interfered with the passing insects, the line of travel over the spot was exactly the same as it was prior to the interruption, indicating that the odor of the ant trail was preserved though it had been temporarily overwhelmed by the spicy smell from the gum.

It is a generally accepted fact that odor is an important feature in the life history of the ant family. Each species of the insect possesses a characteristic smell, which is so strong in some kinds as not only to be recognizable by human olfactories, but is also very offensive. In all probability the odor that is peculiar to a species varies in its subdivisions of colony, caste, and even individuals as pointed out by Miss Field, who has given much study to this side of ant life, otherwise it would be difficult to account for the hostility existing between adjacent colonies of the same species. No one can watch the actions and behavior of ants in their work and meeting with one another without recognizing the use they make of their antennae that they are just as much olfactory organs to the ants as is the nose to the human family.

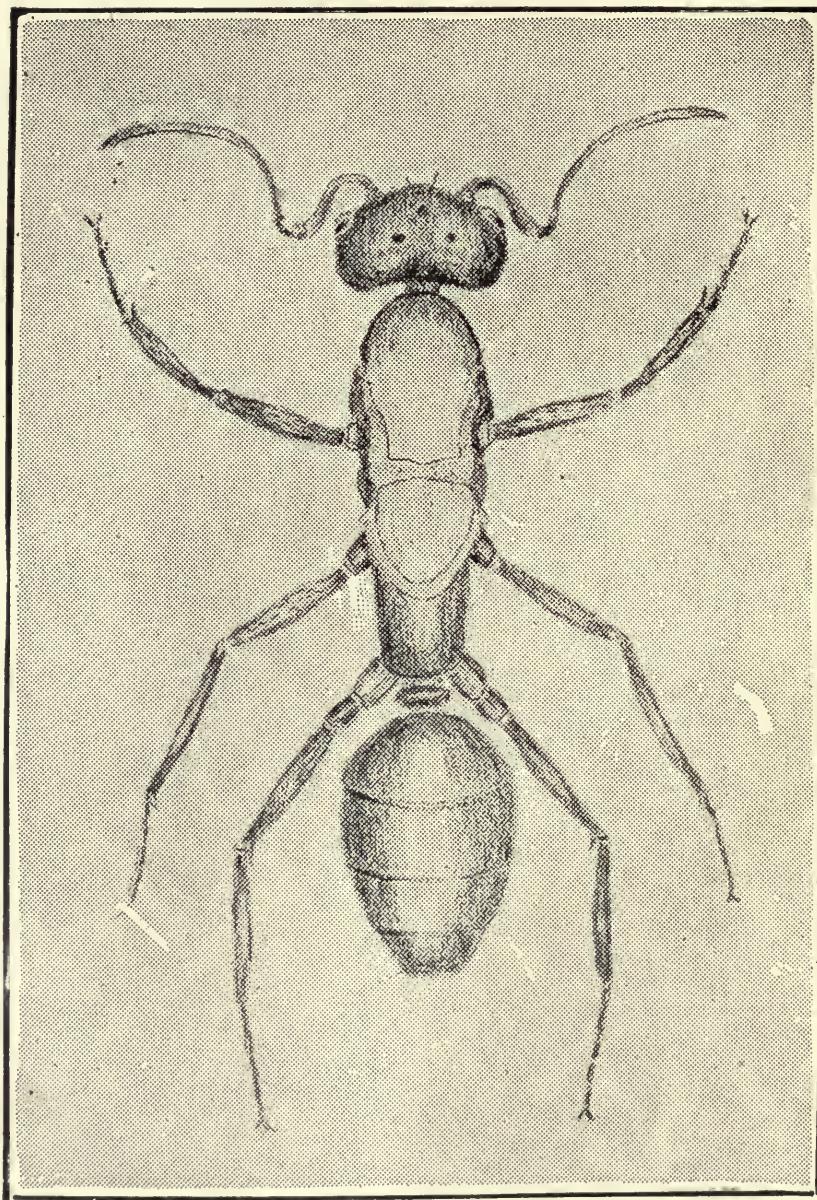
Although fully satisfied that these little insects depended largely on their sense of smell in their activities, I thought to make another experiment. This time I concluded to puff some tobacco smoke against the wall so its fume would envelop the column of workers passing back and forth at that point. I reasoned that if the ants had no sense of smell the tobacco fume would not disturb them or interrupt them in their marching up and down the line of the wall. The first light puff of smoke blown upon the ants caused more excitement and confusion than did the odor of the gum, but the effect was not as lasting. However, they exhibited more distress, some few individuals curled up, lost their footing and fell to the floor; others ran around in a circle, while some stood still, excitingly moving their antennae, probably trying to make out the source of the horrible suffocating smoke. As the fume of the tobacco quickly passed away the ants soon resumed their courses on the wall. It was apparent from their actions that the ants possess very sensitive olfactory organs. Of course this fact was established long ago by investigators of the life history of these insects, but reading or being told of the remarkable things done in the insect world and the operation of human like faculties of some of its individuals is not so impressive or convincing as an ocular demonstration. As the Argentine ants have no friends in this locality I have little fear of rebuke for blowing smoke in their faces. In truth, owing to their impudent, thieving traits there are few, if any, householders who would not have treated

them to boiling water and ant poison instead of Spearmint and tobacco smoke.

There seems to be no limit to their appetites, which are as active at night as in the daytime. Though it is nothing to their credit there are some things of the household provender they will not partake of, but such things are so few the fact does not tend to reduce the unpopularity of the unwelcome foreigners. So numerous and common is the invasion of homes in nearly every part of the Eastbay section by these insects that the inhabitants are at their wits' end in devising schemes to keep such eatables as the ants will attack free from contamination by them. Butter, cheese and milk are among the few articles of food excluded from the diets of the Argentines, and in our home they do not bother flour, mush or plain breadstuff. However, about all other articles of food have to be placed in dishes set in pans of water to protect them from the minute pests.

Professor William M. Wheeler, entomologist of Harvard University, who probably knows more about the habits of ants than any of our other investigators or students, says the food of ants varies with the genera and species. Some kind of ants rely on other insects which they may capture and kill, or find dead. Other ants live almost wholly on the larvae and pupae of ants captured from other colonies. Then there are some ants that find their food in honey-dew which is plant juice that has undergone certain changes in the alimentary tract or by contact with certain glands of the insects. Besides there are kinds of ants which includes the species known as the Harvesters, which feed on seeds of plants, grasses and small fruits, injured fruits, bulbs and tender roots. Finally there is a tribe of ants, the Attii, which lives exclusively on fungus hypae which grows on certain vegetable substances carried into their nests by the ants. Professor Wheeler says "that probably there is no single species of ant able to draw on all these sources of food, but many ants utilize several of them and may be said to be more or less omnivorous, finding it an easy matter to pass from one kind of food to another, if it will only yield to their mouth parts, that is, if it can be imbibed directly as a liquid or rasped off in minute particles from which the liquid can be expressed in the hypopharyngeal pocket." From my observations I would place the Argentine in this latter class of feeders. It is its omnivorous appetite that makes it such an unwelcome guest in our homes.

Though countless numbers of the ants are destroyed daily through the agency of boiling water and various kinds of ant poisons, they multiply so rapidly that their numbers seem to suffer no diminution. Though of tropical or semi-tropical origin, the conditions about the bay of San Francisco seems particularly favorable for their existence and propagation. Immense popularity and greater fortune is awaiting the individual who discovers a method that will rid our homes of these little pests and protect them from future invasion. Ant powders containing



THE QUEEN.

pyrethrum are offensive and death dealing to the Argentines and by a liberal use of the powders we can protect our homes from being overrun, and with care, attention and continued use of the powders we can keep the annoyance reduced to the minimum.

Has the Iridomyrmex come to stay? Will it continue to be a pest of our homes for all time to come? These questions could be best answered by some such authority as Professor W. M. Wheeler, who has made a life study of ant family. It is not beyond a possibility that some species of pupae-eating ant or some other order of predaceous insect might be introduced here that would hunt out and invade the nests of the pest ants and exterminate the colonies by devouring the young, just as the Argentines have done in exterminating about all other species of ants that were common about our gardens and homes a few years ago. This suggestion, however, does not hold out much hope of relief. Nor does the possibility that the pests may be attacked by entomophthorae fungi that at times spread among various forms of insect life, causing great fatality. There are several species of the fungus, but the life history of each is much the same. The germs, or spores, which are extremely minute are supposed to find their way to the internal parts of the insect by being on or in the food which the latter eats. Once inside the fungus begins to develop from the spore and as its parts absorb the interior organs the insect suffers a slow death. Soon after death occurs the fungus makes its appearance on the outer parts of the victim. Some species send stems of shoots several inches in length out from the head, thorax or other parts of the body while other kinds of fungi can be recognized only on the exterior of the unfortunate by the whiteish powdery appearance of a rapid growth. A common example of this species and its work is the ordinary house fly that we sometimes see dead upon the windowpane appearing as if it had just escaped from a flour barrel.

But while hoping for an enemy insect or the fungi to relieve us of the pest, the housewife cannot relax in the use of boiling water and insect poisons to keep the ants reduced to the smallest number; besides giving trial to every reasonable suggestion for the extermination of the invaders. These thoughts prompted me to look up suggestions made by the best authorities on fighting insect pests, when I found that W. Newell, a student of this particular nuisance, recommends a "trap made in form of a box 2x2x3 feet, filled with cotton-seed and straw on other porous vegetable material. The top of the box is left open so that its contents are exposed to the weather. The interior of the compost mass becomes warm through decomposition, and as winter approaches attracts the ant colonies. During the month of January, after the colonies have assembled in the box, its cracks are closed, a pound or two of carbon bisulphide is poured into the compost and the whole is covered with a waterproof canvas till the ants are asphyxiated."

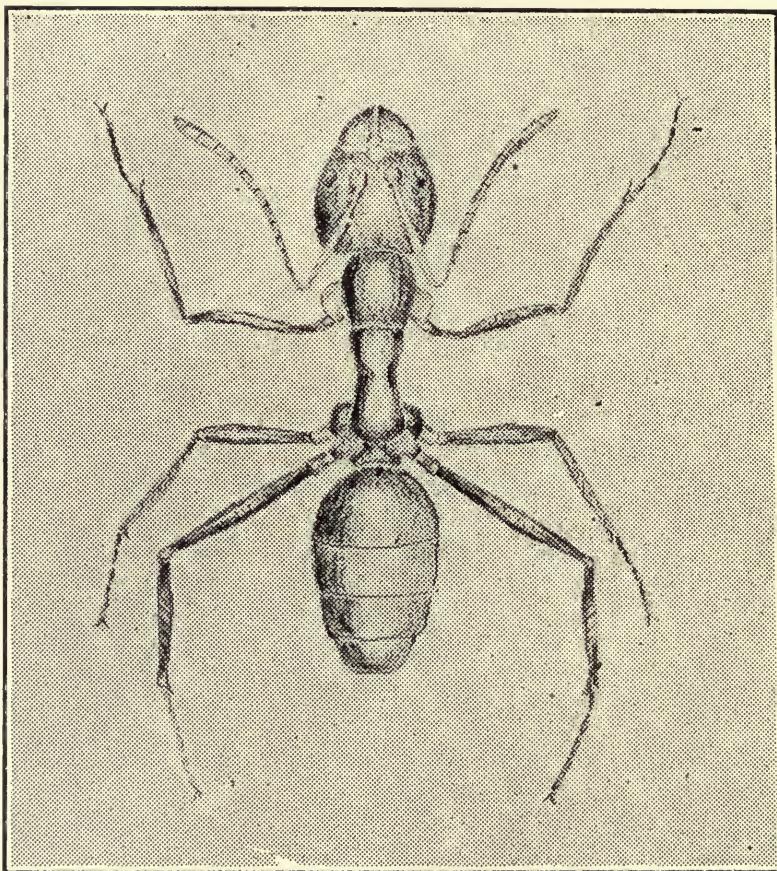
Another plan which neighbors have tried and found very effective, is to put pieces of sponge saturated with sweetened ant poison in perforated tin cans and then place these cans ten or fifteen feet apart around the basement of the house on the ground outside. The theory of this scheme is that the ants, which generally live outside of the houses, will be attracted to the poisoned food before invading the interiors. If the ants are not killed by the poison, the generous supply of food makes it unnecessary for them to go farther. Of course, the supply of poison must be kept up in the sponges.

The Argentine ants have found homes in this country in and about two seaports of the United States—San Francisco and New Orleans. It is a matter of interest to know how these pests, whose nativity or place of origin is South America, managed to get established in this part of the world. It is easy to understand how numbers of ants might be brought here in merchandise shipped from the distant ports of the South, but when we contemplate the fact that colonies of these ants are made up of Queens, males and workers, the latter of which are neuters and are about the only ants in evidence unless we can unearth their nests in which the two former remain until mating season, the transplanting has some complex features.

A peculiarity of the Argentines is that unlike most other genera of ants, the male instead of the queen is the winged ant, as shown in the illustration.

No work on myrmecology at my disposal gives the details of the life history of this particular genus of ants, but in nearly all other genera of ants with similarly constituted colonies, new nests or colonies are started by young queens which leave the parent nest upon being fertilized, and the queen ants are winged when they emerge from the pupal state. Thus they are enabled to fly to some distance from their former abode. When they alight about the first thing they do is to bite off or remove their wings, these appendages being wholly useless to them in all situations of their future life. They then seek some favorable place in the ground, under rocks, wood or chinks in masonry in which to start a nest. There they lay a lot of eggs and raise the first brood, feeding and caring for them with all attention and anxieties usually manifested by mothers of higher order of life. As a rule, this first brood consists of workers which take up the care of the nest and future hatchings, and the queen has no other duty than to remain in the nest and lay eggs.

With this order of life in view, it would seem that queen ants must have been in some manner transported from South America to this country. However, Wasmann, an entomologist of note, found in one species of ant that he had under observation that "one or a few workers became gynaecoid"; that is, became egg-laying workers, and fulfilled the duties of the absent queen. If this peculiarity is a feature in the life history of the Argentine ant, the riddle would be explained. Perhaps



THE WORKER OF THE ARGENTINE ANTS, THE FORM SO NUMEROUS AND SO COMMONLY SEEN. ENLARGED 24 TIMES.

From drawings by Miss Charlotte M. King.

some student of ant life will soon tell us whether it is so or not.

Mr. Newell, who has made some observations of the habits of the *Iridomyrmex humilis*, or Argentine ant, says this species nests both out of doors and in the woodwork and masonry of houses, and the colonies which may inhabit a large area have the unique habit of coming together on the approach of winter and uniting in one large colony which may contain a large number of queens. In the spring this big colony divides or splits up into numerous smaller colonies, which spread out and cover an extensive territory. This fact suggests that the winter months are the best time in which to war upon the pest.

The presence of these ants in the United States was noted eleven years ago, and it was then mentioned that there was a possibility of their overrunning the warmer sections of the country. In all probability, they had been here for a season or two, at least, before it was discovered they were established. So far as I can learn from enquiry and observation, the pest does not seem to have extended its habitat to any distance easterly beyond the range of hills back of Oakland and Berkeley. Therefore it would seem as if there existed some conditions in the easterly section unfavorable to their requirements in the matter of temperature or food. Neither do they seem to have extended their operations south any distance beyond the bay where the frost is more severe and freezing weather sometimes prevails.

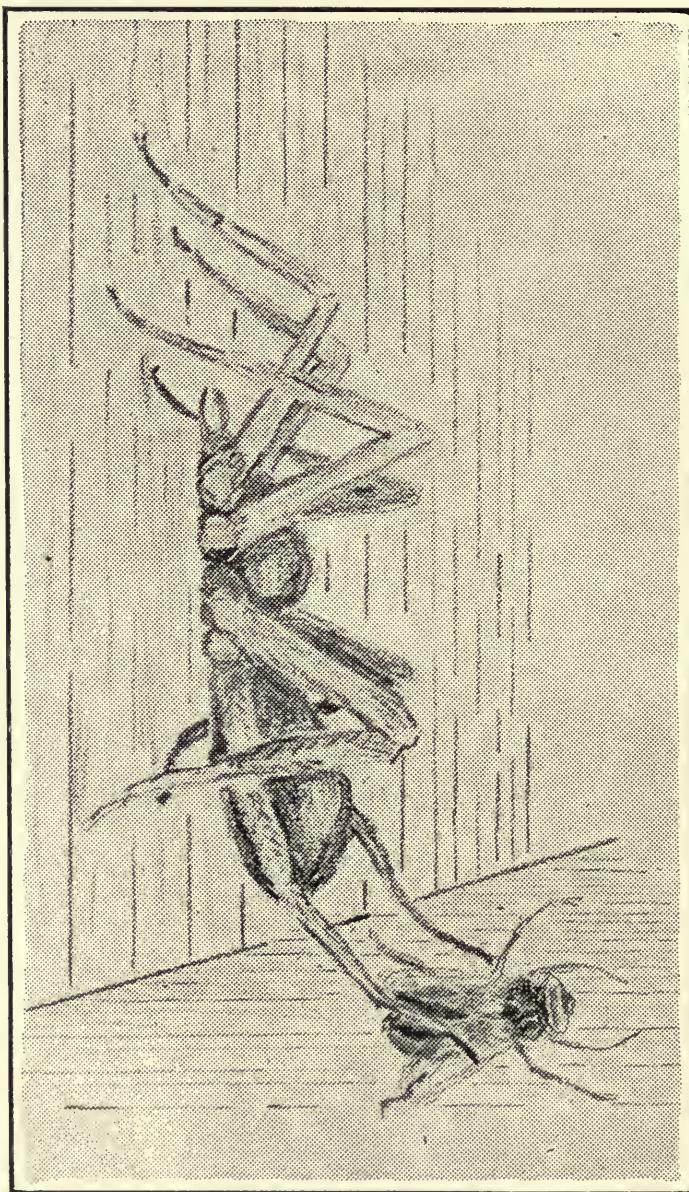
Since the advent of foreign ants the number of English sparrows about the City of Oakland, and some of its suburbs, have become less. The decimation is more noticeable in the streets and the more thickly built-up resident districts. Residents of fifteen years ago will easily recall how numerous these birds were on Broadway and Washington and the central cross streets, as well as in the parks; and how common it was to see the litter of their nesting material hanging from all the nooks and corners of building fronts. Now

some of the streets and buildings are entirely free from the large flocks of sparrows, but without careful investigation and study, it cannot be set down for a fact that the Argentine ants are responsible for the change. If they are to be credited with partially ridding the community of the pest bird, the deed must have been accomplished by the ants swarming into the nests of the sparrows and killing the nestlings when first hatched. This idea was suggested to me by the experience of a resident of Piedmont, who for many years has maintained an aviary in his grounds for keeping and rearing canaries. Up to the last three or four years, he had no trouble in raising young birds, nor did he discover any unusual interference in the various features of the brooding of the birds until in late years. Now it is quite different. Though the birds build their nests and hatch their young as formerly, the baby canaries all die within a brief time after seeing the light of day. For a while the gentleman was puzzled for a solution of the cause of the fatality, but finally he discovered that the nests, after the hatching, were overrun with Argentine ants.

The English sparrows have the habit of nesting in one locality, if not disturbed, and raising several broods in a season. Thus creating a condition similar to the nesting in the aviary, which enables the ants to locate the nestlings more readily and with certainty. In the case of other birds, as a rule, they locate their nests in trees and shrubs away from the buildings where the ants are most common, and get through with their family cares before the locality might be discovered by the enemy ants even if some of their scouts were ranging around away from human habitations, where the ants seem to find a greater supply of food to their liking.

Should the decimation of the sparrow pest prove to be due to the advent of the Argentine ants, there are some people who will look upon the latter with less feelings of enmity than others not annoyed by the birds.





THE BLACK WIDOW CATCHES FLIES WITH HER HIND FEET.

CHAPTER III

THE BLACK WIDOW

Record of the Actions of a Spider While Over Two Years in Captivity

On the 22nd of August, 1916, while rambling over the Pleasanton ridge, I captured a jet black spider, the body of which was about the size of a marrowfat pea. It was while I was overturning objects on the ground to see what character of insect might be found that I discovered the spider under a rock, in a place she made her home, and from whence she went forth to prey upon such forms of insect life as would furnish food for her sustenance. I was not looking for spiders and was not particularly interested in that form of insect life, but this particular spider was so black, neat and clean in appearance, I at once concluded to place her in captivity, so as to have her under observation, and in that way possibly learn something of her habits, traits and manners of capturing the victims upon which she lived.

I placed her in a large-mouth bottle, with the top so arranged as to have plenty of air and convenient for the insertion of other insects as food. The first thing I did after getting home was to consult books on spiders to ascertain what species it was that I had. After some comparisons of descriptions with my captive, I found the latter was known in the classification, of the order as *Latrodectus mactans*, with the common name of Black Widow," the title she was known by in my household for the succeeding two years and seventh months, where she remained an interesting and seemingly contented guest for the period mentioned.

What the average length of spider life is I am unable to state, but I am inclined to think that under favorable conditions it might be four or five years at least. The Black Widow was of mature size when I found her, and if a year old at that time, she was not far from being four years old at the time of her demise in the latter part of March, 1919. My reason for fixing a greater age as a possible length of life for spiders than that attained by the Black Widow is that I feel almost certain that she died of starvation.

Her diet while under my observation consisted exclusively of house flies. During the summer months it was no trouble to find enough flies to feed her quite regularly two or three times a week, but during the winter she was fortunate if fed that often in a month owing to the difficulty in finding flies during cold weather. In the first winter of her captivity I noted that she passed five weeks at one time and over three weeks at another without food, or showing any evidence of hunger or sharpened appetite when fed after the prolonged fasts.

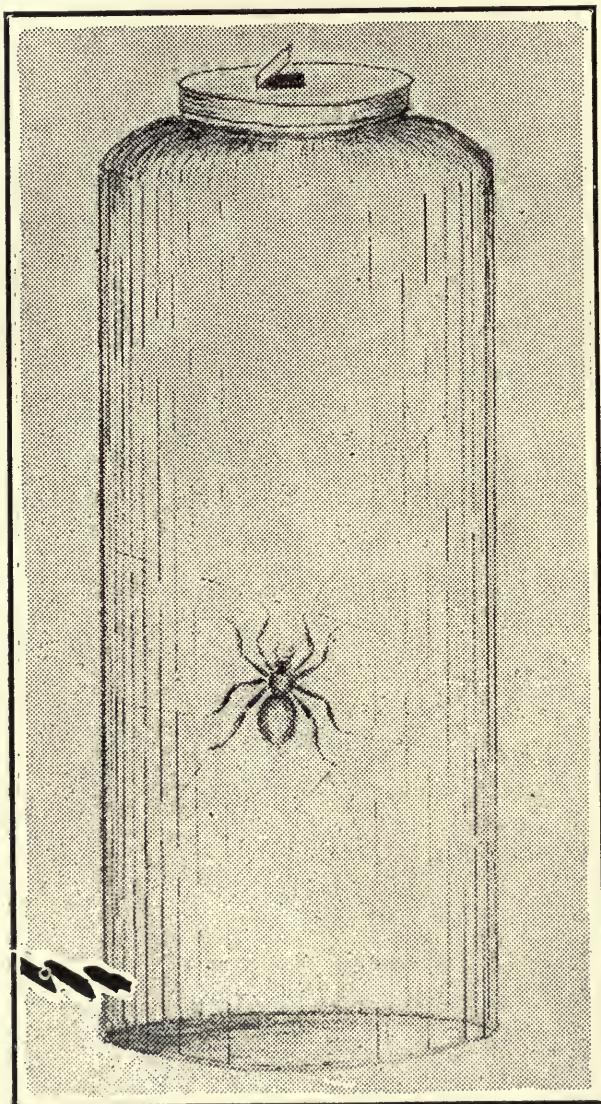
At this time I had three or four representatives of other orders of insects under ob-

servation at my home, and in the winter experienced a similar difficulty in procuring food for them, which occasioned fasts upon their part of durations equaling those experienced by the Black Widow, apparently without detrimental effect.

Contemplating these facts led to the consideration of how carnivorous insects under natural conditions live. The irregularity that must frequently prevail in the length of time between meals, especially when conditions arise making food scarce, cause spiders and other predaceous insects, particularly those forms whose habits of life necessitated their lying in wait for food victims, to undergo periods of irregular lengths of enforced fasting. This being so, nature must endow such forms of life with exceptional powers of endurance. But even here there must be a limitation and the thought prompted me to thereafter record the dates on which I gave the Black Widow and the other insects food. As at this time we are interested only with the career of the Widow, I will give the dates on which she only was fed. The feeding rarely consisted of more than one large fly. The following are the dates: 1918—July 11, 28, August 5, 28, September 10, 16, 19, 30, October 4, 9, November 6, 19, 20, December 22; 1919—January 16.

.From the last date until March 27 there were no flies to be caught in the house. On that date I went to the bottle containing the spider to give her a fly and found that she was dead. She was alive and as active as ever on March 22, when I noticed her working around the web she had made in the bottle. At that time I was conscious of the fact that she had been without food for an unusually long period, and I made a search of the premises, the house and garden for some kind of an insect that would be acceptable to her, but without success. Conceding that she died on that date, she had been without food for a period of two months and one week. If old-age did not claim her as a victim, then something like sixty or seventy days may be considered as the probable limit of endurance of the particular species of spider without nourishment.

While this experience with the Black Widow may throw some light upon the endurance of spiders in abstinence from food, it is not sufficient to establish a limit, or much less supply a rule in fixing the limit of the power of abstinence in other forms of insect life. In saying this I have in mind that during the experiment with the spider I had placed a larva of an omus (a genus of beetle) in a bottle filled with earth, hoping it would pupate. I dampened the earth after the manner of the soil these insects inhabit and



THE BLACK WIDOW IN CAPTIVITY.

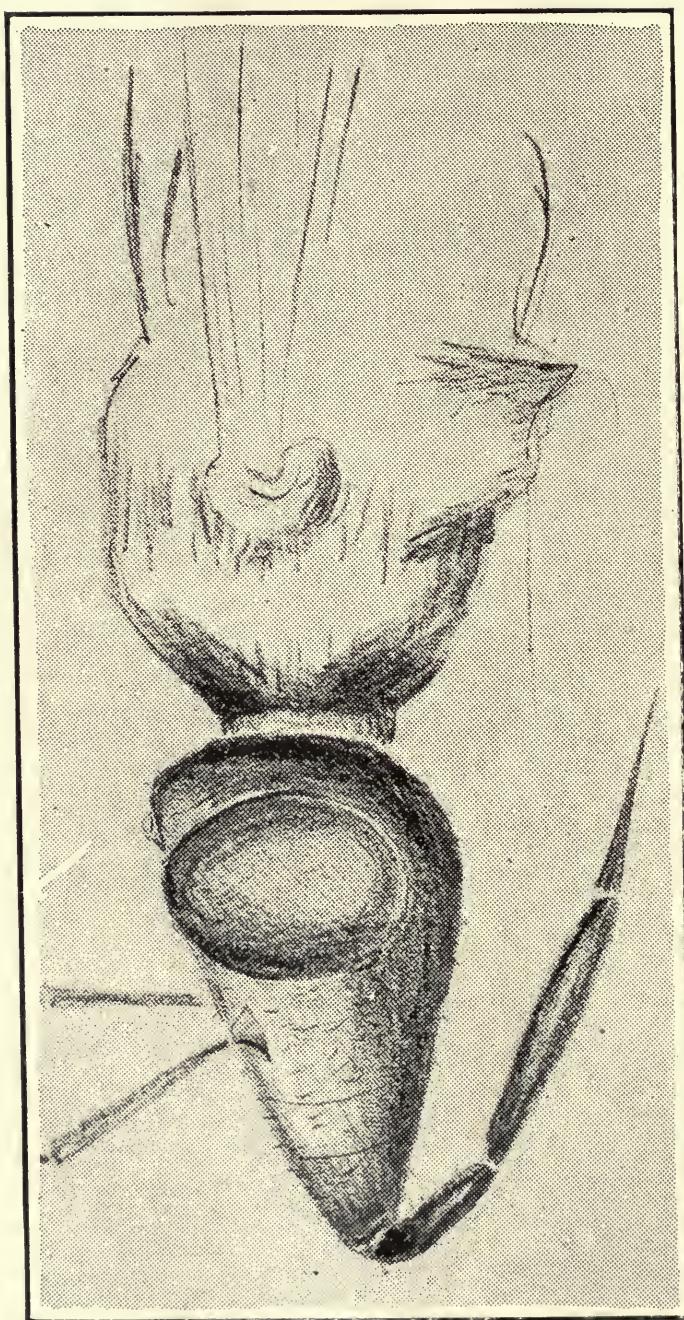
started a hole in it with the point of a lead pencil. The larva took to the hole and soon buried itself from sight. After a day or so I introduced a big fly as food for the prisoner. After a week or so I put in another fly, but after the most careful observation I could not see that the larva had fed on either of them. It certainly had not masticated them, as these insects are supposed to dispose of their victims. Therefore I concluded the larva either did not eat flies or was entering upon the stage of pupation when insects do not eat anything, and I did nothing more than to occasionally moisten the earth in the bottle for a period of seven months. At the end of this time I thought the larva must be dead or pupating. To my great astonishment, when I broke the bottle and opened up the earth it was in neither condition, but very much alive and even larger with its hideous features more developed. Upon being disturbed it opened its huge and fierce-looking mandibles as if in declaration of its willingness for a "scrap." Under natural conditions these beetles in larva form live in holes made horizontally in banks of earth which they never leave until they change to the mature form of beetle. The larva comes to the mouth of entrance of the hole and there, with its head sticking out, awaits the coming of some insect which it may seize and make a meal of. This latter statement is on the authority of other observers, for although I have examined many infested banks I never caught sight of a larva peering out of a hole. The mouths of the holes, with their beveled rims, bear out the statement that the insects do come part way out, but their appearance is probably at night, and not in the daytime when I made my search. The beveling of the edges of the entrance to the holes is undoubtedly caused by the exerted part of the body of the insect swaying around. But when you consider the steep banks and dependence entirely upon chance for some unfortunate insect to fly to it or crawl over it in such a way as to come within reach of the larval inhabitants, hanging out of their windows waiting for a gift of food, it is no more than reasonable to suppose that the meals in those domiciles are not only very irregular but seldom served. This supposition would explain the remarkable endurance exhibited by my omus larva in existing without food while in captivity. Nature, it would seem, in fixing the scope of activities of this particular species of insect, decreed that it should remain within the limits of its home or hole in the ground while in the larval stage, and at the same time endowed it with compensating power of enduring without food, for what seems to human kind, remarkably long periods of time.

However this may be, let us return to the subject of this sketch. When I first placed the Black Widow in the bottle I used a round paste-board pill box for a stopper, inverting it in the mouth of the bottle, perforating the bottom of the box for air. The box thus placed afforded something of a dark place where she made her retreat and remained the greater part of the time during daylight. At night she would come down and work on a web

which she spun all around the inside of the bottle, which she eventually connected with threads run on angles across from side to side, making a kind of ladder which she used in going up and down.

She had the web partially constructed when I inserted the first fly. It soon became entang'd in the spider's net, but the spider did not pounce upon it at once, as I was rather expecting she would. For some moments she remained seemingly indifferent to its presence. She was not yet sufficiently familiar with her new surroundings not to be frightened when I gave her the fly. However, shortly after, when the fly began to make a strenuous effort to escape from the web the Black Widow began to move her body up and down, showing that she had taken notice of the presence of the victim. After a few seconds' indulgence in this movement she made a jump for the victim, landing near enough to throw a rope of her webbing apparently freshly spun for the purpose around the body of the fly in such a manner as to bind down its wings. Then in less time than it takes to relate it she made several more wraps around it. In short, the spider quickly made a perfect job of trussing its victim so it could move neither wings nor legs. This work she did with her hind feet, and the fact that her head was away from the point of action was no hindrance in the dexterity of the operation. While engaged in the trussing process she stopped two or three times to turn and bite the victim. The effect was to quiet the struggles of the fly and make the work of binding it up easier.

Now the Black Widow was ready to take the first meal she had in captivity. She grasped the fly with her third pair of legs, those next to the hind ones (spiders have four pair instead of three, as do the true insects), and carried it to her place of retreat in the upper part of the bottle. She began her feast by applying her mouth parts first in one place and then in another about the thorax of the victim, turing the fly around and about quite as easily and dexterously as a squirrel handles a nut. This procedure occupied a few moments, and whether it was one of examination of fitness for food or for hastening the death of the fly, though that seemed to have been accomplished by the biting when it was first attacked by the spider, I could not say. Apparently satisfied that it was all that it should be, the Widow moved down her ladder, this time carrying the fly with her two hind legs. She took a position about half-way down and then began the meal in earnest. She applied the mouth appendage by which she extracted the juices of the fly, apparently between the thorax and abdomen, and there it remained for almost one hour, leaving the inference that she had been feasting for about the same length of time that an epicure in affluent circumstances would give to a meal in a first-class hostelry. After finishing the fly, she left the remains hanging in the web, but the next morning I found the dead fly at the bottom of the bottle. And I may state here that the spider uniformly made the same final disposition of all the dead bodies of the flies



THE HEAD OF THE KISSING BUG.

that I fed to her in the more than two and one-half years of her captivity, excepting the last three flies I gave to her; these were left hanging in the web at the place where she had finished with them.

This radical change in her habits of neatness and order cause me to think that possibly the Black Widow was reaching her age limit and probably would not live much longer. However that may be, I cannot repress the thought that the last long fast at least hastened her demise.

Referring to my notes on the conduct of the spider while under observation I find the following taken from the record of her actions and disposition relating to the second fly fed to her: "The spider bound the extreme ends of the two wings with the hind legs of the fly securely to the body; these being the most troublesome appendages, were the first dealt with, indicating caution and method on part of the spider. She then proceeded to secure the other legs of the fly from movement by binding them up to the body with webbing. In both actions this was handled or spun out with her hind feet. I could not see that she bit this fly during the trussing process."

After two or three weeks of captivity the Black Widow ceased to be disturbed or alarmed when I picked up her bottle preparatory to feeding her. On the contrary, if the movement of the body up and down mentioned in the description of her dealing with the first fly was a necessary or habitual act in preparation for an attack on a victim, she certainly must have learned to recognize in my act of picking up her bottle at feeding time, for she invariably went through those motions on all such occasions and seldom delayed pouncing upon the flies as soon as introduced.

On the whole I think the Widow probably lived a longer life, with more agreeable experiences, in captivity than if she had been left in the hole under the rock where I found her. Her enforced quarters were larger, and besides she was immune from attack by insectivorous birds and reptiles and the greater danger from spider-hunting wasps.

As with snakes, many people have instinctive feelings of revulsion toward spiders. Though they may be fond of animals, snakes and spiders are the last things they would think of making pets of. Though I confess to this feeling in some degree, it does not go to the extent that I want to kill all these forms of life I meet with. I am free in mind to pass by all that are not harmful and dangerous to human life. It is known that the non-poisonous snakes are not only harmless but are a decided benefit in the help they give the farmers in keeping down the numbers of destructive rodents that infest the country. As to spiders, it is a question whether they are dangerous, or harmful, or not. It is possible that their appearance belies their power to harm. Spiders will bite, but some authorities say the effect is less serious than the sting of a bee and no worse than a wound caused by a mosquito. Others, while admitting this to be true as to the spiders infesting the temperate zones, say there are species in the

tropics capable of inflicting wounds that in some instances may involve death. Frank E. Lutz of the American Museum of Natural History says in his "Field Book of Insects"; "The bite of all spiders is poisonous—that is the way they kill their food—but there is so little poison and so few spiders are strong enough to bite through the human skin, even if they would try, that spiders are not dangerous." Again he says, speaking of a black spider that lives under stones or pieces of wood, "It is the only spider of Northeastern United States concerning which there is even moderate evidence of its seriously biting human beings."

On the other hand, the standard dictionary says: "Some spiders are by far the most venomous animals in existence in proportion to their size; that the bite of a spider can be fatal to man (and there are authentic instances of this) implies a venom vastly more powerful than most poisonous snakes."

When considering that the dictionary comment applies to spiders of the whole world, including the tropics, and Lutz' description only to the species infesting the northeastern part of the United States, the two statements may be regarded as less conflicting than careless reading would make it appear.

So far as my own observations in this matter goes in affording any evidence it would be to sustain the conclusions of Dr. Lutz. I have seen many serious-looking wounds that people attributed to the bites of spiders, but in every instance the bites have been inflicted at night while the victim was asleep.

Inasmuch as we have in this section of the country a species of hemiptera that is quite numerous at times, which enters our homes, especially in the country, in search of insects that infest houses, and is not backward in inserting its sharp dagger-like beak into human flesh, I think it more logical to charge it with the offense laid to the spider. This insect is a reduviidae and is commonly called the "Kissing bug." The sting made by its proboscis is not only very painful, causing large inflamed swellings at time, but the effect is more lasting than any insect wound I know of. Sometimes in some districts they are more numerous than spiders, yet while everybody knows the latter when they meet with it, not one in 500 people can identify the Kissing bug or is aware of its harmful character. It would be a good idea for those people unacquainted with the bug to familiarize themselves with its appearance, for it is one of the things in this life that is best to avoid socially. It is a little over a half-inch in length and has somewhat the general appearance of a common beetle, though it does not have the chitinous wing covers that characterizes the latter kind of insects. When not flying it keeps its wings folded close to its body. There are six or more species in the United States, which vary to some extent in shape and markings, but the one most frequently found in our dwellings is marked with red on wings and body.

Spiders do not eat, or masticate, the solid parts of the insects they kill for food, but only suck the juices of the body. Their mouths are

WILD LIFE IN CALIFORNIA

equipped with a pair of jointed appendages which when unfolded for use look like a pair of mandibles. They are known as falcæ. The outer joint is saber-like and folds inward like the blade of a pocket-knife. The falcæ are used to kill their prey. A duct runs through each joint, opening at the tip, through which the spider forces a jet of poison from connecting glands located in the cephalothorax. Not infrequently spiders seize and hold their victims with their falcæ, especially when the prey is large and troublesome to subdue.

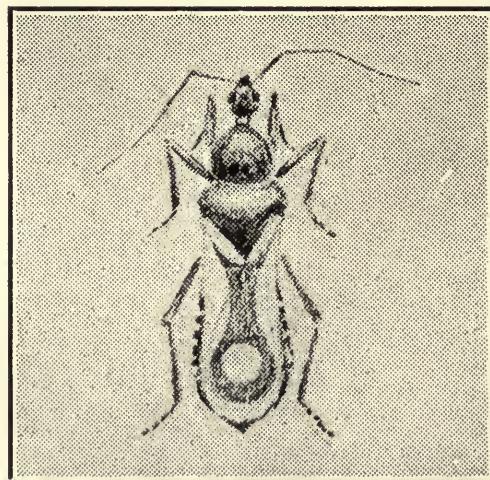
I had a house spider also under observation after I became interested in the Black Widow, which, as I have stated, was a field or outdoor spider. The former had a beautiful seal brown color of a velvety texture and was about a half-inch in length. Upon capture she was placed in a ten-ounce bottle, where she remained for a few weeks over a year. For the first month I kept the mouth of the bottle covered to prevent her escape. During this period she constructed a capsule of webbing on the side of the bottle in which she deposited a batch of eggs. This act indicated that she was contented with the situation; therefore I removed the cover of the bottle, giving her opportunity to leave if disposed. But so far as I know, she never went outside of her glass domicile. Of course, I supplied the flies necessary for her food.

I think this spider might properly be styled a dainty eater. One fly seemed to satisfy her needs for some time. If two flies were placed in the bottle within the same half day the second one was ignored for hours. In fact, she would back away if it happened to come in proximity to her in its ramblings.

Her method of attacking the flies was somewhat different from that of the Black Widow, which it will be remembered threw webbing around her victims and trussed them up so they could not move either wings or legs. "Brownie," the name I gave the last spider, simply waited for its victims to come within reach; then she jumped upon and bit them and, so far as I could see, used no webbing whatever. In fact, there was little need, if any, for it, for the effect of the bite was instantaneous, resulting either in death or complete paralysis. After capturing the fly the spider would feed on its juices for three to four hours.

Three months after her residence in the bottle she made another capsule in which more eggs were deposited. Six months after that still another nest with eggs was formed and about ten weeks later a fourth. The capsules were all close together. She passed all of her time on top of the capsules, as if guarding the welfare of the eggs they contained. I maintained a careful watch of the eggs, but never observed the slightest change in their appearance from the first time I saw them.

This spider was fed more generously than the Black Widow, but on four or five occasions during the winter months, by reason of the scarcity of flies, it experienced fasting periods of two and three weeks each. During these times I thought hunger might induce her to leave the bottle on foraging expeditions, but she did not, appearing to prefer remaining at home and having her meals brought to her, although irregular and far apart.



THE REDUVIIDAE—THE KISSING BUG—THE BITE OF WHICH IS SOMETIMES ATTENDED WITH THE MOST SERIOUS CONSEQUENCES.

CHAPTER IV

NESTING IN A BOTTLE

Queer Place Selected by a Wasp in Which to Build a Nest Subsequent Raid of a Skunk

In a six-ounce bottle that I had been using as a trap for beetles, at Larkcrest, near Pleasanton, I found that a wasp of the genus *Polistes* had started a nest of nine cells. The bottle had a wide mouth, and I usually placed it in a slightly reclining position in a depression on a bank sheltered by a board. A little oil or piece of animal fat served to attract beetles which, after entering the bottle, did not seem to be able to get out again. This trap I visited and collected the victims as often as I went to Larkcrest. This Spring my visits had not been as frequent as usual, and some six weeks had passed prior to June 5th without an inspection of the trap. On this day I put my hand under the board and brought out the bottle, and to my great surprise I saw that a wasp had started a nest in it and the "lady of the house" was "at home." I was so startled by the nearby presence of an insect with such a reputation for venom that my first impulse was to drop the bottle and "beat it," as the boys say. However, as Mrs. *Polistes* did not show any resentment at my familiarity I took the opportunity to see what she was doing in my trap.

The cluster of cells comprising the nest were hanging down in the form always constructed by this species of wasps. The stem supporting the cluster was attached to the bottle near the mouth. There were nine cells, most of which were completed and contained grubs or the larvae of the wasp. I replaced the bottle under the board. Eight or ten days later I again visited the place and upon inspection of the nest found that several of the cells had been covered or sealed up indicating that the grubs had entered upon the next stage of the wasp's life cycle. As I was spending the greater part of the summer at Diablo, a distance of seventeen miles from Larkcrest, I concluded to remove the bottle with the wasp and embryo family to the former place where I could better watch the development of the little colony.

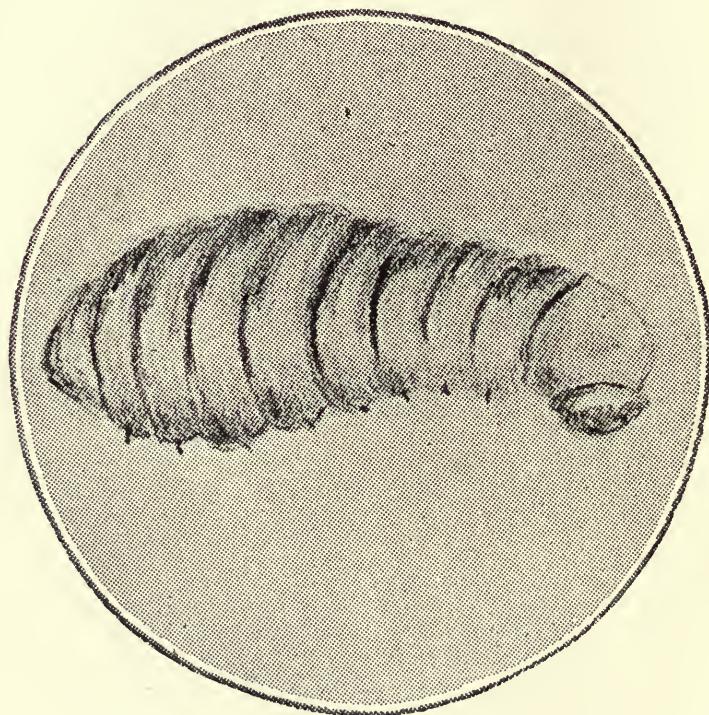
The next day, early in the morning before the mother wasp had become warmed sufficiently to justify her going out for her breakfast, I took the bottle and fastened a piece of cheese cloth over the mouth, thus preparing for the removal of the wasp home and household. I put the bottle in my suitcase with my clothes. Upon arrival at Diablo I removed the bottle and found mother *Polistes* perched on the nest without manifesting the least discomfort or objection to the treatment she had undergone.

However, I concluded it would be well to keep her a prisoner for another day as long as she made no effort to go out. The next day I placed the bottle on the ground under the end of my porch and removed the cover. She did not take immediate advantage of the liberty thus presented as I was somewhat fearful she would do, and all the surroundings being changed, became bewildered and lost. Judging from human experience she must have been hungry after such a long imprisonment. In the course of half an hour she left the bottle. Whatever it may have been that prompted her to leave the nest, whether to satisfy her appetite, inspect the new surroundings, get a drink, or to procure material for the construction of additional rooms for an increasing family, I was unable to determine. When I found she had left the nest I knew I was soon to be informed as to what effect the change of seventeen miles in location of the nest and of entirely different surroundings was going to have upon its proprietress.

I took a seat where I could easily see the wasp if she were disposed and able to return to the nest. In about a half-hour I was greatly pleased to see her come back and take a position on the nest as if she were wholly indifferent to the alteration of the surroundings. Her return meant that, with no accidents to interfere, I was going to have the opportunity of watching the proceedings of nest-building, hatching, rearing of young, etc., by this species of wasp under unusual and most favorable conditions.

For the first week there was nothing to note beyond the starting of the bases of some additional cells and laying of eggs therein. At the end of this time one morning before it was warm enough for the wasps to be about, I found three wasps on the nest. It was evident that at least two of the pupae had matured and that two young wasps had emerged from their cells and increased the family to that extent. Within the next day or two, two more wasps were added to the family. The newcomers were as industrious as their parent, for they began at once to assist in adding more cells and completing the cells partially constructed by their mother, and in the performance of all the other family housework.

During the middle or heated part of the day the different members of the family were making trips to and from the nest, presumably for the material for enlarging the nest



BABY WASP.

or food for the grubs that were hatching, probably for both. I endeavored to find out what kind of food it was they were bringing home. It was either in too minute parcels or taken into the mouth in such a way I could not determine. On one occasion, however, I obtained a glimpse of an insect held in the jaws of one of the returning wasps, that appeared to be a small fly or gnat, but of that I could not be positive.

There were a number of *Polistes*' nests in the neighborhood and many of the wasps were to be seen at all times during the middle part of the day scouting around the outer branches and leaves of the large valley oak trees in our yard, which seemed to be infested by numbers of small insects. The actions of the wasps suggested that their presence there was for the purpose of capturing some of the insects.

Quite often during the day all the wasps, but one, belonging to my bottle family, would be away. At no time did I ever find the nest wholly unguarded.

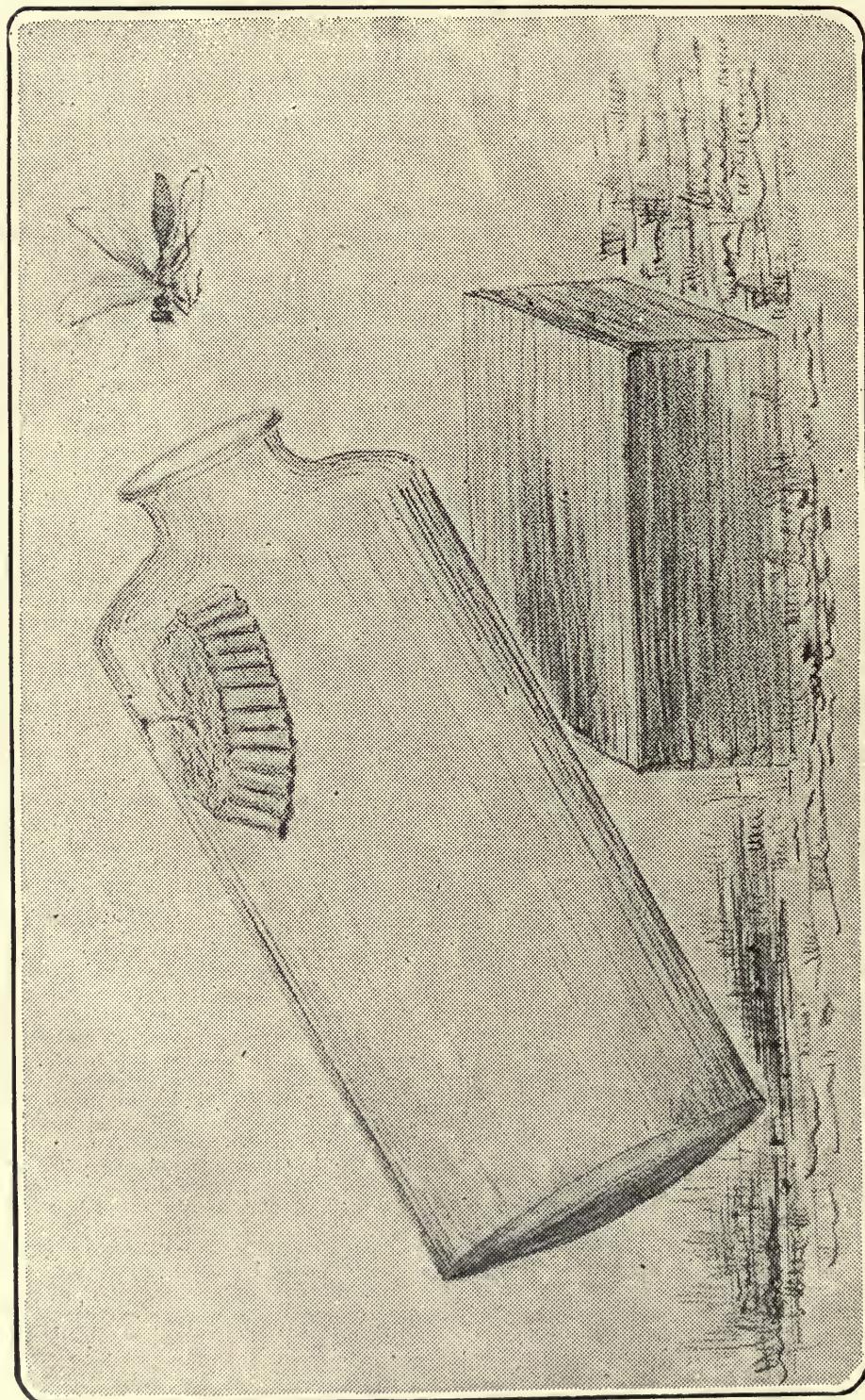
By the addition to the family mentioned the number of workers was materially increased, and an enlargement of the nest was noticeable. Cells started by the mother or queen wasp were completed and several new ones were added to the group.

Fearing something might happen to interfere with the progress and prosperity of the family if I left the bottle on the ground, I planned to change the location by placing it on a shelf on the side of the house, about five feet above where it had been on the ground. I made the change after dark. The next morning early I found that all the members were on the nest and so far undisturbed by the removal of the bottle containing their home. However, by noontime I found all but one were away and I waited a couple of hours or more in vain for the return of the absentees, but none came back. Evidently the family did not intend to acquiesce in my purpose to place their nest in a safer position. Upon examination of the location where the bottle had been for several days I found some of the wasps at rest on the under side of the flooring of the porch while one was flying slowly around the spot as if trying to find out what had become of the nest or to satisfy itself that the nest had surely disappeared. I then returned the bottle to its former place on the ground and within a half-hour all the wasps were back on the nest. I repeated my attempt to make a permanent change of location the next night and for the three following nights but my efforts were unsuccessful. The results were the same each day. Then I concluded to let the bottle remain on the ground. The only way that I could account for the fact that the nest could be moved seventeen miles and not be abandoned when the inmates were released, and not moved six feet without contrary results, was the thought that in the first instance the surroundings were in every detail altered, while in the latter case the only change in surroundings was that made

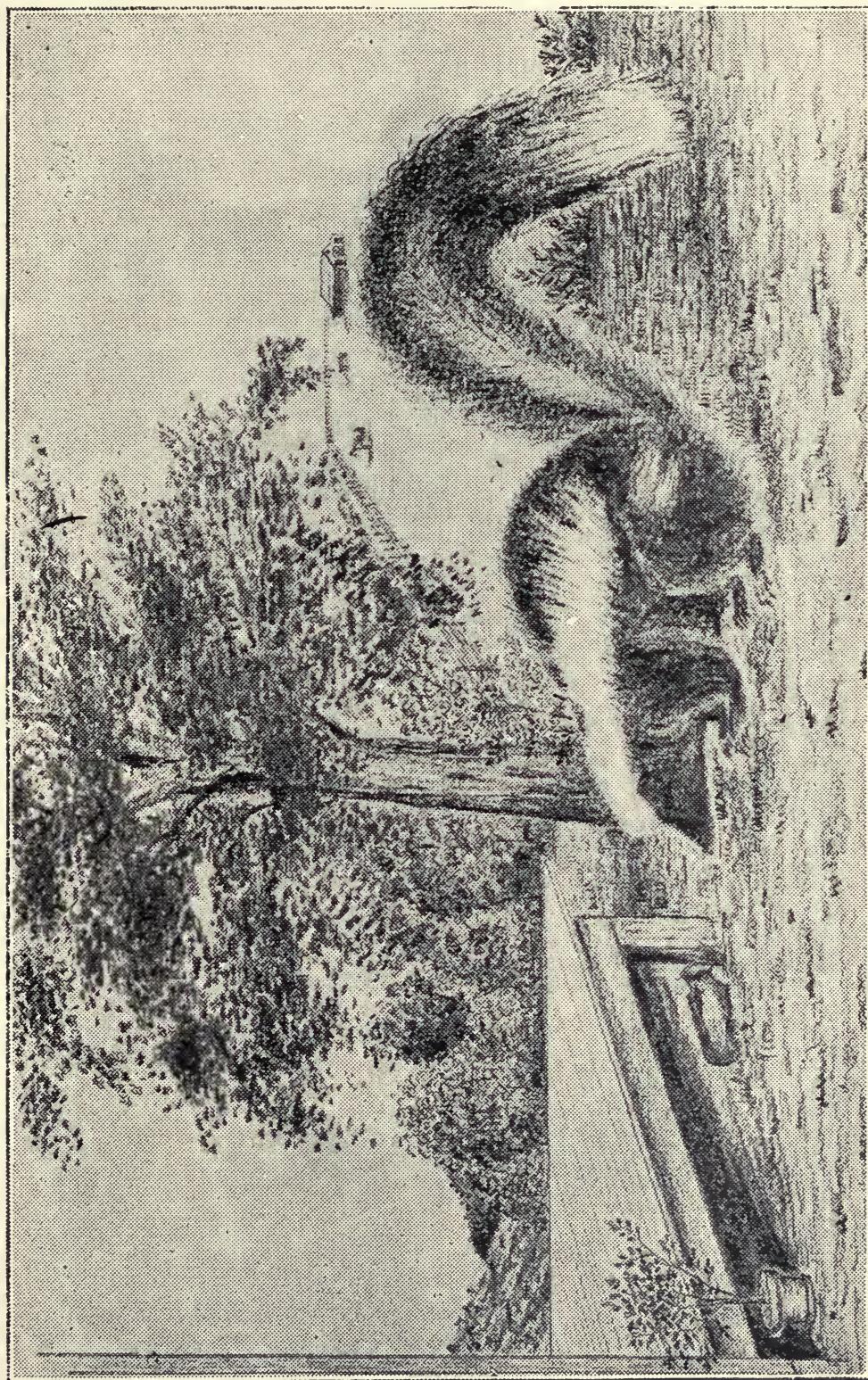
by the slight change of location of the bottle. The house porch, trees, shrubs, vines and grass, the location of which they had become familiar with, were all there just as they had always been in their experience, and their intelligence was not great enough for them to remember that they had left the nest from another location, or in other words recognize the fact that a change had been made when they flew out of the bottle in the mornings.

For two or three days and nights nothing happened to disturb the family, when early one morning just before daybreak I heard a noise under the porch which made me think that, possibly a skunk was attacking the wasp nest. I got out as quickly as possible to rescue my pets if necessary. It was not yet light enough to see all objects clearly, but I heard a noise such as a small animal going through the brush and dry leaves would make, so concluded whatever it was it had been frightened away and I returned to my bed. When I arose for the day the first thing was to visit the wasp family. To my sorrow and great disappointment I found the bottle bottom side up down the embankment several feet from the porch. A hasty examination showed the stem by which the nest was attached to the bottle to be broken and the group of cells with their contents hanging by but little more than a thread, so that it swung and swayed with the least movement of the bottle. I moved the bottle with the greatest care and placed it so the nest would hang as near its normal position as possible. Several wasps were in the bottle. I did not count them. I was intent upon getting the nest and bottle back to its place under the porch.

After breakfast I visited the wasps, wondering what they would do or how they would be affected by the damage done to their nest. I rather expected to find that the thread or fibre that had been holding the nest in suspension was broken, and that the nest would be found lying on the bottom of the bottle. I was unprepared for what I did see, for it was wholly inconsistent with the result of Fabre's experiments with the mason bees. To my surprise and great satisfaction, I found one of the wasps carefully examining the break in the stem. By the rapid and nervous working of her antennae around and about the broken stem I judged that these appendages were playing no small part in the examination. I at once surmised that this preliminary inspection meant that something more interesting was soon to follow, so I carefully replaced the bottle, then afterwards made frequent visits to it. Every time I made an observation of the condition of things in the bottle during the next two days I saw one or two wasps working around the damaged stem. In short, the wasps were repairing the damage by renewing the stem at the broken place. At the end of the two days the work of repair, so far as I could see, was completed. When I picked up the bottle I found the nest to be firmly suspended once more by the renewed stem. The wasps set up a buzzing remonstrance at my familiarity with their



THE WASP NEST IN THE BOTTLE.



THE SKUNK THAT RAIDED AND DESTROYED THE WASP NEST IN THE BOTTLE.

WILD LIFE IN CALIFORNIA

habitation, so I replaced it without much delay.

As I view the action of the wasps in examination of the broken part and subsequent work in repairing it, it is not difficult to recognize a rational act. In the first place there was the recognition of a damage to their nest. Something exceptional in character in the life history of this particular family of wasps. It is quite probable that no accident of this kind was experienced by the ancestors of these wasps for ages past, so no precedent to supply even remotely an impulse of instinct. In the next place, their work showed they understood that the condition of the stem necessitated repair for the security of their home, and they made it promptly and in a workmanlike manner.

If these insects were endowed with no power that we call mental or rational whatever, and were guided solely by instinct that supplies a routine of actions throughout their existence, that is, impels them to build a nest at a certain time in a certain form, lay eggs, provide food for their young, etc., having once fulfilled the requirements of that instinct, it is not reasonable to expect them to duplicate or repeat any action that is not duplicated in the routine of their lives. In fact, that was Fabre's test in his effort to find out whether his wasps and bees were actuated by reason or instinct. He based an opinion that it was instinct alone on results obtained in experimenting with the mason bee, where he broke off the bottom of a cell, and the poor bee continued to deposit honey in the top. As it ran out at the bottom as fast as she deposited in the top, of course she was unable to fill the cell.

To protect the wasp family from another attack by marauding skunks I drove some small stakes into the ground around the part of the bottle that was exposed. The other side was protected by the porch construction. Two weeks or more now passed and things seemed to be going along nicely and prosperously with the Polistes. More wasps were hatched and the nest was enlarged. The daily actions of the members of this industrious family were so far as I could see wholly confined to the duties already described. I said industrious,

for they seemed very busy while at work. However, they did not believe in long hours of labor. As a rule it was about 9 o'clock in the morning before any of them left the nest, and generally they were all back and on the nest for the night by 5 o'clock in the afternoon.

They seemed very attentive at all times to the grubs in the cells. I noticed wasps that had been out, upon their return put their heads into open cells, and I supposed they were feeding the baby wasps. I would like to have witnessed the operation, for I had read that the young ones open their mouths to be fed somewhat like young birds, but I was unable to see what took place, as the head of the mature wasp feeding the grubs filled the mouth of the cell.

Somewhat over a month had passed since I transferred the nest and bottle from Pleasanton to Diablo when I was called to Oakland on some business matters. I was absent from Diablo two or three days. Upon my return, about the first thing I did was to visit the site of my wasp family home. What I found was very disappointing and somewhat surprising. I had underrated the cunning and strength of the skunks when some fat, rich wasp grubs stood as a reward for their efforts. The stakes had been pulled apart so they could get the bottle out of the pocket I had made for it. Then it was an easy matter for the animals to complete the destruction of the unique wasp domicile with no one around to interfere with the murderous raid. When I found the bottle about four feet from the pocket there was not a vestige of the nest remaining in it, nor could I find any part of the nest or cell on the ground thereabout. I never did fancy skunks and now I had another grudge charged up against them. They not only destroyed an object of curiosity and extraordinary interest, but interrupted all further possibility of acquiring any new information as to the conduct and habits of this colony of wasps. A nest in a clear glass bottle, affording such exceptional advantages for close and thorough observations of the habits and work of the insects, was something I could hardly expect to find again.



CHAPTER V

INTERESTING EXPERIENCES

While Engaged in Studying the Habits of Some of the Wild Birds of California

On a midsummer evening while walking out among the shrubbery and flowers in the grounds of the Diablo Country Club I saw a small bird which I thought was an olive-sided flycatcher. As this bird had not been previously noticed in that locality, its presence there on this occasion was a matter of more than ordinary interest to me. It was very busy catching insects and did not seem to notice my approach. It was perched on a low-strung telephone wire when not on the wing in pursuit of a bug or fly. I finally obtained a position not more than 20 feet from the bird without disturbing it in the operation of collecting its supper. Thus I was enabled to determine its coloring, the size of its bill, and make note of the features that differentiated it from other members of the fly-catching family.

Every moment or two it would spy a victim flying in the air. Sometimes in darting or flying to catch the bug or whatever kind of insect it might be it would go a distance of 30 feet or more. I could not see the victim in its flight; the bird's eyesight was keener than mine; but generally I could see the capture, after which the bird would fly back and resume the perch on the wire. It was most interesting to study the bird while it was on the watch for the coming of a victim. Its head was never still, as it was continually on the lookout for game. It would cock its head first one way, then another, and by the motions it was plain that the eyes were following the flight of some insect well up in the air, or some bug scouting around near the ground among the flowers. It was not only wonderfully sharp in eyesight (no human eye could equal its keenness and accuracy), but it was exceedingly clever in the capture of its victims. It seldom made a miss.

Finally it made a change in its perch from the telephone wire to the top of a tall flower-stake driven into the ground about six feet from where I stood. This move on the part of the bird improved my opportunity for the study of it and watching its movements when in flight for an insect. The bird made several flights from the new perch and on one flight it did not return to the stake top but made another change of perch. This time it selected me, for it lit on top of my head, or, to be exact, on top of my hat. I remained as quiet as possible. The visitor made one excursion from this perch and returned as was its custom at the other perches. I called to one of the gardeners to witness the novel sight. The

sound of my voice did not seem to frighten or disturb the bird, for it remained on my hat while I talked to the man. However, as soon as I moved the bird darted away like a flash and that was the last I saw of it.

This is the second experience I have enjoyed in having a bird use my person as a perching place. The other happened a few seasons ago near Pleasanton. One forenoon I went out and took a seat under the shade of a tree near some heavy underbrush and while reading, with my legs crossed, a little California Creeper flew down from the tree and lit on the toe of my shoe. I recognized the little chap as a member of the Creeper family, something of a stranger in these parts, never having seen more than one or two specimens of this particular species before and none since. I remained perfectly quiet so not to alarm it, full of wonderment at its familiarity and curiosity as to what it was in search of there. After eyeing me for a few seconds, cocking its head first one way, then another, it flew to my right shoulder, then ran around my neck to the other shoulder. The inspection of my clothes seemed to have much interest for it. After leaving my shoulders it visited nearly every part of my body and limbs, running up and down, over and under, as is the habit of the bird when working around tree trunks and limbs. After a most thorough inspection of my clothes it flew off a short distance, but remained on the new perch for a few seconds only when it returned to a position on my foot once more, from whence it made another extended trip over and around my legs and body; then departed to be seen no more. The acquaintance was short and I was sorry to have it end so soon. I have often wondered when thinking of the incident why this particular bird should have had no fear of me. Was it for the reason that it was of the migratory class and came from a wild section of country where there were no human enemies to teach it to avoid as dangerous all forms of the so-called higher order of life? Or did the bird by reason of youth and inexperience just fail to recognize in me the form of a common and dangerous enemy?

In front of the window of my "den" where I spend considerable time when in Piedmont I have a place where I feed the wild birds. The arrangement is such that the birds, when they come to the place, are so near to me I could put my hand on them if they would submit to it. So I have opportunity to watch

WILD LIFE IN CALIFORNIA

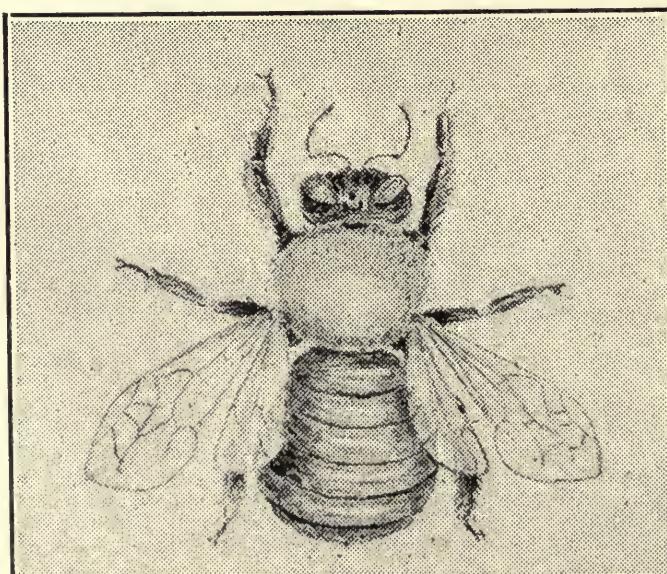
the birds and study their peculiarities at close range. One thing in particular has impressed me while making these observations, and that is the variation in dispositions among the birds of the same species, or kind. Some are very timid, some are quite gentle and not easily alarmed, and some are bold and aggressive. The regular patrons of the "free lunch table" are English sparrows. Towhees, White and Golden crowned sparrows, Juncoes and Heermann Song Sparrows. Although the House Finches, or Linnets, were numerous about the place, for a long time, or to be more precise, two years, they seemed to be above being seen in the "bread line," but they now are my most numerous visitors and freely partake of the seeds daily thrown out for the birds.

In watching the actions and behavior of the birds another thing struck me as worthy of note, and that was the independence, courage and fighting qualities of the little Song sparrow. Time and time again I have seen this smallest of all my visitors drive intruding members of the other sparrow families away. Once I saw it put to flight five English sparrows. It does not seem to hold the same degree of enmity toward the White crowned, but does not hesitate to attack them whenever its part of the feast is encroached upon. Of course, the bigger Towhee is the bully about the table. He lords it over all present.

The English sparrow has the reputation of being most selfish and pugnacious—qualities which he is credited with manifesting in a shameful way, making life so unpleasant for other bird people that they leave the territory frequented by the foreigners. I am sure I held this opinion, not from observation, however, but from the numerous newspaper squibs aimed at the bird. Now I must say that from what I have seen from my window the English sparrow has been maligned. While he may be properly classed among the "undesirables" on account of his queer appear-

ance, his disagreeable voice and his flocking habits, he is as well-behaved as the other visitors here, all of whom make him stand back from the desirable feeding spots. This being so, why should he be accused of driving other birds out of a locality? Other birds do go and come. White crowned sparrows were constantly around our premises every day for more than two years. Subsequently every last one disappeared, but after an absence of a few months they returned in smaller numbers. I would be surprised if other and better reasons than the English sparrows could not be found to account for the disappearance of certain species of birds from localities where they had been commonly noted.

The "free lunch table" in front of my window is supplied with bird seed only. There is no tablecloth supplied. The food is just scattered on the ground over the area of several feet, so as to give the weaker birds a chance. While the seed remains on top of the ground it is easy work for all of the visitors, but in a little while there is nothing left but what is down among the clods or has been covered with earth by the birds hopping about. Then the place has no further attraction for the White crowned and Song sparrows. They appear to be poor scratchers. But with the Towhee scratching is its strong forte. I have had them dig up every single garden pea in a bed where the seed had been planted two inches deep, and not a seed pea had been left on top of the ground to advertise the planting. And they did not dig or scratch indiscriminately like a hen, either, but went right down the rows without missing a seed. The English sparrow does not leave the lunch table, because he is compelled to exert himself to some extent. But he does not scratch—he noses the vagrant seeds from among the clods and dirt with his beak. The way he makes the dirt fly with that bill would put to shame some shovelers I have seen employed on public work.



CARPENTER BEE—NATURAL SIZE.

CHAPTER VI

CARPENTER BEES

Wise Insects that can Work in Wood, but Avoid Hard Labor When Circumstances Permit

A large bee common to California, if not to the Coast, called the Carpenter bee was frequently seen about our garden at Diablo in July and August. This insect might be taken for a large bumble bee, for it has much the same form and general appearance, though in color it is wholly black without the yellow markings that distinguish the various species of the bumble bee. This statement, however, should be qualified, for while the female Carpenters are all black, the males of at least one species are wholly yellow in color and there is a large species found on the Atlantic side of the continent that is marked with a yellow thorax.

These large bees were given the name of Carpenter from the fact they bore holes in dead wood of various kinds in which to nest.

At Palm Springs, in the desert section of the southern part of California, the largest known species of Carpenter bee, or member of the *Xylocopa* family, is quite common; holes in logs, fence posts and other dead wood, into which a person could insert a finger, made by these bees are frequently seen. While there is little or no trouble in finding a black female, it is not so easy a matter to find, or see, one of the big yellow males. They are not only swift in flight but shy, consequently they are not easily captured. These southern bees are about an inch in length with a wing spread of nearly two inches. The holes they make for their nests are sometimes as much as a foot deep and are always made in dry wood; never in green or wet wood. In the farther part they make lateral cells for the accommodation of their young.

There is a very small member of the Carpenter genus which is only about a quarter of an inch in length. This dainty little bee is known as *Ceratina dupla* and is of a metallic blue color. It makes borings into pithy twigs for the nests, removing the pith and making a series of cells one on top of the other. Into each cell an egg is laid on a supply of pollen for the larva when hatched. Observers of the work of this little insect say it is one of the very few insects that seems to have any interest in the maturing of its young. The mother remains with the nest until the brood reaches maturity, when she "leads forth her full-fledged family in a flight into the sunshine."

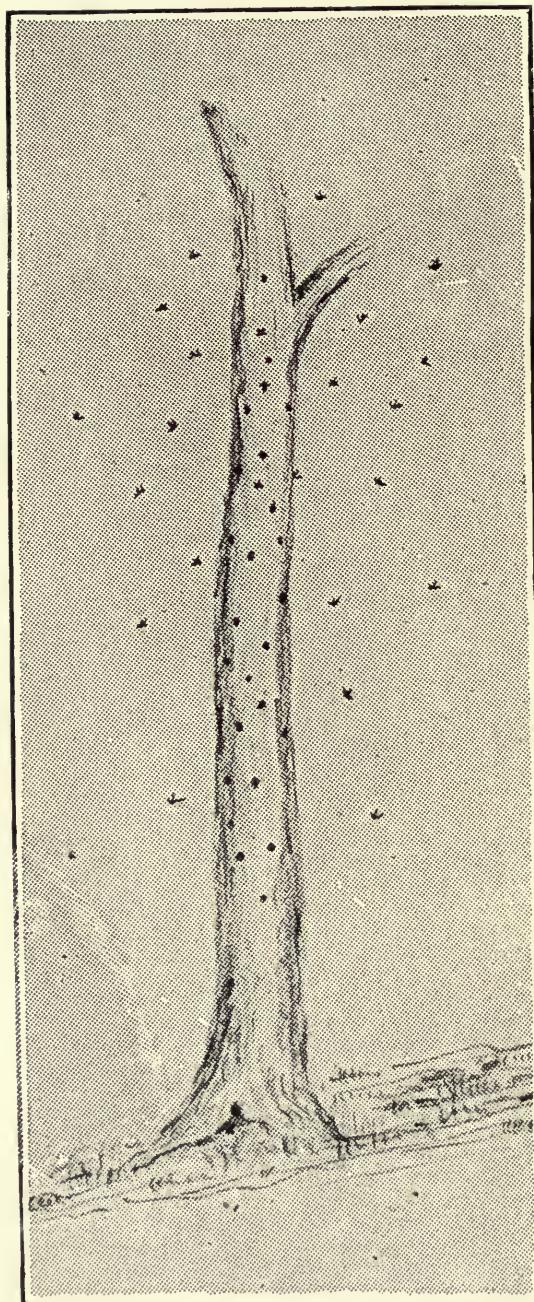
The large Carpenter bees that visited our garden at Diablo were a trifle smaller than the big fellows of the southern part of the

state. The only specimens of the species that I saw about Diablo during the summer were those that came to the *Salvia* blossoms. At almost any time of the day between the hours of 10 a. m. and 3 p. m. from one to five of these bees could be seen working around the base of the flowers of the *Salvia* plants. They visited no other flowers in the garden, though there were many other kinds which were attractions for numerous other species of bees and members of the wasp family.

The operations of the Carpenter bees at the base of the flowers and on the outside part attracted my attention, and I found upon investigation that they were making holes through that part of the flower in order to insert their tongue-like process and reach the nectar of the blossom. The long, narrow flower would not admit of the entrance of the bulky form of the bees so they could obtain the honey in the usual way from the inside; but the Carpenters were not to be denied the sweets of the *Salvia*. With the sharp tools used in boring holes in wood it was a simple matter to perforate the soft petal substance of the flower. The question arises, was the change of method of securing the nectar in the flowers instinctive or the manifestation of reasoning power? Of course, no one knows. We can only apply our own reasoning power to the facts and draw conclusions. Those who can not concede any degree of mind action to the lower forms of life will insist that instinct alone supplied the impulse underlying the action, while others who think nature gives brain tissues to all forms of life for a like purpose will conclude that it is more logical to accept a seeming rational act as the result of something akin to what we call mental operation in humans.

Perhaps in the distant future when the mind of man becomes more potent and is able to delve deeper into the mysteries of nature, with a greater knowledge and understanding of the cells, tissue and organs of all forms of life, the mooted question will be given a solution acceptable to all students of nature.

On the occasion of a visit to Deerwood, a country retreat of ours in Mendocino county, I found the same species of Carpenter bee as that last mentioned numerously represented about the grounds of a summer home there. While observing their operations I noticed that all the holes made by the bees were uniformly in the softest wood to be found about the place, and their work showed that they were not only able to pick out the soft



DEAD TREE STUMP SHOWING OCCUPANCY BY CARPENTER BEES.

from the harder wood, but were able to recognize and select the softest part of such wood in which to operate.

Unlike the hive or domestic honey bees, with their queens, workers and drones, there are only male and female Carpenters; and unlike the bumble bees, of which only the females survive the year, both male and female Carpenters hibernate during the winter and come forth in the spring and prepare for new families. However, it is the female that does all the work. She selects the places and bores the holes in the dry timber and makes the tunnels therein as well as the cells for the baby bees. She, too, alone gathers the pollen and nectar from flowers to store in the cells as food for the babies when hatched. I watched the actions of male bees for hours and about the only activity they engaged in was hovering around flowering shrubs, maintaining, as a rule, a distance of about 20 inches from the blossoms and engaging in combats with other male bees of the species when they came around. Females were allowed to go to the flowers without much interference. The males would dive at them once in a while but would not follow them up and exhibit the vicious disposition manifest in their dashes at other intruding male Carpenters. I could only reconcile these actions as being their manner of mating, considering the good sense and sound judgment these insects showed in other habits.

As stated there were quite a large number of bees of the species about our place, considering the fact that this family of bees is not large. Sometimes as many as a half-dozen females could be seen flying about the porch examining the dry timber of its construction, and as many, or more, could be seen working among the flowers. And more females than males were always in evidence. I found no small interest in following the female bees while they were in search of a nesting place. Perhaps I should have first stated that the bees do not excavate new holes other than when compelled by force of circumstance, but use the old holes over and over. In fact, I did not see them make a single new hole. Up to the time I left the bees seemed to be able to find excavations made by previous generations and old auger holes in posts in sufficient number to supply all their requirements. As an example of the thoroughness of their search for apartments to save the labor of construction I will mention the actions of one female. She commenced at one end of the porch on the south side of the house and passed along examining each post from top to bottom on all sides, not overlooking the rail fastened to the posts under the eaves of the porch, as well as taking an occasional trip to scrutinize the boards of the underside of the roofing. She did all this

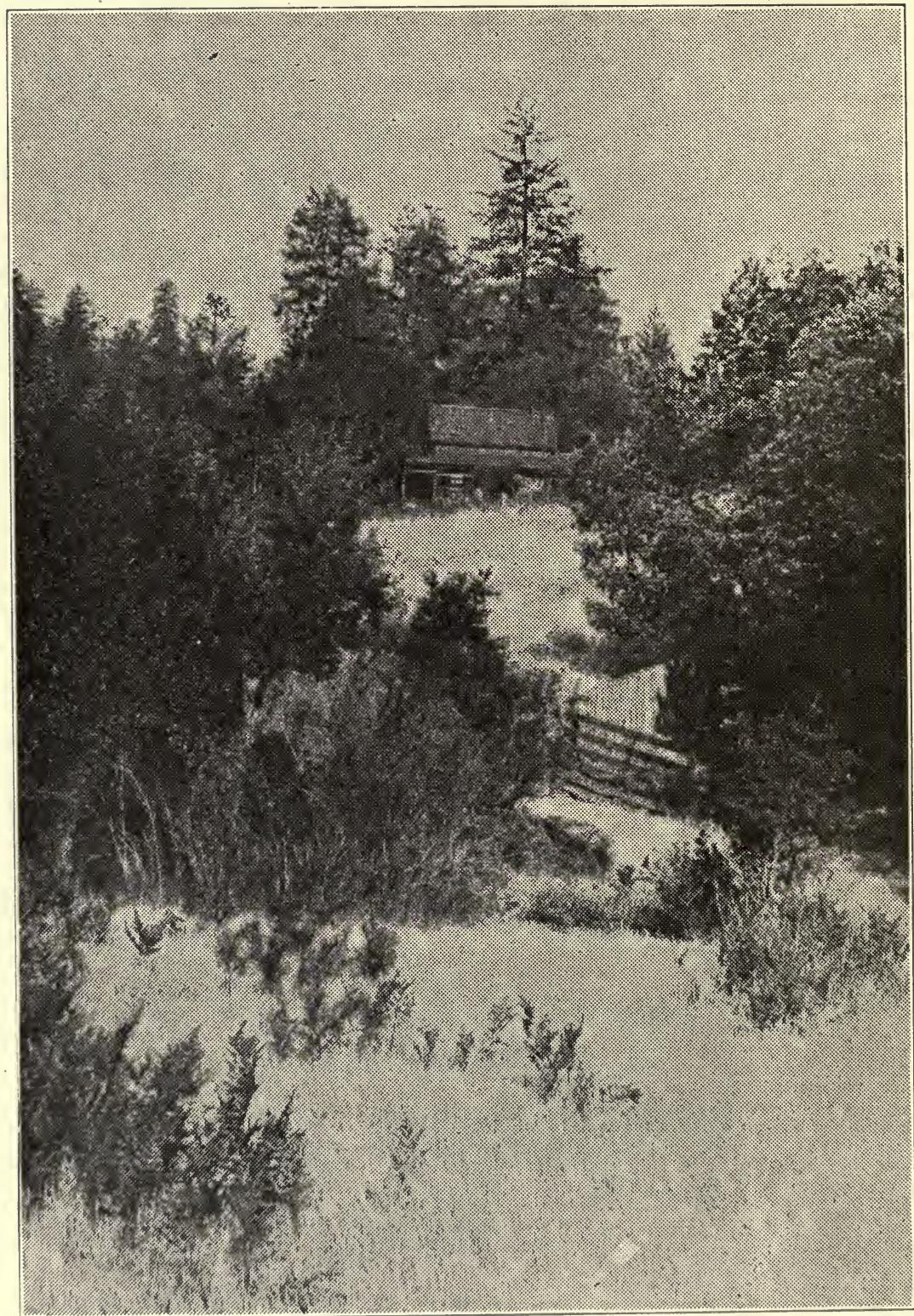
work mainly on the wing, stopping once in a while to give closer inspection of some depression in the wood. Similar inspections by other Carpenter bees were constantly going on about the premises during the warm hours of the day.

There were a number of bee holes about the place, but none of them showed any indications of having been made this season, though in one case the inmates gave some time to enlarging an excavation or extending the tunnel; chips and fine particles of wood were occasionally ejected from the hole. In one instance I saw a bee, after hunting some time for an apartment, stop on a dry board and start to bore a hole. She made slow headway and after working four or five minutes she abandoned the work. In that time she had excavated a place less than a thirty-second of an inch in depth and in circumference but little larger than her head.

All the old holes seemed to be occupied by the early-comers and the inmates were busy carrying pollen and nectar into them. When the late-comers, in their search for quarters, would come across one of the holes, which by the way was a matter of frequent occurrence, they would generally stop and go part way in as if to inquire "Is this place occupied?" Finding it tenanted, they would back out and continue their search.

At evening time, when the air begins to chill with the disappearance of the sun, the bees that had nests, or holes, retired to them. The females not yet supplied with such quarters, together with the males, seek a cavity of such form as will afford them protection for the night. In a large redwood post standing in the rear of our place there had been bored through it two holes five-eighths of an inch in diameter. These holes were popular places of resort for the night. It was surprising to see the number of big bees that would crowd into one of the holes. As the holes were bored through the post the bees made use of the double entrance to the lodging house. They would crowd in until the unique apartment was filled to the doorways.

This particular Carpenter bee enjoys a wide range of habitation, especially in the way of elevation. I found the bees active in their nesting operations at several places on the floor of Yosemite Valley in the early part of June. There the elevation above sea level is about 4000 feet, while the elevation at Diablo does not exceed 500 feet, and that of Deerwood 1200 feet. The snow, frost and ice that occupies the famous valley during the winter months, which is not experienced at the other places, does not appear to have any influence in shaping the life history of the bees there differently from that of their relatives which pass their lives nearer the sea level in a much warmer winter climate.



DEERWOOD.

CHAPTER VII

IN THE WILDS OF MENDOCINO

A Retreat in the Redwoods. Its Birds and other Animal Life. Details of Peculiar Habits of Bees and other Insects

Deerwood is the name we gave to a little country place, belonging to a member of my family, located in Mendocino county, twenty miles or so northwesterly from Cloverdale, in the world-famed redwood belt of California. The location is made more attractive by reason of its situation on the banks of that beautiful stream known to trout fishermen throughout the country as the Rancheria. The property embraces a broad but short canyon opening into the narrow valley or canyon of the Rancheria. With its gentle sloping sides it is suggestive of a grand and huge amphitheater covering between eight and ten acres in area. The greater part of the floor is under cultivation and dotted with trees that in their seasons supply us with the most perfect and delicious fruits. On three sides—south, west and north—the towering wall of the redwood and fir forest forms the margin of our nook and not only lends a feature of grandeur to the site but by its protecting height shelters us from the severities of strong winds. Our amphitheater with its open side to the east gives us a vista up the main canyon for a distance of a mile or two until obstructed by the densely-wooded mountain range whose steep sides form the east side of the canyon of the Rancheria. The dwelling we occupy upon our occasional visits to Deerwood is situated on the elevation of the back part of the amphitheater, affording us an advantageous point from which to enjoy this beautiful landscape, embracing numerous representatives of the trees famed in the flora of California — the oaks, white, black and the evergreen; the shapely laurel, the handsome madrone, maple, ash, and alders. The view is varied by open sections of green carpeted spots, enlivened at times by the presence of cattle or sheep and not unfrequently by deer. Besides there is a glimpse of the running waters of the Rancheria, its gravelly bed and willow-lined banks, to add to the charm of the picture.

When I contemplate the beauty and varied quantity of wild flowers and ferns to be found here together with the great number of birds, including the sweetest songsters whose delightful music fills the air from the first break of day to twilight, and numerous other forms of life whose habits and characters make a study that widens our vision of things and opens the doors to some of the wonders of Nature. I feel as if this was one of the spots where the Almighty ruler of the universe had chosen for an earthly temple wherein there

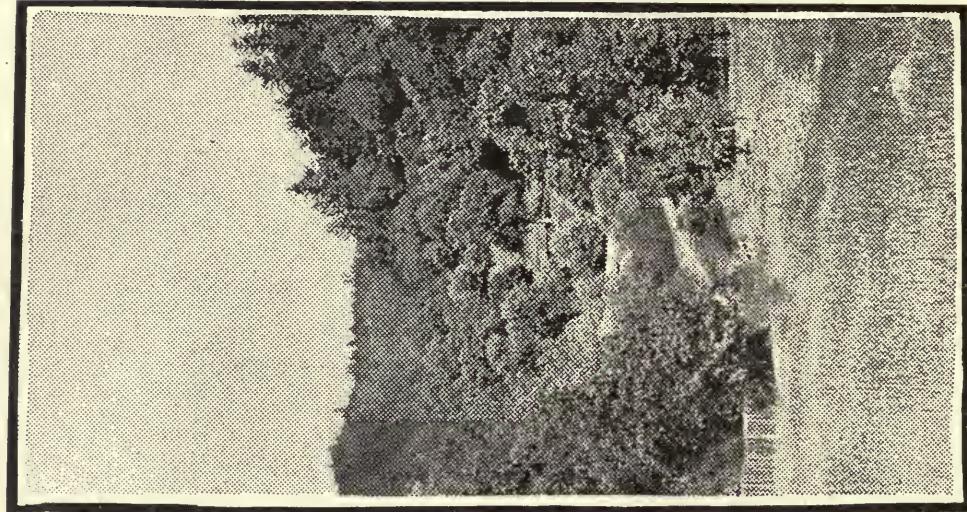
was gathered in the springtime of the year examples of His most beauteous work, for the people who find pleasure in association with them, as well as for the education of students of Nature who would know more of His laws, the knowledge of which gives a fuller insight of the purpose and utility of all organic life and of those relations that make for the betterment and greater comfort of all mankind.

It was in this environment that I passed two weeks and more of the latter part of April and the first of May, and I now propose to relate some of the things that came under my observation that interested me and may possibly be a source of interest to others.

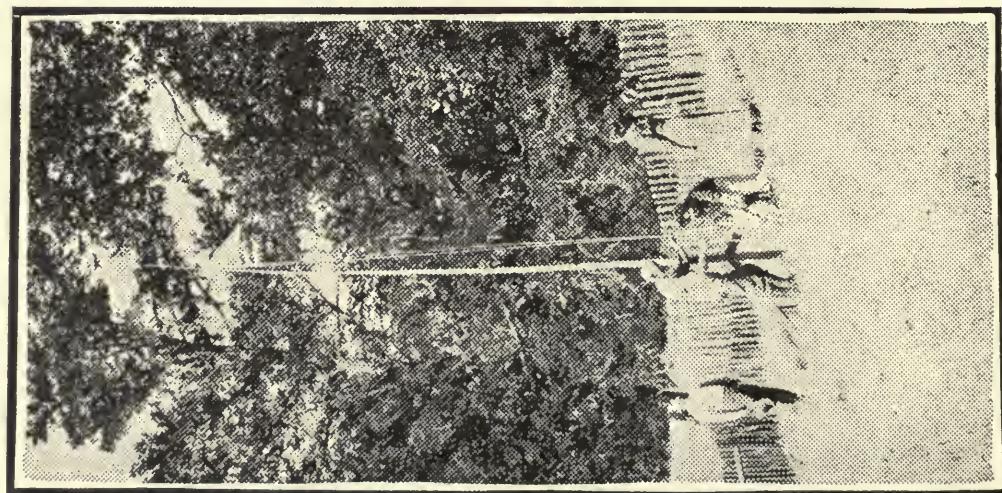
In our amphitheater were more birds than could be found in any neighboring sections. In the course of two or three days I noted twenty-six different species. The greater part of this number were observed from my comfortable seat on the porch of our dwelling. No doubt I could have increased the list if I had given the time for search among the trees and undergrowth of the grounds for the more shy kinds. The popularity of the place with the bird life was probably due to the fact there were less of their natural enemies in the area occupied by the house and orchard, the greater amount of sunlight in the opening (much of surrounding country being densely wooded), and the greater abundance of food in the way of seeds and insects.

The list of birds included a majority of the best songsters we have in our state and while daylight lasted their sweet, joyous and musical voices could be heard at all times, but it was in early morning and at the close of day that the singers seemed inspired to fill the hour with their best and most choice selections. Especially was this so in the evenings when the grossbeaks perched on the topmost branches of the trees, the linnets about the house, the little wrens in the rosebushes, song sparrows in the willows nearby, orioles in the treetops, and the russet-back thrush in a neighboring canyon, were the principals in these grand concerts, most delightful to the ear and soul-inspiring.

This was the height of the nesting season, when the birds were mating and building their nests, adding further interest in the activities of our feathered neighbors and associates, for they were about us and with us all day long and day after day. The other morning a little coon-faced chickadee flew onto our porch and was hopping about in search of nesting mate-



LOOKING OUT THE AMPHITHEATER, DEERWOOD.



FLAG-RAISING AT DEERWOOD.

rial, picking and pulling everything that might yield a thread. In the course of its search it came within two feet of my position, showing no fear in its anxiety to find just what was wanted or needed in the construction of its nest. The next day it made a visit in as familiar manner to the kitchen part of our premises, where it was more successful in its search for strings. Its squeaky, little chirps in keeping with its diminutive size seemed like notes of joy and contentment.

Two pairs of wrens were nesting nearby. One pair occupied a hole in an oak tree that shaded the house. The location of the other pair I was not able to discover. One of these couple had selected the fire-box of our cooking stove before our arrival and had a nest well along in its construction when our necessities compelled them to seek another location. The stove's place is on the back porch and the little birds found entrance by the hole made for the pipe of the "waterback," removed when the stove left civilization. This species of wren is known in ornithology as the Vigor wren, *Thryomanes bewickii spilurus*. They are restless little creatures, and can be seen and heard singing about the house at any hour of the day.

For several days a black-throated gray warbler (*Dendroica nigrescens*), a bird somewhat smaller than the wren, with not quite so long a foreign name, was a common visitor to our front yard, where it gathered material for its nest. After securing the particular thing it wanted it would fly to a scrub oak about ten yards away. Consequently I concluded there was where I would find the nest if I wished to inspect it later on. But subsequently I discovered that the flight to the oak was deceptive; that the bird went out on the opposite side and then flew to a thick manzanita bush where it had built its nest. This bush was so located on one side that a direct flight to it from our front yard was but a few feet more distant than the flight to the oak. I leave it to the reader to determine whether or not the warbler in taking the course it did was not trying to conceal the location of its nest-building operations.

While the linnets, or redheads, were among our most numerous visitors, I noticed only one nest and that was in the attic of our house. The nest was built in one of the rooms where a corner of heavy wall paper was torn away from the wall, making a projection and support. As this part of the dwelling was not used or occupied by our family we did not dispute the bird's preemption of the premises but left it to rear its family in peace and the security from natural enemies the spot afforded. How did the bird enter this part of the house? This was the first thing that came into my mind when I discovered the nest. Upon looking around I saw a pane of glass missing in one of the windows. Subsequently I saw the linnet make use of the opening.

At no other place in the state did I ever see so many grosbeaks as were to be seen at this time in and about our amphitheater. As mentioned elsewhere their melodious warb-

lings, trillings and whistlings were to be heard from morning until night and were so musical and sweet that it never became tiresome. There was one singer that spent the greater part of the day on the topmost branches of a large madrone tree not more than sixty yards from the house, that seemed to be a superior songster. He possessed a greater range of changes in his song and his execution of trilling and soft whistling notes, in which he indulged more at evening time, was not equaled by any of the other singers occupying other tree tops thereabouts. This fine singer was one of a pair building a nest in a young oak tree near the house. However, it was the lady of the household, as in some families of the highest order of life, who was doing all the work of constructing the nest. If the male member had contributed a straw, twig, string or anything for the cradle the mother required for her bables, the act was not witnessed. If he had done so perhaps we should have been denied the pleasure of much of his song. In his own defense he would have probably declared he could not render classical music and work at the same time.

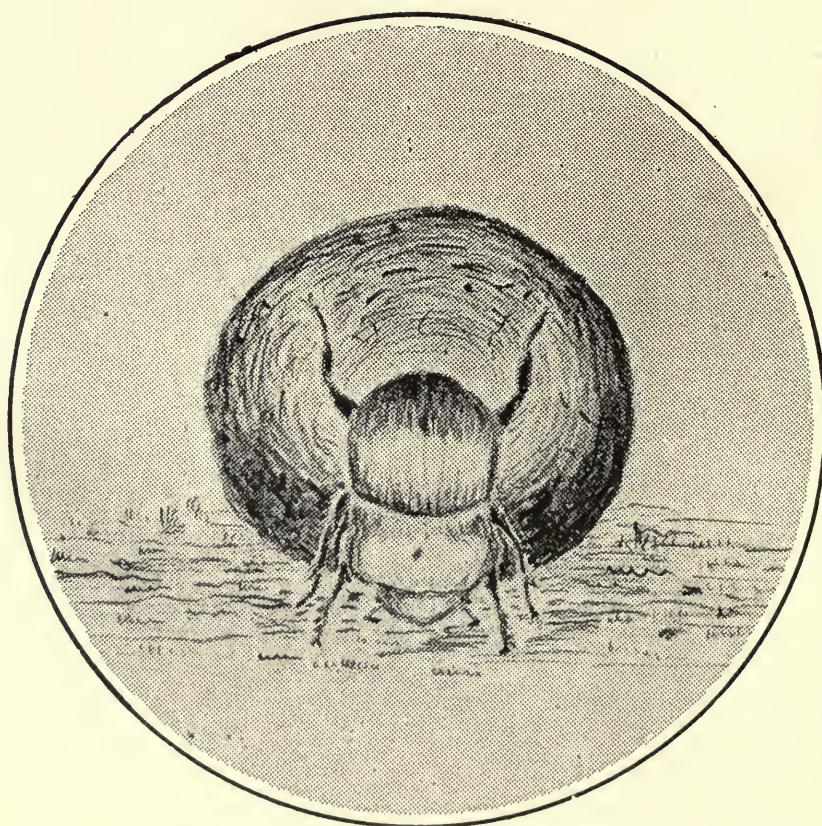
A valley quail selected a place within 60 feet of our back gate for her nest. Under a bunch of dry grass, that would not ordinarily attract attention, she had shaped a place to hold her brood of eggs. When we first discovered the nest by nearly stepping on the bird only one egg was in it. But nearly every day the mother bird returned to the nest and deposited an egg and on the day of our departure for home there were six eggs in it. The call the mountain quail makes in the mating season was frequently heard by us from the adjacent woods surrounding our place, but the birds are so shy that we have seen but one pair, though from the noise they made one would think the "woods were full of them."

Enumeration of the species of birds to be found here will vary but little from the census of bird life of other wooded parts of Central California. I missed here the presence of the mocking bird that I have seen on the Pleasanton ridge, Alameda county; on Mt. Diablo, and in northern Mendocino; also some of the warblers and sparrows common to the first two districts mentioned. But what we lacked in variety was made up by quantity.

Of the four-footed forms of animal life common to this section deer were formerly most prominent. Up to three or four years ago one could not go more than a few hundred yards in any direction from our place without expecting to come across one or more of these beautiful animals. But now the automobiles having made all distant hunting grounds more accessible and with the greater number of hunters by reason of the rapid increase of the population of the state, the number of deer has been greatly reduced, also the possibility of seeing one in our rambles. Though one day on this trip while out whipping the Rancheria for a mess of trout a doe and yearling came down into the bed of the stream and stood for some little time on a



HOUSE AT DEERWOOD.



TUMBLE BUG ROLLING ITS PILL.

gravel bar about 60 feet away. As long as I remained motionless they gave no attention to my presence. But evidently they "sniffed danger," for they held their heads high, nervously flipping their big ears and looking first one way, then another. However, when I made the first step they were off like a flash, the little one quickly passing the mother, into the brush that hid them from further view.

Another time while fishing on this same stream in a large pool made dark by over-hanging treetops I saw a mink come down the bank on the opposite side. At the edge of the water it stopped long enough to look around, and then to my great astonishment took to the water and swam directly towards me. As I stood in the margin of the pool when the mink landed on my side it was on top of my right foot which was in position for a strong kick, which was made with enough force to land the animal half-way across the pool, into which it fell with a splash. In all probability the spell of astonishment was transferred from man to animal by the act. At any rate it was so thoroughly convinced that it had come into sudden contact with a superior force that it did not come to the surface of the water again but swam like a fish to a retreat on the other side.

The handsome, big, bushy-tailed gray squirrel must, like so many other forms of life, find this place well adapted to its needs and comforts for the species is well represented. On warm bright days it was no trouble to see one. In fact it was not uncommon to see them running along the top of the fence about our dwelling. Their friendly visits extended even to the roof of the building. One afternoon while sitting on the porch I heard a squirrel on the roof overhead. I whistled softly and it soon peered down at me over the edge of the roof. Apparently not satisfied in its curiosity, it came down to a board fastened to the porch posts about six feet above my head and after full inspection of me it leisurely hopped along the entire length of the board, then returned to the roof. I think it would be no trouble to make them so tame they would come for food and be pets about the place.

As might be imagined from the description of the country, formerly coons, skunks and other objectionable animals were also very numerous hereabouts, but the very high price at which their pelts sold during the last year or so incited every man and boy in the country to trapping, and as a result very few of these animals remain to represent species once so common. The destruction of these animals, especially the skunks, will in all probability be of advantage to brooding quail, as there are so few left to destroy the eggs or the young birds after hatching. Therefore there should be a corresponding improvement in the numbers of these handsome game birds. An event quail hunters will hail with delight.

In the matter of wild flowers I know of several districts of the coast section of the State where a greater variety prevail, but I know of no place where native flowers that find representation grow to greater perfec-

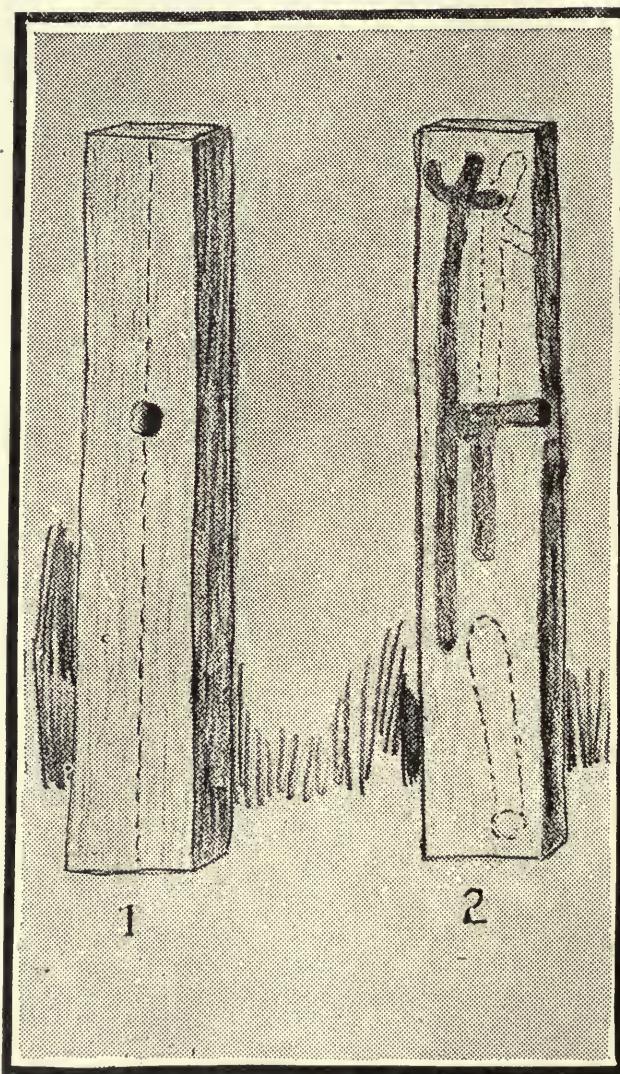
tion and beauty. This is particularly true of the iris, which is to be seen almost everywhere. The creamy white species *Douglasiana*, are extra large. I found some specimens that measured nearly five inches across; four and a quarter inches were very common. Great clumps of varied shades of the *Macrosiphon* were not uncommon. Beds of baby-blue-eyes, and delicate tinted violets were common enough to satisfy the most sentimental lover of flowers.

The grass covered slope of a half acre or more in front of our house presented a beautiful sight for nearly a fortnight. It was mantled by a mass of bright yellow poppies, blue-eyed-grass, brodiaeas and other flowers of lesser prominence. The effect of the colors of these blossoms was suggestive of the Blue and Gold of our university. I will not dwell longer on the subject of flowers other than to say the profusion of blossoms had attractions for some of the lower orders of life as well as for the highest. The flowers together with the warm and pleasant weather brought numbers of various kind of insects and it is of the doings and habits of some of these neighbors I propose to give a few interesting details.

Let us begin with the bees, for their life history, generally speaking, is inseparable from flowers, and they were present in greater numbers than any other single insect family. Nearly every genus of the Bee family was represented in our amphitheater from the big, burly bumble bee to the most diminutive form of Halictidae, not more than a quarter of an inch in length. Of course the bees I am writing about are wild bees. I never have seen a beehive in this section of country, but hive bees that have gone wild are quite numerous. Though, as I have said, that bees of nearly all kinds that are common to this section are in evidence and seemingly very busy in their employments, very few of their nearest relatives, the wasps, are around yet. The time I am writing about is the last of April; in another month, however, the wasp family will outnumber the bees.

The first bees to attract my attention on this trip were the big, Carpenter bees, *Xylocoopa*. In the United States there are several species which vary in size, but so far as I can learn the habits of all are much the same. The females of the two large species that I have seen on the Coast are entirely black, while the males of one species are all yellow, and in the other the males have only a yellowish thorax with black abdomen. The former of these are the largest, or the giants, of the bee family. These I saw on the Colorado desert. It was members of the other species I found so numerous here.

In tearing down a small structure we found a 3x3 split redwood post, the upper end of which for a distance of twelve inches contained several holes made by the Carpenter bees. I cut off the perforated part and split it open, revealing the tunnels, shafts and raises, connected with the entrances bored into the sides of the post. From the



BEE TUNNELS.

Sketch to represent a piece of split redwood post, 2 by 4 inches, a foot in length. No. 1 shows the stick before being split at the dotted line, with the entrance hole on that side. No. 2 shows (in black) the tunnels, shafts and side cells made by the Carpenter Bees, from the entrance shown on No. 1. The dotted lines indicate other excavations for nests, with entrances on the opposite side of No. 1.

highest to the lowest part of this internal work the measurement was almost thirteen inches. The inside excavations were all connected, whether by accident or by design, must remain a matter of speculation until we have some evidence that will settle the question.

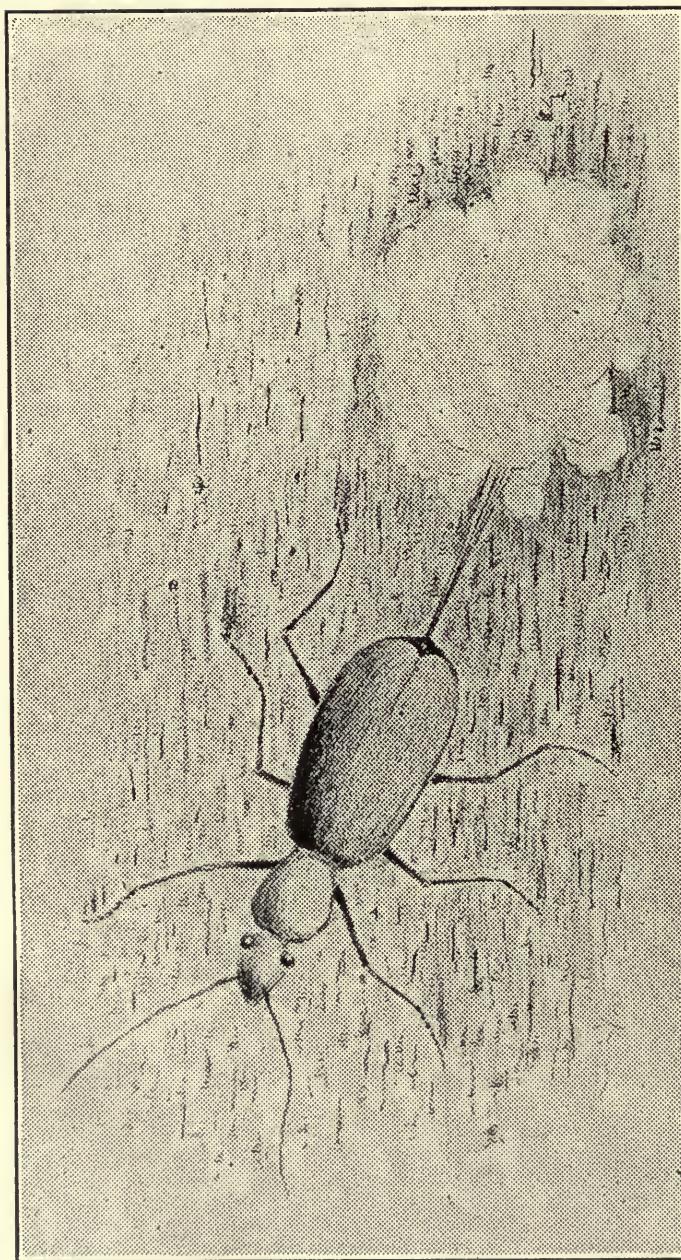
While the diameter of the excavations in the post justified the conclusion that the work was that of the Carpenter bees, the foreign material found in a section of one side excavation showed that Carpenter bees were not the only kind that had made use of a portion of these quarters to raise their young. In a cavity exposed by the splitting of the post there were six partitions made of clay dividing it into as many cells, or rather they were parts of partitions, for they had been broken through by the insects hatched in the cells after reaching the stage of maturity. In the last cell I found the remains of two small black bees. There was enough of the desicated bodies of the insects left to enable one to identify the remains as being those of bees and to suggest the probability that they were of a genus known as *Osmia*, which is quite numerous in this section of our State. I recovered a wing in perfect form and an examination of its venation confirmed the conclusion as to the species. It is also characteristic of the *Osmia* to utilize hollowed out places made by other agencies than themselves for nesting places. How they managed to pre-empt a section of the Carpenter bees' apartments and hold it against their big, overgrown relatives is a mystery. The latter may have tolerated the little bees, or possibly the last mentioned may have occupied the place late in the season when Carpenter bees were not using it. However it may have been, the little bees showed their disposition to avoid hard work by preempting the old cells. When there are no ready-made places for nests to be found by the small bee it excavates the pith from elderberry bush stems, or like pithy growths. The desire to shun the work of excavating in wood, or pith, by both species of bees mentioned is hardly reconcilable with the theory of those writers who insist that such insects act only under the impulse of instinct. Their idea is that nature has endowed these lower forms of life with an instinct that impels them to perform certain acts in a particular way at certain times, filling out their cycle of life, and for this reason they cannot execute any of the requirements in their life history in a different way. According to this theory the Carpenter bee being endowed with instinct that directs it to bore holes in dry wood for nesting it would be expected that these bees should be found boring holes for the purpose instead of insidiously hunting for a hole made by some more industrious bee, or other agency, the year or years before, an act that seems to indicate some reason and judgment and the possession of dislike for laborious work, a disposition so commonly manifested among the human kind.

The *Osmia* according to Sharp is one of the most important genera of bees in Europe. The famous entomologist of France, H. Fabre, gives much space to the doings of these bees in his writings so popular the world over.

Anthidium is the name of another small bee noticed at Deerwood. We discovered it while in the very act that has given it the name of "wool gatherer." The bees were engaged in stripping off the wooly substance, or pubescence, of the underside of leaves of wormwood plants. It was very interesting to watch them in the operation and note the thoroughness and dexterity they showed in shaving off the so-called wool. The insects did the work with their mandibles, which are broadened on the ends and bear minute saw-toothed edges. The shaving was rapidly done with a cleanliness and smoothness that would excel the operations of some barbers. The wool as it came off the leaves was tucked under the chins of the bees and rolled into the form of a ball and held there with the aid of the fore legs. The shaving operation continued until a bee gathered a bunch as large as a small buckshot and would then fly away. Some observers say "this wool is gathered to line the cells of the nests they make in excavations made by other insects." The cells made one on top of another are filled with pollen and honey for food for the larvae when hatched from the single egg deposited in each cell. We were not fortunate enough to find any nest of these little members of the bee family.

However, it was while watching the actions of some bees in the vicinity of the operations of the *Anthidiums* I suddenly discovered that I was sitting on the ground in the very midst of a whole colony of bees, finding many more nests in a smaller space than I had ever seen before. Fortunately for my comfort the bees were too small to be able to or so mild mannered they did not, resent my intrusion into the place of their habitation in the manner so painful and common in the actions of the large species of the family under like circumstances.

Soon after getting down on the ground I saw several little bees flying closely about me, but being among some wild flowers and grass I thought these were the attractions. Finally I became interested in the little fellows and concluded to watch and find out if possible what they were doing there. I soon noticed one disappear down among the grass roots, but it did not occur to me that the bee had gone down into its burrow until I had noticed two or more disappear after alighting on the ground. Closer examination disclosed several mounds of finely pulverized earth at the entrance of the burrows. On some of these I had been stepping, besides in moving about I had tramped and mashed down much of the grass and flowers covering the restricted area occupied by the bees. It was a triangular piece the three sides of which were not more than three feet in length. Over this I now saw maybe fifty, or more, bees hovering and flying in slow zigzag manner. The



BOMBARDIER BEETLE.

Found in some parts of California—that explodes a "bomb" in the face of an enemy when attacked. (Enlarged five times).

meaning of this gathering was soon explained. Individual bees returning to their burrows were unable to locate the places by reason of the disturbance of the landmarks, i. e., the grasses and flowers, and were flying slowly about trying to find their homes. Soon the place was alive with the distracted insects, some of them alighted on the ground and searched for their burrows. A few were successful. As I could not restore the landmarks or in any way make amends for the damage done I left them to themselves.

While watching the actions of these little bees it was easy to interpret their confusion. The grass stalks and flower stems, before I had crushed them down, were as familiar to them and were as much landmarks to them as would be to us the trees about our place. Once in a while one little bee would rise higher in its flights as if to take observations of the greater landmarks indicating the position of the colony; then apparently convinced it was at the right spot, would resume its search among the flattened and twisted grasses. I did not have the heart to commit further outrage upon the colony by using a trowel, or in other words dig up their burrows for information as to their nesting habits, which I concluded was obtainable in some of my books. These bees are the smallest of all those that burrow into the ground and average about a quarter of an inch in length. They belong to the genus *Halictus*. Their congregation into communities and arrangement of their homes—apartment house fashion, several families in a burrow—as Comstock says—is one of the peculiarities of the little fellows, unknown with other genera of the bee family.

All bees, of which there is said to be fully fifteen hundred species including the hive, or domestic bees, eat or depend exclusively upon vegetable food in some form, while members of the wasp family may feed on both vegetable and animal matter. With bees their food is ordinarily in the form of pollen and the nectar extracted from flowers. The pollen that is gathered for the use of the nestlings is carried on a certain part of the posterior pair of legs by some kinds of bees, under the abdomen, and on the thorax behind the wings by other species. The nectar, converted into honey, gathered for the same purpose, the surplus of which finds its way as a dainty dish on man's breakfast table, is swallowed by the bee. According to David Sharp the nectar passes down the throat of the bees as far as the crop of its alimentary canal, into what is called the honey sack, and at the hive, or nest, is regurgitated. In the process the nectar of the flower is converted into honey, supposedly by the contribution by the bee of some glandular secretion. The male bees carry no pollen.

The young of the social bees are raised in the abode of the parents and are fed after the manner of baby birds by the workers of the hive, or nest, but with the solitary bee the parents and young never see each other. The female, according to the species of which she is a member, finds, or makes, a suitable place to construct a nest. It may be a crevice in the rocks, or a hole excavated in wood, the

earth, or the hollow of some pithy stem growth. In such a place she makes a cell, stores it with pollen and honey, lays an egg on the food, after which she closes up the cell, then completes a few more cells in the same way, one on top of the other. When this undertaking is finished the mother bee, except in the case of the little carpenter bee, shows no more interest in the nest or its occupants.

A most wonderful provision of nature for preventing the fouling of the food of the young bee by faecal matter while it is in the larval stage and confined in the cell is that the posterior part of the alimentary canal does not connect with the stomach until the larva is about ready to pupate.

The near relatives of the bee family, the wasps, were still in their winter retreats, with very few exceptions. The wasp must have warm weather. While the days were warm the nights still bore a frosty air. Now and then a representative of the *Polistes* could be seen flying around in search of material with which to build a nest, or for food to supply its needs following a winter's fasting. These are the slender black and yellow marked wasps that build open inverted nests under house eaves, sheds, rocks, etc., and catch various kinds of insects which they masticate and feed their young. Four or five specimens of a species of the *Sphecidae* family were seen on the warmest days flying up and down the road with occasional excursions into the grass bordering the roadway. This wasp when nesting digs a hole in the ground in which it places a grasshopper for food to supply the larva from a single egg when hatched. It is a very interesting sight to watch the operations of these wasps engaged in making the nest and stocking it with food. In another chapter I have given the details of the intelligent actions of some of the wasps while occupied in this work which I had the good fortune to observe on two or three previous occasions. At Deerwood, however, the *Sphex* had not yet commenced the serious work of their lives. I spent much time following their flights and their actions when on the ground, but so far as I could discover the wasps had no particular object in view other than to enjoy the warm sunshine. I had hoped to witness their actions in capturing a grasshopper, which usually is much larger than themselves. The grasshoppers were about but their presence was ignored by the wasps. The summer and fall in which to work was yet before them, and as the making of a nest and stocking and closing it up after laying the egg is the work of only a few hours or days at the most, they probably reasoned that there was an abundance of time ahead in which to perform the hard work nature demanded of them, and until it was time to begin work they would pass their days in ease—as I saw them. How many nests one of these wasps constructs in the course of a season no one seems to have yet discovered. It must be quite a number, otherwise the species would not persist, for the nests are subject to destruction by reason of

their locations, and quite a large percentage of their larvae become the victims of parasites.

In season Deerwood is one of the most popular places with the yellow jackets, *Vespa Germanica*, and the so-called hornets, *Vespa Maculata*. The latter are larger than the former and are black marked with white. They are rather vicious in disposition and it is well to give their nests a wide berth. One of their habits is making game and food out of their cousins, the yellow jackets, which our folks last fall were disposed to regard as a redeeming feature in the character and reputation of the white-faced hornet, owing to the great number of the yellow jackets that persisted in obtruding themselves about the house, provender and cooking. Up to the time we took our departure from Deerwood at the end of the visit of which I am writing, not a single specimen of yellow jacket or hornet had put in an appearance. However, in a very short time they would have outnumbered the bees.

Nature has a time for everything in insect life. Some particular kinds appear early in the year and pass through all the changes that characterize their career of life and are seen no more until another year rolls around; some are with us, objectionably so, from early spring to late fall; while others follow along in the order of their adaption to seasonal and food conditions, go through the routine of the existence of the species, and disappear. Similarly the activities of the majority of insects are confined to certain different hours of the days. Some confine their operations to daylight hours, while many are exclusively nocturnal in their habits, and remain hidden away during the day. Even of the daylight species, some are to be seen at certain hours only. Some waiting until the air is warmed by the morning sun, some that are active for only three or four hours in the middle of the day, while there are others that do not show themselves until the shadows of the setting sun are elongated over their habitations, or the sun itself has disappeared below the horizon. One of the exceptions to these features in insect life is the mosquito. It is always with us in the vicinity of water suitable for the propagation of the pest.

"Tumble bug" is the name commonly applied to certain species of Scarabaeidae that are quite common in the United States, and many other parts of the world. It gets its common name from its curious habit of rolling little balls of animal excrement along the ground to some place suitable to its purpose where it buries it. Some authorities say the ball is for its own food, others say it is a provision for its larvae. Perhaps both are correct. The tumble bug is a chunky little fellow, and like many other members of the Scarabaeidae family is almost as broad as it is long. They vary somewhat in size. Much has been written about the habits of this group of beetles, but the statement of some of the observers do not always agree. Fabre, the famous naturalist, gave much time to the

study of their habits and some of his most interesting writings relate to the life history of these beetles. He says that at first they procure and bury this peculiar food for themselves, storing enough under ground to last them through the hot days of summer, where they quietly remain during that season, emerging again in the fall to store a larger underground chamber with dung as provender for their young.

I had the opportunity of watching the operations of members of this particular kind of beetle at Deerwood one afternoon. The species was identified as *Canthon Militarus*. They were little fellows about three-eighths of an inch long. A day or so before a drove of sheep had been driven by the place where we found the beetles. It was droppings from these sheep that three beetles were rolling along the hard ground, all going in the same direction, apparently, as it afterwards appeared, to a spot where there was some rather loose sandy soil. The sheep droppings were spherical and considerable larger than the "bugs," and it was remarkable to note the ease and speed with which they moved the load along. Each of the three beetles had a ball, but on one, which I will refer to hereafter as Number one, was a motionless beetle, firmly clasping the sphere with all of its outspread legs. The movement was given to the balls by the beetles standing on their front and middle legs, walking backwards, pushing and directing the load with their hind legs and feet. Where the ground was free from rock fragments and grass stalks, rapid progress was made and the rolling over and over did not seem to disconcert the beetle riding on number one, whatever the bug pushing may have thought about the extra work imposed on it by the beetle insisting on "dead-heading" it. Occasionally the push-beetle would stop, leave the ball and walk around it, as if inspecting the obstacles impeding its work. A few times it stopped when there were no impediments. Whether it was to rest or to examine the soil as to its fitness to bury the ball, who could say? However, afterwards I was inclined to think the stoppage was for the latter, for finally it came to the place with loose soil and there stopped and walked about the ball for a few seconds, never going farther away than an inch or so. Expecting it to resume its travels I was surprised to see it take a position alongside of the ball and commence to crawl into the earth. The bug did not dig a hole in which to enter but just forced its way down into the loose soil. It was soon out of sight, but I could see that it was moving still by the heaving of the surface of the ground for a space of about the diameter of a half dollar. Now the ball began to sink, which seemed to be the cue for the beginning of the actions of the beetle that had been motionless on the ball all this time. It suddenly slid off the ball and putting its hind feet against it quickly rolled the ball out of the pit that was opening to receive it, and then began pushing it away, and succeeded in moving it about 20 inches, where it was stalled by getting in among some broken

rocks. To me the transaction appeared a flagrant act of theft. Up to that moment I had looked upon the rider of the ball as being the partner of the one pushing it. However, the thought may have been unjust to the beetle, for in the beginning it may have been the original discoverer of the strange morsel of food and its action in clinging motionless to the ball might have been a strategic act to maintain possession of its property, defeating the purpose of a dishonest and stronger kinsman trying to rob it. Either way you view the matter, the action of the bug in quietly waiting until its opponent was far underground preparatory to burying the ball, then suddenly waking up and running off with the prize while the other beetle was in such position it could do nothing to retain it even if it knew that the ball was being taken away, was a remarkable display of cunning, call it instinct, or intelligence, or what you may.

The beetle having pushed the ball into a place from which it seemed unable to remove it, I picked up both the bug and ball and placed them on some loose soil. The beetle lay quiet simulating death for a few moments, after which it "dug in" where it lay, making no effort to take the ball with it nor did it return to the surface while I was there. I watched for the other beetle to come out during the hour I had the insects under observation, but it did not make an appearance.

The next beetle to come under notice was rolling a ball after the manner described in the foregoing. It had no contestant for ownership. It was rolling the ball in the direction of the same spot of soft earth to which the other beetle had rolled the ball of contested ownership. When number two reached the place, after overcoming several obstacles, making a few stops for rest or inspection of the route, it buried itself alongside the ball, and in the course of a moment or so the ball began to sink in the loose soil. It descended slowly as if it were a substance sinking in a fluid mass of a little less density, and finally disappeared. Like the Chinaman's description of the electric car: "No pushee! No pullee! It go all samee!"

Number three was discovered in a rougher piece of ground rolling its ball in the direction of the soft patch of soil. It was making very slow progress, but exhibited remarkable strength and good judgment in overcoming the difficulties met with. Its actions in what appeared to be stoppages for inspection of its surroundings were the same as described for the other beetles. After watching its slow progress for some time I picked up both beetle and its ball and put them down on the

loose soil. The little fellow immediately disappeared in the sandy earth but made no effort to take the ball below, neither did it return for it while I remained on watch. Seeing another of the beetles out on the hard ground rambling around as if in search of a ball I picked it up and placed it alongside of the ball abandoned by number three. The bug lay on its back as if dead for fully fifteen minutes. I then placed a leaf so to cover both bug and ball. After a wait of a few moments I removed the leaf and found the beetle on top of the ball clasping it with outspread legs and feet. It remained in this position eight or ten minutes, then slid off and burrowed into the earth, leaving the ball on the surface of the ground. I remained in the vicinity for a half-hour, but there was no re-appearance of any of the performers—the entertainment, to my great regret, was over.

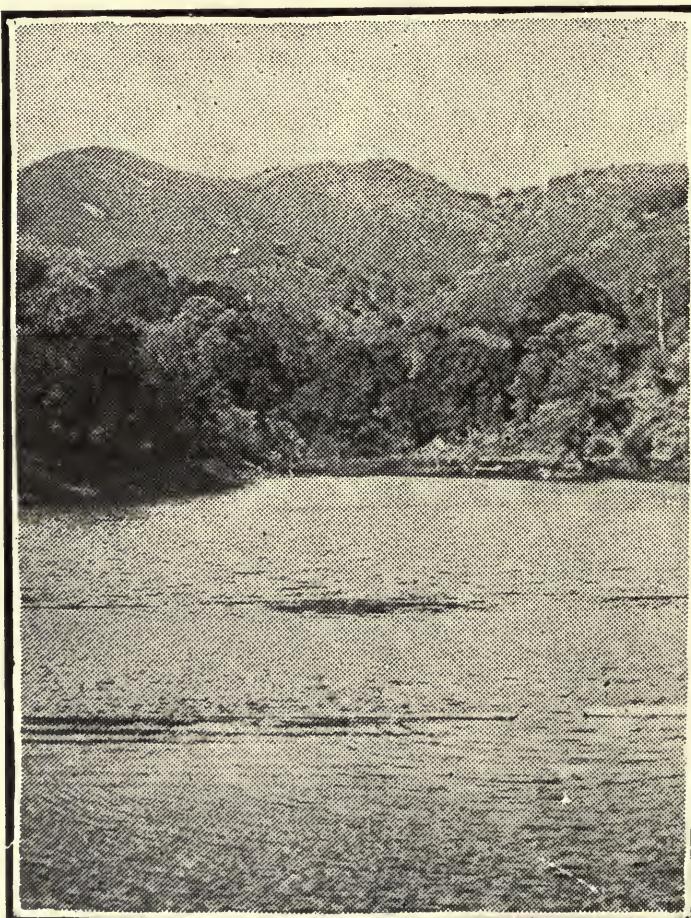
On an occasion of a visit to the dry bed of the stream flowing past our place in search of insects we found all the damp places inhabited by a small highly colored beetle known as the **Bombardier**. The wing covers were dark blue, while the thorax, head and legs were red. We saw none of them until we began to turn over the cobblestones; frequently as many as half dozen were found under one stone. They were extremely lively and it required quick action to make a capture. This would be the time when the beetles would display the remarkable peculiarity from which they obtained their name of **Bombardier**. As soon as one was caught it ejected from its rear end a jet of fluid which upon contact with the air turns to a gas and looks like smoke. As the change is followed by a tiny pop, the sound and "smoke" suggest the explosion of a miniature bomb. Some of the beetles were able to eject three to four "bombs" with almost rapid fire effect. The explosions were accompanied by a slight smell somewhat offensive. Observers who have dissected these insects say the fluid is contained in a little sack located at the hind end of the abdomen. It is used as a means of defense when attacked by enemies. For instance, when a larger beetle pursues it the **Bombardier** throws a "bomb" in its face, and in the smoke and confusion of the explosion sometimes finds opportunity to escape.

This beetle belongs to the genus *Brachinus* of the Carabidae family. There are twenty-six species known in North America. While some seasons they are quite common if you know where to look for them, at other times a search of their habitats will not reveal a single specimen.





VALLEY AT THE HEAD OF DIABLO CANYON.



LAKE AT LOWER END OF DIABLO CANYON.

CHAPTER VIII

DIABLO CANYON

Familiar and Strange Things of Interest Observed During a Day Spent Within Its Walls

While sojourning at the Mt. Diablo Country Club a beautiful spring day suggested to me that a walk up on the sides of old Diablo would not only afford pleasurable recreation, but where all plant life was stimulated by seasonal conditions to activities that gave freshness and beauty to the surroundings, and the bird and animal life of the mountain was to be found at its best, I should probably meet with something in Nature's great family and in the fulfillment and operation of her laws that would be new and instructive to me.

I will confess it was more the thought of the wild flowers, for the variableness and beauty of which Mt. Diablo is celebrated, that was uppermost in my mind when I started out on the trip. I chose the old road, which has been closed to travel for several years, as affording an easy grade up the wooded canyon, to the left of the Toll House, as well as being less frequented by the public, and where the thoughtless automobilists had not ravished the flowering shrubs by the roadsides, robbing them of their beauty in flowers and symmetry, or depopulated the bird life with the repeating shotgun.

Others with more imaginative minds and poetical thoughts than I possess have walked up this same canyon long before it became my privilege to enjoy its grandure and enchantments, and have given freedom to their enthusiasm and inspiration in vivid and prettily worded descriptions of its bowered nooks, tree-canopied trails, flower carpeted ridges, majestic rocky walls, crystal springs, soul-inspiring views and other features firing the spirit for mountain tramping and communion with Nature. This has been done so well and so frequently I will leave the subject of the canyon with the general statement that it is worth the while of anyone, who loves the hills of the Coast Ranges and has the strength, to walk through its entire length a distance of about two miles from the Toll House. Nearly every foot of the way has something of interest for the artist, for the student of botany, lover of birds, the collectors of entomological specimens, and fossil deposits for geologists. There is plenty of brush to crawl through, rocks to scale or clamber over, deep gulches and steep ridges, to make a day of as tough mountain work as one has ambition for. But all that can be avoided by keeping on the old abandoned wagon roadbed and following its turns and grade to the head of the canyon, where it intercepts the new toll road going up to the summit. The old road is shaded much of the

distance by the friendly branches of numerous oaks, laurels and maples, growing in the canyon and by the roadside.

I had made two or three trips up the canyon before and I must say I was somewhat disappointed in the variety and number of wild flowers met with, although I was prepared for it by the knowledge that dry winters mean absence in the following spring of many species of flowering plants. Yet I was hoping the mountain would do better than the neighboring range to the west, in keeping with its reputation, but as I have intimated, the variety was limited and the number far less than was expected. The amount of rainfall and the changes of temperature in the winter and early spring months determines the character of Nature's floral display in the spring and summer following. This fact was plainly manifested during a period of several seasons on the Pleasanton ridge, where I made a study of the wild flowers of that section. Some species of plants, like the sunflower, cyclamen, brodiaea, California poppy, tulip, pansy and about all that blossom in the early spring, could be depended upon to make their appearance every year in the same localities with little or no variation in numbers, while many others were wholly absent, or scarce or in profusion according to the season's rainfall and temperature. Among the plants noted as being so influenced by seasonal conditions were godetia, wind poppy, clarkia, eschscholtzia and larkspur. Some years patches on the hillside of some of these flowers were so thick and extensive they formed conspicuous spots in the landscape, visible miles away. Yet on the following season, because of too much, or too little rain or too much, or too little warmth, scarcely a representative of the floral profusion of the previous year was to be found. Every flower seed has its time for germination, some in the early winter and others along toward summer, and if the moisture and warmth of the ground is not sufficient to awaken into life the mysterious little germ it holds when that period approaches, then the seed must lay dormant until a season of favorable conditions comes along and gives it the assistance required to fulfill the purpose of Nature. Other seasonal conditions complicate matters, such as extended periods of drought after the sprouting of the seed and before the young plant has been able to send its little roots down into the soil, and the plant is killed. There may be other causes contributing to the intermit-

WILD LIFE IN CALIFORNIA

tent occurrence of wild flowers which a study of the subject would develop.

It is known among botanists and some students of our wild flowers that there is an epilobium and another flower belonging to the liliaceae that are frequently found in profusion in burned-over brush land or forest tracts. The former is commonly called Fire Weed. It is a purple flower and grows in other places, but it makes its greatest attraction in the burned-over areas by the mass of color arising from the thick setting of the plants. The other plant is commonly known as Bear Grass, Basket Grass and Squaw Grass. Its botanical name is *Xerophyllum terrax*. It is quite common throughout the Coast Range and is known as far north as British Columbia.

The plants look something like large clumps of bunch grass, but with broader and longer leaves, which turn outward with more graceful curves. It is said that the Indian women made their finest baskets with the leaves from this plant. The blossom forms on the end of a fast growing stalk and consists of a spike of closely arranged little cream-colored flowers. The stalk sometimes reaches a height of six feet or more, and continues to send forth new buds and flowers daily from the terminal end from the time it makes its first appearance above the surrounding leaves until it reaches its limit of growth. Nearly all the botanical books on the flowers of California describe the plants as blossoming only once in from five to seven years, and then dying, whereas it is claimed by some observers that it blooms, in the Coast Range at least, only on a section of country that has been burned over. However that may be, it is only on sections of redwood forest that had been recently visited by fire that I have met with the plant in bloom. In truth, although I had known the plant by commonly meeting it in the mountain for years, I was not aware of its flowering quality until I saw its blossoms in great profusion, acres of them, in a patch of Mendocino redwood country which had been crossed by a severe forest fire during the previous year. It was a remarkable sight. Yet you would not care to say it was beautiful, charming, etc., for the picture still bore too many features of the destructive work of the fire of the year before, but it was attractive and a subject fit for the artist's brush that can faithfully mingle the innocent and beautiful with the tragic and terrible. In the seasons following the years when the fires that traversed portions of the flanks of Mt. Tamalpais, destroying so much vegetation, the basket plants caused much surprise and comment among frequenters of the section, by the sudden change in its character, from little more than bunches of what appeared to be ordinary grass to very showy blooming plants.

Another thing that tends to confirm the opinion that it is the conditions of soil brought about by a forest fire that stimulates the plant into throwing up flower stalks is the fact that every plant to be

found located well in on the burned-over area is made to blossom. If it were the peculiar habit of these plants not to bloom until 5 to 7 years old then die, the plants in the burned district would not all be in blossom at the same time. Obviously the plants I saw in Mendocino could not have been all of the same age, yet all were in flower. Next year, or in the following season, upon visiting this particular burnt district I found numerous basket grass plants but not a single one in blossom, nor have I seen another flower there since, though several seasons have come and gone.

The discussion of this subject has by degrees led us away some distance from the locality of which I started to write, but I will take a short cut back, by mention of two or three of the plants and shrubs that seemed more conspicuous and attractive by reason of their beauty and variety, found on my trip through the canyon. One and the most common was the Red-osier Dogwood, *Cornus stolonifera*. This is a very handsome shrub and when covered with its clusters of cream-white flowers and yellow stamens is quite fragrant. Its branches and twigs of dark red carry leaves the upper surface of which are rich green, with pale green beneath. Its blossoms apparently were abundantly supplied with nectar, judging from the great quantity of insect life upon and about the shrubs. No less than four different orders of insects were represented by about a dozen different species. The shrubs in the canyon of Mt. Diablo were most shapely and grew to a height of eight or ten feet and would be ornaments in a private garden. Apparently the plant requires considerable moisture, for I did not find it anywhere at any distance from the bed or banks of the creek.

I had been told that the Western wall-flower, *Erysimum asperum*, was to be found in abundance in places on the mountain. As I had never found a specimen in all my rambles about Pleasanton and Livermore I was more than anxious to meet this stranger. Although I kept a watchful eye on the lookout for its occurrence in places favorable to its growth I did not find a single plant of it in the canyon, but while returning home by way of the new, or Toll Road, I found it in spots almost as thick as the mustard of which the wall flower is a very near relative. In fact a careless observer might not discover any difference in their appearance, but of course there is. The wall flower is larger and has a richer color and is very fragrant. It is said that it is found to vary from the yellow to orange and even purple in some parts of the south coast.

Another of California's showy trailing vines, much admired when in bloom, is the wild *Aleutianis*, *C. lasiantha*. The vines trail over the brush and rocks and their yellowish flowers of an inch and a half or more in diameter make a pleasing contrast to its dark green foliage. It is said that in some localities of the Sierra Nevada mountains as well as of the Coast Range at times the plants are so num-

erous and the flowers so abundant that they make the places conspicuous. In all my travels in the mountains I never happened to meet with such an occurrence. With the clematis I was almost a total stranger, so when I saw the pretty vine with its attractive flowers creeping over the top of a mountain shrub along the old roadside I was more than pleased, though at first I did not recognize it. However, a few moments of study of its peculiarities soon enabled me to identify it. For the last three seasons I had been looking for this particular plant. I do not recite these facts to question the accuracy of the writers who claim for it appearance so numerous in places, but it might be truthfully said those places are not common. It reminds me that while on a visit to Catalina Island I found two specimens of *Isomeris*, the only ones that had ever come under my notice. Later while exploring a canyon near Palm Springs, Colorado desert, I came across a couple more plants of the same kind. Up to this time I concluded this plant was exceedingly rare even in Southern California, its home; but it was a conclusion I freely gave up later when from a car window while on a trip in the southern part of the State I saw miles of *Isomeris* growing along the roadside.

Another flower found on this excursion, said to be common in some sections, which I had not met with for many years, was a specimen of that odd but pretty little yellowish blossom known as *Whispering bells*, *Emmenanthe penduliflora*. Its range is given as being from Lake county, Calif., to Arizona. The topmost flowers on the flower stalk stand erect when they first open, but as the stalk grows and other buds take the terminal position they droop until they hang gracefully downward. Later they become dry like paper, keeping their cup, or bell, shape, and as some people thought they detected a faint noise arising from the wind-shaken blossoms they were called Whispering bells. The plants are about twelve or fourteen inches tall, and the flower stalk carries eight or ten blossoms—the bells of which are a little over a half inch in depth.

While traveling along the old road near the upper end of the canyon I had noticed here and there great numbers of fly-like insects slowly flying about; their manner of flight was erratic, and was confined to but little more than the breadth of the road and to not more than fifteen or twenty feet of its length, and in this area they seldom flew higher than six or eight feet. I passed through three or four congregations of these insects, without giving them much thought or attention, as my mind was almost wholly taken up with the botanical developments and possibilities of the trip. However, after passing out of the canyon and starting for home down the new road I encountered more groups of the insects, which seemed to be flying about in the manner described as if they were deriving as much fun and enjoyment from the exercise as a lot of youngsters on roller skates. I stopped to make a closer inspection of the ever-moving insects. Then

I noticed that in nearly every instance of what I had taken to be individual flies were two or more insects united soaring about as one. I could see that the insects were slimmer than house flies and were about a half inch or more in length, and something of the form of the mosquito. With a gauze insect collecting net I soon captured some of them. On every occasion the captives consisted of a united group of three flies, but always I found one fly to be dead or nearly so. At first I thought the flies were of such delicate nature that they succumbed to the blow of the cloth in netting them, but after capturing a dozen or more groups and finding only one dead fly in each case, and that the other two flies were so far from being injured by the operation, that it was with some difficulty that I could get them in my fingers. Now I noticed that the dead flies were somewhat smaller and apparently of a different species, although similar in form. A little further observation of the action of the insects dancing round and about me in the air revealed facts that put an altogether different interpretation upon the actions of the assembled flies. Instead of an innocent gathering to while away time and to enjoy the delights of a most agreeable atmosphere, a tragedy on a large scale was being enacted. It was a dance indeed, but a dance of death for a multitude of victims, furnishing a bloody feast for the ogreish hosts, which were none other than a species of the ferocious family known as Robber Flies.

The assemblage in certain localities as mentioned was due to the presence there of their victims, which in turn may have collected to feed upon some special article of food. The Robber flies soared and hovered around like hawks and swooped down upon their victims with the unerring certainty of their prototypes. But unlike most other predaceous forms of life, instead of retiring to some place where they could alight and feed upon their victims with the least chance of interference or interruption, they continue to leisurely fly around while sucking the life juices of their captives. Another remarkable feature in the conduct of the flies in their raids for food is that as soon as a Robber fly captures an insect another Robber fly or two attach themselves to the victim and proceed to join in the feast, the duo or trio of robbers continuing their feasting flight as one insect. Apparently the selfishness so commonly manifested over food by all animal life is absent here, and instead there is concordance of purpose and a harmony of wing movement, making a unity of action that gives the blood-thirsty duos and trios the appearance while in flight of being one insect.

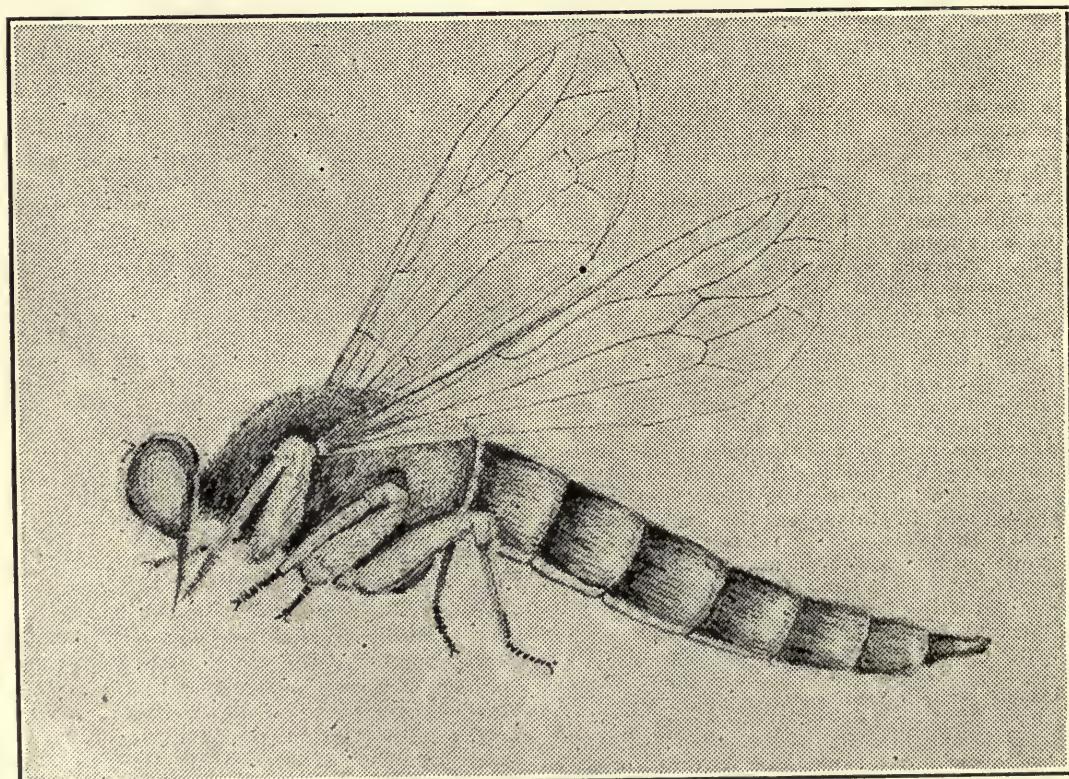
Although there are said to be in the neighborhood of about 3000 species of this family of flies known to entomologists, varying greatly in form and size, the slender mosquito-formed flies described in the foregoing are more typical of the voracious tribe. The family title of Robber flies is *Asilidae*, which Sharp places twenty-fourth in the order of

Diptera, thereby showing its relation to the common house fly as well as to other flies.

The Robber fly is equipped by nature with a strong projecting beak which it thrusts into its victim. Thus it is used as a weapon and at the same time affords the means of sucking the life juice of its captive. Its feet bear strong claws to aid it in holding securely the insects that it may capture. Authorities say that these flies are among the most voracious of all insects and that they prey on all other forms of insects, fearing none, not even wasps or other forms armed with defensive weapons. David Sharp, the well-known English entomologist, in writing about the Robber flies says: "As is the case with so many other insects that prey on living insects, the appetite of the Asilidae seems insatiable; a single individual has been observed to kill eight moths in twenty minutes. They have been said to suck the blood of vertebrates, but this appears to be erroneous." Therefore, if the fears of the timid excursionist have been aroused by the story of the ferocious actions of the Robber fly in Diablo Canyon they may be put aside, for the fly does not attack members of the human family. Its presence there in no way detracts from the charms of the beauties of the canyon, and so far as mankind is concerned is not even an annoyance. It is a terror to other members of the insect world only.

Since writing the foregoing I discovered a very much smaller species of the Robber fly on the roads about the foot of the mountain. These insects averaged less than a quarter of an inch in length. They were more numerous than their relatives of the mountain side, but their conduct was the same in congregating in numbers and flying and circling about certain portions of the road, with from two to three of the Robber flies attached to one victim, which I universally found to be a small gnat. Undoubtedly the little Robbers congregated on the lower roads because there was where the victims that constituted their food were to be found, just as the circumstances appeared on the upper road, in the case with the larger flies.

A few weeks later when near the summit of the mountain I saw representatives of another specie of these insects, some of the very largest of the Robber flies. They were about an inch in length, with the same characteristic slender and frail structure. The big flies were not present in any great number; nor could I find any with captive insects or feeding otherwise. Nor were they flying about as were both of the smaller kinds I have described, but seemed to be resting on the brush, rocks and grass, and took to the wing only when disturbed.



SKETCH FROM LIFE OF ONE OF THE LARGER SPECIES OF ROBBER FLIES
(Enlarged four times)

CHAPTER IX

ASTUTE BEETLES AND WASPS

Peculiar Gatherings of the Former. Foraging for Food for their Young by the Latter

Representatives of the woodboring families of beetles can most always be found on and about a newly felled tree, in the spring, summer and early autumn months of the year. Through the possession of some peculiar sense that apprises them of the fact that a living tree, whether uprooted by storm or felled by a woodsman's ax, supplies wood in proper state to aid in propagation of their species, they seek the tree for the purpose of laying their eggs in the crevices of the bark in a very short time after the tree is down. Whether they discover the presence of the fallen timber through the smell of the sap so noticeable to humans about a freshly felled tree, or are endowed with some sense of recognition that is beyond human experience, I cannot say. I only know that within a very short time after a tree is down in the summer or early fall it is not unusual to find certain beetles in great numbers in, around and on the branches, big limbs and trunk of the tree, where prior to that time a thorough search of the section thereabouts would not have produced a single specimen.

It would be a matter of interest to know to what distance or over what extent of territory the knowledge of the fallen tree is spread. Information on which to form an estimate is very slight. If in a section of country where it is next to an impossibility to find a longicorn or buprestid beetle before a tree is cut down and in ten hours or so after we should see these insects about the tree by the dozens, even hundreds, one would naturally think that at least some of them came from a long distance and that a wide expanse of territory was necessary to furnish so many visitors. While this might be true it is possible that our inability to find them in the first place is not because of non-presence of the insects, but for the reason we are not sufficiently clever to discover their hiding places.

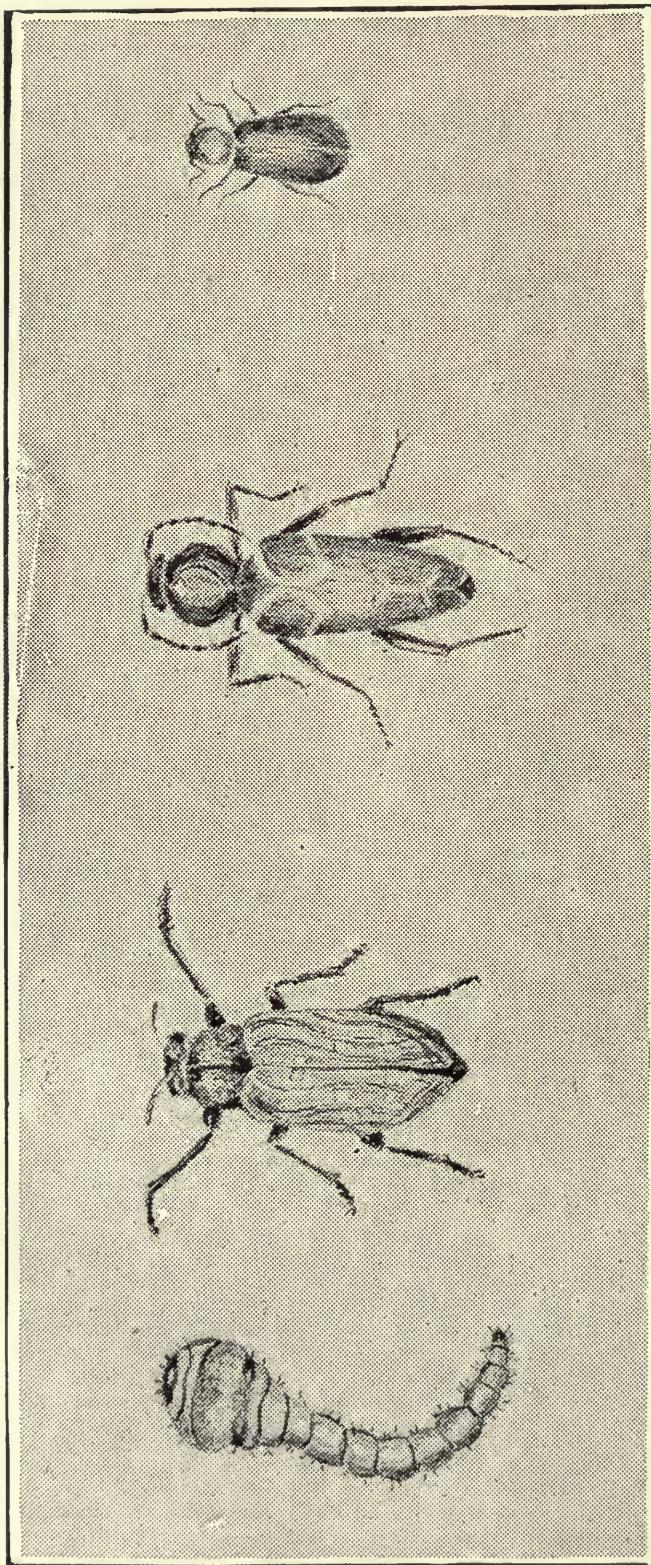
In the basement of our quarters at Diablo, Contra Costa county, a supply of freshly cut firewood for use in the fireplace was stored in the fall. The wood consisted of oak cut in blocks or logs from good sized limbs. The basement had one large window and a doorway that was protected with a screen door. On the first real warm day in the following August I discovered while on a visit to the basement four or five beetles on the glass of the window running about as if trying to find a place through which to make an exit to the open air. I found them to represent

two species of the Longicorn group, or long-horns, and surmised that they came from the wood above mentioned. An investigation of the wood pile proved the surmise to be correct. I not only found the holes with the fresh wood dust about the orifices, but discovered one of the beetles just as it was making its exit from the log.

For more than two months thereafter this particular kind of beetle continued to come out of the wood then go either to the window or the screen door, there to remain until they found opportunity to get outside of the basement or fell victims to the cyanide bottle of a collector of Coleoptera. On several occasions I noticed those beetles that chose the doorway for way of escape endeavoring to cut a hole in the wire screen by biting the wire with their mandibles. Of course they were unsuccessful. While their jaws were sharp and strong enough to enable them to bore a hole through the wood that had confined them after emerging from the state of pupa, they were unequal to the task of cutting the small wires of the screen. However, the effort apparently indicated the possession on the part of the insect of sufficient degree of mentality to recognize its unnatural imprisonment. Its confinement in the log of wood after its change from the larvae form to that of a mature beetle was a natural one and undoubtedly its acts in effecting release from the wooden cell were instinctive, but the secondary confinement by the interposing wire screen was probably something never before experienced by any generation of this family of longicorns. Consequently the instinctive powers of the insect alone could not have been expected to give the impulse to a rational act towards effecting its release. Reason must have intervened.

It is the theory of those who claim that such insects have no power of reasoning that all of their acts and operations are directed solely by a hereditary instinct that gives the impulse for the routine of conduct filling the periods of their existence, and having once performed any one of these acts they will not and cannot be expected to repeat it.

Such was the conclusion reached by that great French naturalist, Henri Fabre, after several experiments and observations with the mason bee, *Sphex*, and some other members of the wasp family. Notwithstanding the care taken by Fabre in his observations and the accuracy of his conclusions, the Peckhams of our own country experimenting with



WOOD-BORING BEETLES—FROM LEFT TO RIGHT: A BUPRESTID AND ITS LARVA, A LONGICORN, AND A CLERID

some of the same species of wasps found that Fabre's conclusions could not be relied upon.

In concluding the details of observations of the conduct of the longicorns in the basement it may be of interest to note their strange and wonderful action in responding to the changes in climatic conditions. Let it be borne in mind that the basement was partially underground, in fact one side and two ends were almost wholly so, consequently the temperature was quite uniform and varied but little with the changes frequently occurring outside. Notwithstanding this condition the beetles would emerge from their cells in the wood only on such days as were warm and bright outside. When days occurred that were cool with an overcast sky, the beetles seemed to prefer to remain in the darkness and confinement of their cells than to make their entrance into freedom under such climatic condition, and none were to be seen on the window or door screen. This would not appear so remarkable if the logs had been outside where the sun's rays would beat upon them. In that way enough heat might be absorbed by the wood to acquaint the insects harbored under its bark with weather conditions that existed to their liking. But of course that was impossible in the basement, for wood is a poor conductor of heat and could not through outside conditions vary in temperature to any degree appreciable by man. Then how did these beetles distinguish between warm and cool days? I confess I do not know, and the only solution that occurs to me now is unsusceptible of proof, and that is the insects are far more sensitive to weather changes than we can comprehend from our own experience. We do know that the sense of sight, hearing, smell, direction, etc., is developed in some other forms of life to a far greater degree and is of more delicate nature than has ever been known in man.

While taking a stroll on one of the back roads in the northwestern suburbs of Napa one pleasant day in the middle of September, I noticed a yellow jacket, *Vespa Germanica*, scouting around, flying a few inches above the ground, as if in search of game. Finally it made several close circles over a fragment of a twig which was about the size of a man's finger, then lit upon it. From previous observations of these wasps in search of game I at once concluded that this yellow jacket had reason to believe that the twig was giving shelter to some kind of insect that it was hunting for. I got down on the ground as near by as possible to observe what took place in the next few seconds. There was a small depression in the earth along one side of the twig with a smaller hole leading under the twig. Into this the wasp made an effort to enter, but the hole was apparently too small to admit much more than its head. Finding that it could not enter and secure whatever was hidden there it soon gave up the effort and flew away. From the maneuvers of the wasp I felt sure some kind of an insect lay under the protection of the

twig and my curiosity was aroused to know what it might be, but before I could remove it to ascertain what it was, I was astonished to see a common-looking fly not unlike an ordinary house-fly come part way out of the small hole to a position where it could get something of a view of the surroundings. It apparently knew that one of its enemy had made an attempt on its life and curiosity to see and know what it was had prompted it to come out of its retreat for that purpose. It had not been out more than a few seconds when unfortunately I made some movement that caused the fly to disappear in a flash back down in the hole.

The interesting feature of the incident was the remarkable perceptive power of the yellow jacket in locating the fly in hiding under the twig. How did it know that under that particular twig, out of sight, lay a morsel of food for which it was in search and possibly in need? Its preliminary hovering over the spot indicated its discovery of the lair of the fly, and by going directly to the hole leading under the twig immediately after alighting, was convincing that some kind of intelligence, or actions inspired by a highly developed sense of smell, or the endowment of a peculiar power, without intellect or reason, which some naturalists describe as instinct, directed the whole proceeding. Which is a question that observers have been disputing for years past, and one that may never be settled scientifically.

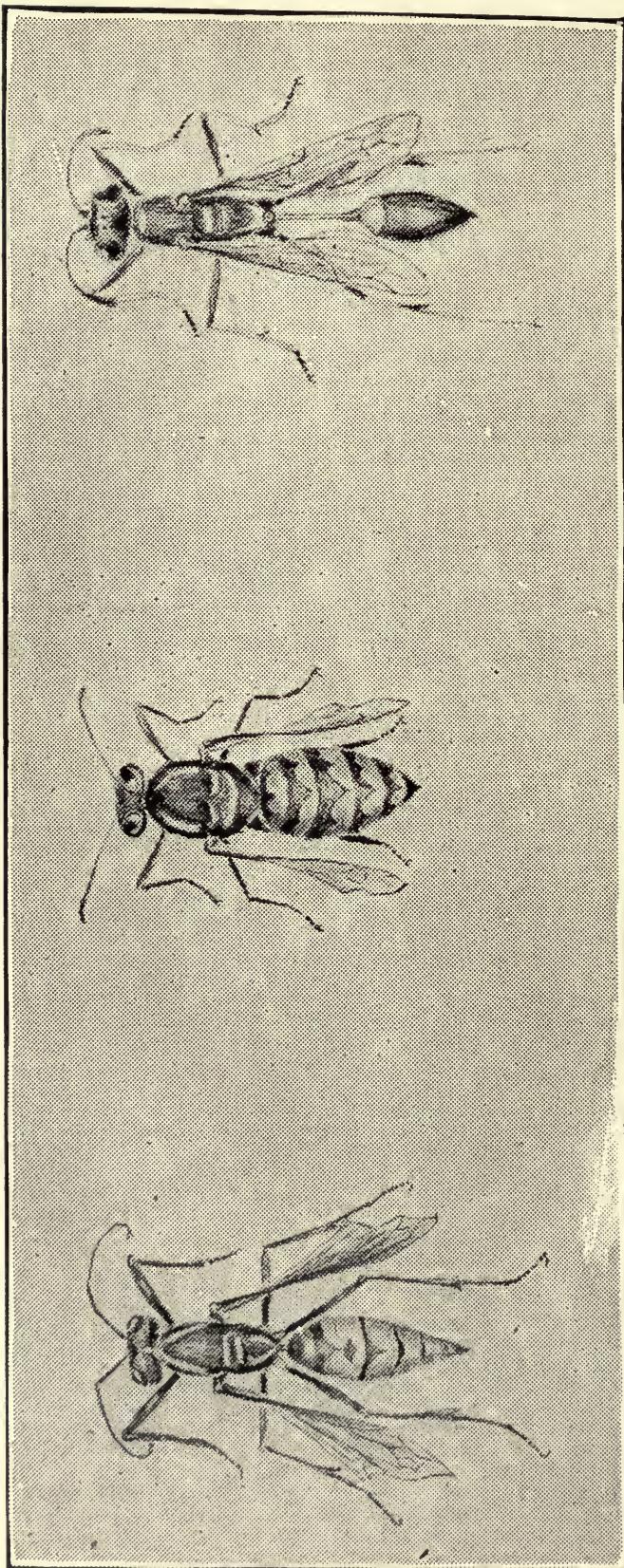
The subsequent act of the fly in coming part way out of its retreat to get a view of the intruder that had threatened its existence was but little less in interest as another exhibition of intellect or a strangely developed instinct.

It is impossible, so far as my knowledge of the subject is developed at the present time, to accept the theory that such insects mentioned in the foregoing have no mentality whatever, and that such of their acts coinciding with the acts of animal life of higher order with known brain power under like conditions, are only the impulses of instinct. To adopt this idea is to acknowledge that the brain with which nature has supplied their organization has no other function than that arising from connection with the nerve ganglia.

No close observer of the doings of the individuals of lower forms of life can be unmindful of the fact that instinct, developed to a wonderous degree, is the directing force responsible for the main work of their existence and the systematic and peculiar methods followed in its accomplishment. However, some of these observers do not believe that the possession of such instinct precludes consciousness and the ability to reason to some extent.

Perhaps when the question is solved, if it ever is, it will be found that the solution lies somewhere between the claims of the extremists of both sides.

On one August afternoon at Diablo, while walking in the hay stubble near the house, I noticed a *Vespa Germanica* (yellow jacket)



POLISTES

VESPA GERMANICA—YELLOW JACKET

PELOPOEUS I MUD DAUBER

WASPS COMMONLY SEEN ABOUT HABITATIONS IN THE COUNTRY

scouting around on the wing, flying low among the stubble. I concluded it was hunting for food for its young so watched it closely. Finally I saw it pounce down upon an object partially hidden from my view by pieces of straw. The attack was made within four feet from where I stood. I quickly dropped to the ground that I might get a near view of the action. I saw that the wasp had seized an insect as large as itself and plainly witnessed the application of its sting twice, curving its abdomen under the victim both times. Without any delay the wasp severed the head of the captive insect and flew off with it in a northeasterly direction. I then picked up the remains and found that the victim was a domestic or honey bee.

From previous observations in similar cases I concluded the wasp, knowing the bee, intact, was too large to carry off to its nest, had dismembered it to make the task easier, and would masticate the parts to put them in condition for food for its grubs while on the journey home, therefore in time would return for the remains of the victim. In about five minutes it came back and this time it quickly cut off the abdomen and flew away with it. In about ten minutes more it returned again and picked up the thorax, all that remained of the bee, and rising to a height of six feet or more flew off in the same direction as before. On its return trips it gave no evidence of trouble or difficulty in locating its victim. It came flying close to the ground zigzagging about six or eight inches, finally dropping at the exact spot. After its second trip I killed a common house fly and laid it down within a couple of inches of the remains of the bee. In a moment or so I saw another wasp scouting around among the stubble in the same manner observed in the first one. It soon discovered the fly and bee, which caused me to think it was the owner of the bee. However, when it lit it only nosed the fly and bee and then flew away. While pondering over the unexpected action of the visitor I noticed the first wasp on its way back. Ordinarily yellow jackets do not appear so considerate of property rights; they seem ready to take anything in the meat line when and wherever they find it, though this practice may be due to the character of ownership. They may have the habit of respect of title where it rests in one of their own kind as instanced above, and not be so particular when it is otherwise.

On the same day while passing a bank which was thickly covered with blackberry vines, my attention was attracted to a slight fluttering of a large insect which appeared to be entangled in a thinly spun web of a spider. Now, I thought, something is about to take place that will prove of interest as well as yield some information. I stepped up close, moving as slowly and quietly as possible, so as not to have the intrusion of my presence influence the event or what might take place. Upon examination I found that a wasp of the family *Polistes* was in among the threads of the web hanging on to them with the middle and hind legs, while she was using the pair

of fore legs and mandibles, or jaws, in securing possession of a small baby grasshopper that had become helplessly entangled in the web. The wasp finally succeeded in getting through the meshes of the web to a position where she could seize the little grasshopper. It was apparently dead. Whether the wasp had stung it to death or it had been previously killed by the spider and left on the web, I could not tell. As soon as the *Polistes* got hold of it she began to sever the abdomen from the rest of the body of the insect. She was not nearly so clever in this butchering process as the yellow jacket. In the operation she required more minutes than the *germanica* did seconds. It is only fair to say that the latter wasp is better equipped with tools for that kind of work, in the shape and keenness of her mandibles.

When Mrs. *Polistes* finally succeeded in separating the body she took a good hold of the chosen part with her jaws and began her efforts to extricate herself from the spider's web. This was no easy job. She did not appear excited nor did she show any evidence of fear of trouble in getting out. She seemed to understand just what was necessary to do and how to go about it. Her progress was rather slow and at times she found it necessary to use the propelling power of her wings as an aid in the operation. The unusual shaking of the web brought the spider running out to find what kind of game had been entangled in her net. However, the sight of the wasp quickly brought her to a standstill and she remained stationary at a safe distance watching proceedings. Finally the wasp got past all of the troublesome threads and attempted to fly away with her booty, but a strong thread still attached to the fragment of the grasshopper brought her to standstill, though on the wing. With engine in reverse she backed and tugged until finally the thread yielded to the persistent strain.

The wasp seemed somewhat exhausted from her exertions, for she lit on a broad leaf within a foot of the spiderweb and proceeded to brush and clean her body with her legs and feet, all the time with her jaws holding on to the morsel that she had worked so hard to obtain. After the cleaning process was completed she proceeded to eat out the soft part of the grasshopper's abdomen, discarding the undigestable outside covering. A remarkable feature of the proceedings was the way she held the part with her forefeet while she used her mandibles to dig out the meat. The action reminded me of a squirrel eating a nut. The middle and hind pairs of legs gave all the support needed to her body, so she was free to use the pair of fore legs with their feet as one would his arms and hands, which she did most cleverly. Upon completing the work she flew away.

I find very little in the accounts of other observers as to the character of food that the *Polistes* eat. Probably so because of the difficulty of finding out. I have seen this species of wasp on fruit, especially ripe, sweet fruit, apparently partaking of the juices. I have

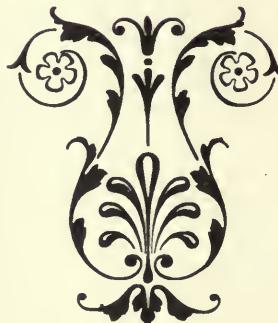
WILD LIFE IN CALIFORNIA

seen them more frequently and in greater numbers hovering about and alighting on the outer leaves and branches of oak trees that seemed to be infested with minute insects; but in neither case could I determine beyond doubt whether the wasps were gathering food for the young or were eating for their own sustenance. The only time I ever saw a *Polistes* consume any food and felt sure there could be no mistake about it was in the case of the incident just related of the *Polistes* taking the baby grasshopper out of the spider web; but even then it might have been preparing it for its young.

Lutz says the food of the *Polistes* consists of "chewed-up animal matter, such as caterpillars, but some species use honey and pollen also." Kellogg says the "food consists of partially masticated remains of various insects pursued and killed by the queen and 'workers.'" Comstock says the entire family to

which these wasps belong are predaceous, and they "feed their young upon insects which they have masticated. These wasps are also fond of sweets of flowers, the juices of fruits, and honey dew." Sharp states that the queen wasp first supplies her young "with saccharine matter procured from flowers or fruits, but soon gives them a stronger diet of insect meat, reduced to a pulp by means of the mandibles; this is offered to the larvae which are said to stretch out their heads to the mother to receive the food after the manner of nestling birds." The Peckhams say the *Polistes* "feed their young on animal food" without bringing into play their stings to aid in the capture of insects for the purpose.

Here is presented considerable testimony as to what kind of food the larva of the *polistes* are fed upon, but not much as to what the mature wasp after it changes from the grub form relies upon to sustain its existence.



CHAPTER X

STORIES ABOUT DIGGING WASPS

An Ammophila that Accomplished an Astonishing Job in Masonry Work A Collision with a Priononyx and the Result

This summer, while passing considerable time at Diablo, Contra Costa county, I noted the presence in the flower gardens of an unusual number of species of wasps and bees. It occurred to me that these insects being so common that later on I ought to be able to find their nesting places and thereby have opportunity to observe and study acts of their home life. I knew from my reading on the subject where to look for the nesting places of the species that are least seen in or about human habitations and are almost wholly unknown to the common public, such as the *Halictus*, *Osmia* and *Megachile* of the bee family and the *Eumonidae*, *Crabonidae*, *Cerceris* and *Ammophila*, of what is commonly known as the Wasp family. I was particularly desirous of finding an *Ammophila* "at home" and acquainting myself from personal observation how she constructed her abiding place and provided for her progeny. The members of this genus are easily recognized, being about the most slender, long-legged and short-winged of the tribe. Some of them are an inch and a quarter in length. I found them among the most numerous of the visitors of the flower gardens and the hope of having my curiosity satisfied was correspondingly raised.

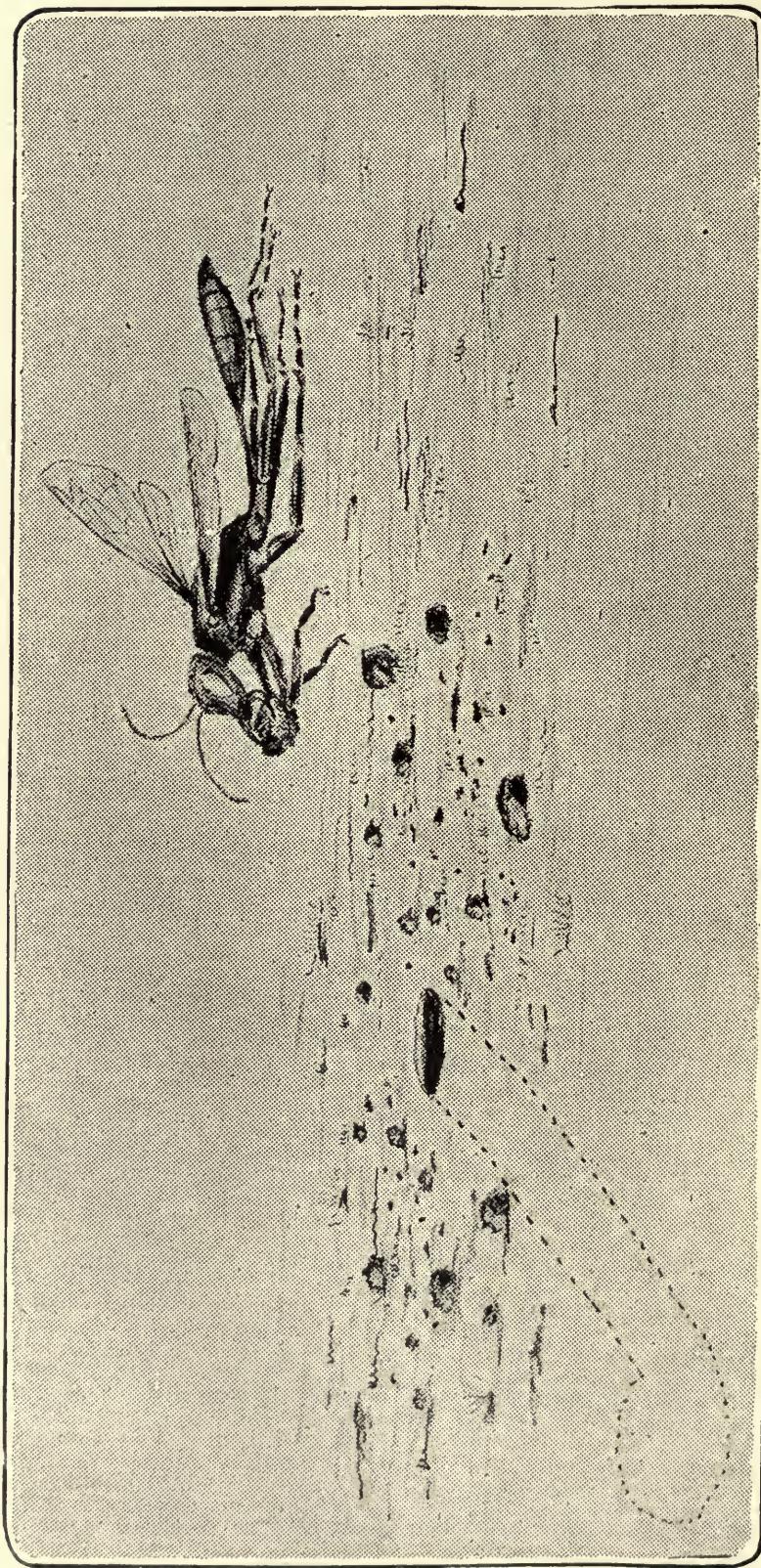
I had read in the details of the life history of this particular insect as given by two observers that it was the habit of one species of *Ammophila* to excavate its nest in sand beds, therefore I began my search by inspecting and watching at all the sandy places I could find. After a couple of weeks had passed and I had about given up expectation of meeting the lady wasp as I had wished, one day in the latter part of July, soon after lunch, while walking over a piece of ground that had been leveled off for a house foundation in a lot adjacent to our place, I discovered an *Ammophila* in the act of going into a shallow hole in solid ground. I afterwards learned that this species of the family sought this kind of soil for its nest.

There was no mistake about the identification. It was certainly the wasp I was looking for, but was she making a nest? This was hard ground full of little pieces of rock and no sand. I said to myself, if she has no objections I will try to discover what she is doing, if not making a nest, in soil so different from that credited to her habit.

The hole at this time was apparently about an inch and a half deep on an incline of about 45 degrees. I stood at a distance of about 15 feet away from the place of her operations when I first discovered her. From this posi-

tion I saw her go into the hole and remain about ten seconds, then emerge backwards, taking the wing as she got out, rising about a foot above the ground, going not more than 16 or 18 inches away, then back to the hole. This act was repeated several times, when I concluded she was excavating a place for a nest and the trips out were for the purpose of disposing of the material excavated. While she was in the ground I would move a foot or two at a time nearer to the point of her operations. My presence did not seem to attract her attention until I reached a position of about four feet from her hole; then when she came out, instead of going back immediately, she flew out, making a wide circle around the hole, then once or twice around me; then lit on the ground, lying flat. After about 10 seconds she flew to the hole, making a small circle or two over it and then resumed her work, apparently having assured herself that my presence bore no menace. While I felt sure that she was bringing out the excavated material in the short trips she was making, I could not see the operation of dropping the material, so I concluded to make a nearer approach and finally obtained a sitting position about two and one-half feet from the hole. When she came out and found me so near she appeared quite agitated. She flew around me several times, then made larger circles as if to see if there was anything dangerous connected with this intrusion. She lit on the ground several times, sometimes near and other times some distance away, always lying flat, a position I never saw any of the wasp family assume before. (The Peckhams noted this peculiar action by a *Priononyx* wasp as new to them.) I remained without movement, fearful that I had been too impatient and that my disturbance would cause the insect to cease her work; so I was greatly pleased to see her finally resume labor in the hole. I could now not only see the pieces of dirt and rock, but could hear them drop as she threw them out while on the wing.

I timed her trips—they were seldom less than 10 seconds or longer than 15 seconds. I estimated that she averaged about 12 seconds to each load, which would be at the rate of about 300 in an hour. Judging from the sizes of the pieces I recovered as she threw them out, I concluded she made at least an inch and a half in depth in an hour. Some of the pieces were not larger than a pin-head, while occasionally she would drag out a fragment of rock too heavy to fly off with. These would be left within four or five inches of the



WASP CARRYING ROCK FROM HOLE

entrance of the nest. Two or three times after she had resumed her labors she took occasion on her outward trips to make further inspection of my person by circling around, then alighting on the ground, eyeing me. When apparently satisfied that my presence meant no interference with her plans she would resume the work of excavation. In 20 minutes she had deepened the hole so that when she went down she was entirely out of sight; all of her actions were rapid and when on the ground were accompanied by nervous flipping of the wings.

While watching Mrs. Ammophila's flights out of the hole, flipping her loads away from the entrance, scattering the debris so there would be no accumulation in any one place to mark the presence of her nest, then her dash back, all with such lightning-like speed that it was with difficulty I followed her actions, I became aware there was another intensely interesting feature of the performance going on before me. A small insect, a species of fly, somewhat smaller than the ordinary house fly, was present and also deeply interested in the operations of the wasp. First let me explain the purpose of the presence of the little pest, then there will be more interest in detailing its actions. It seems it is the habit of this fly, when it can, to deposit an egg, or eggs, on the caterpillar that the Ammophila captures and stores in her nest. Of course the fly is no match in a scrap with the wasp, and it is compelled to accomplish its object by stealth. It seemed to equal the wasp in intelligence and rapidity of action. By its maneuvers on this occasion it appeared to be trying to enter the hole during the brief absence of the owner or it may have been only making momentary observations of the progress of the work of the wasp so as to be on hand at the proper moment. For a greater part of the time it occupied positions not more than five or six inches from the hole. From these points it would fly to the mouth of the hole but get back out of the way before the return of the owner, and several times while the wasp was working down in the excavation the little pest would fly to the hole and hover over the mouth until the buzzing of the wasp gave notice of its coming out, then it would retreat as before. By the quick alteration of the position of the fly, first this way, then that, it could be seen that it was keenly watching every movement of the wasp, but it took care not to get within reach of it.

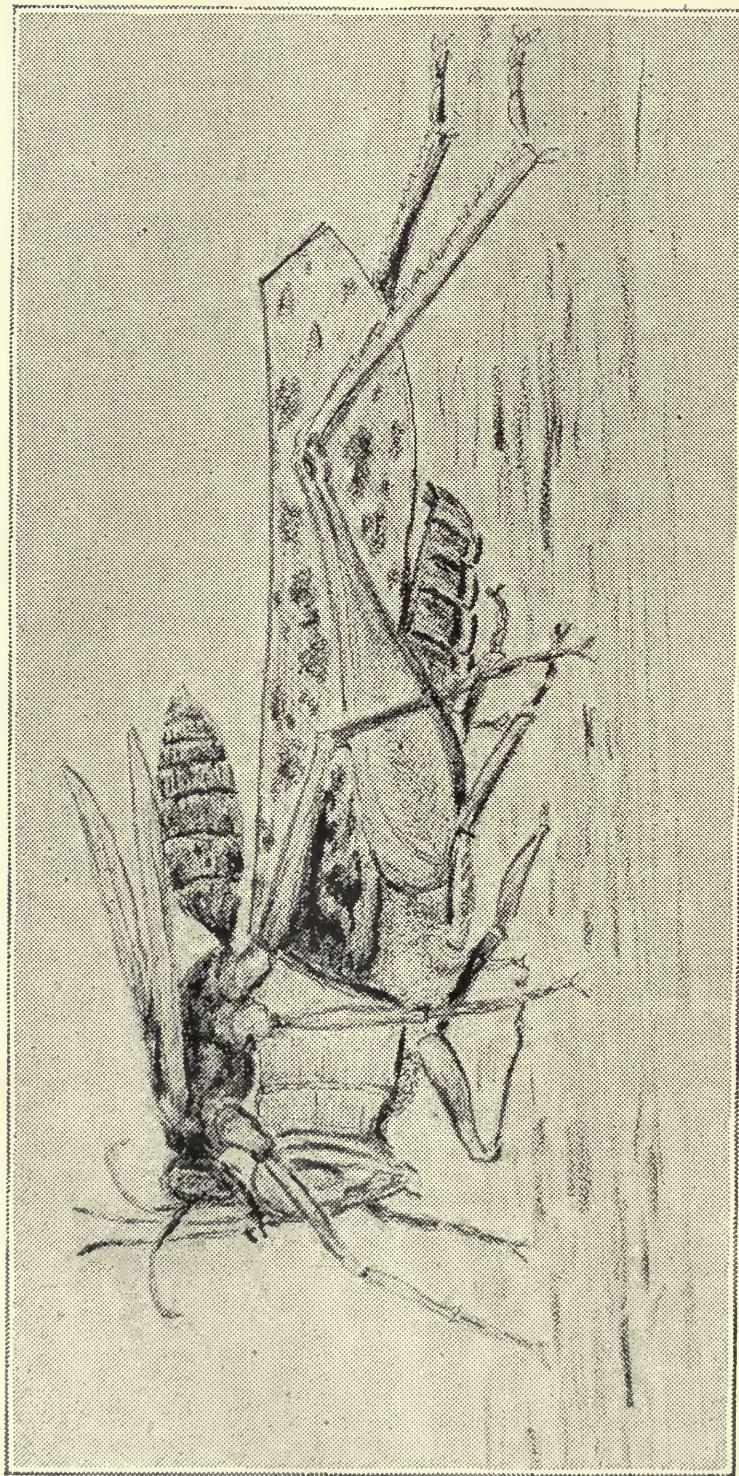
By this time I had acquired a reclining position with my head barely a foot from the ground, and the little fly very accommodatingly on one of its returns from the hole lit on the ground under my eyes. I not only had a chance to note its peculiarities and possibly determine the species, but more clearly perceived the cunning and artful character it possessed. With lightning-like rapidity it followed every movement of the wasp and when the latter disappeared in the hole the fly in a flash was hovering over the place.

I spread a piece of cloth on the ground within the radius of the distribution of the debris the wasp was bringing out so I might

recover some of the material she was excavating. When she came out and saw the cloth she appeared somewhat disturbed and flew around it several times, then lit upon it and walked around until apparently satisfied it boded no harm. Some of the material was earth and some rock, and in size ranged from the dimensions of a pin-head to a pea. I was interested to know how she held the stuff while carrying it out, whether by her mandibles, her feet and legs, or by the aid of both. While she was on the wing her actions were so rapid that it was impossible to determine, but finally she came slowly backing out of the hole with a load that appeared to be about all she could handle. This proved to be a piece of rock about one-quarter of an inch in diameter. She carried it free from the ground in her mandibles, which looked like miniature ice tongs. This and what I afterwards saw showed that her mandibles only were the appendages utilized. It was marvelous to see how dexterous and skillful she was in their use.

As I understood that the Ammophila digs a hole only about three inches deep, I thought my wasp must be nearly through with that part of her work. Then again it was getting late in the afternoon when the heat of the day had passed and the majority of the wasp family cease work and seek some secluded place where they remain until the warmth of another day invites them to further activities. So I felt sure the monotony of the digging operations would soon end and I should witness some other of the intelligent acts of this curious insect. The increased activity of the little fly in following the movements of the wasp indicated it shared in the same thought.

We had not long to wait for Mrs. Ammophila to flip out her last load of dirt. When that happened, instead of going down into the hole, she lit near the mouth of it and walked around rapidly with a nervous flipping of her wings, and suddenly seized a pebble nearly as large as the end of my little finger and in less time than it takes to tell it carried it to the hole and dropped it into the entrance. The piece of rock lodged in the mouth of the hole a quarter of an inch below the surface of the ground outside. Now came further exhibition of the wonderful mental power possessed by the wasp. To complete the filling up of the mouth of the opening and make it uniform with the surrounding surface of the ground required some further work on her part. Apparently she deemed it necessary to protect the nest from invasion by other insects to close the entrance tight by a bit of masonry work and thus remove all indication of the existence of her domicile. This work she completed in a way that astonished me in the rapidity of action and the mechanical perfection of its execution. Out of the numerous little fragments of broken rock lying within a radius of four or five inches of the entrance to the hole she selected five pieces, three small and two larger. She walked quickly around among the fragments looking for the pieces of the size needed and without hesitation or delay picked them up one by one and carried



WASP DRAGGING LOCUST TO ITS NEST

them to the hole, and when the last fragment was dropped into its place the point of a knife blade could not have found an entrance between any of the pieces. In other words, she had fitted them so perfectly as to leave no chinks and with a surface even with the ground. All of which was accomplished in but little more than 10 seconds of time.

It was evident that she had completed her work of building this nest, or had simply quit work for the day and closed the hole to shut out intruders. According to the records of observers it is a peculiarity of many of the wasps to work only during the heat of the day. Now for the first time feverish haste in her actions were suspended. She walked around the hole two or three times, not going more than four or five inches away, then enlarged the circuit in a couple of more trips. While doing this she stopped to examine two stalks of straw, one prone, the other erect. The one lying on the ground she straddled and walked along its entire length with her antennae rapidly working as if feeling for something on the straw that she could not see. The stalk that was standing erect she climbed for about eight inches, using her antennae in the same manner as with the other straw. The significance of these actions I could not determine unless it was to familiarize herself with the location of the nest, for during the short and longer circuits she made two or three trips to the place of entrance to her nest although there was nothing, as far as I could see, to indicate its location other than the five fragments of rock so closely laid together as to appear almost as one. She finally extended her circle to twenty feet or more, lit once or twice on the ground, then flew away.

The little fly had remained in the neighborhood all the time while the wasp was inspecting the surroundings but wisely kept out of her way, but when the wasp started off on the large and last circle the little rascal seemed to know the coast was free from danger, for it flew to the hole and remained a few seconds while it inspected the conditions. If it had hoped to find an opening large enough to admit its tiny body it was disappointed, for it, too, flew away. I waited for more than an hour for the possible return of the wasp, thinking she might have closed the nest temporarily while off hunting for a caterpillar.

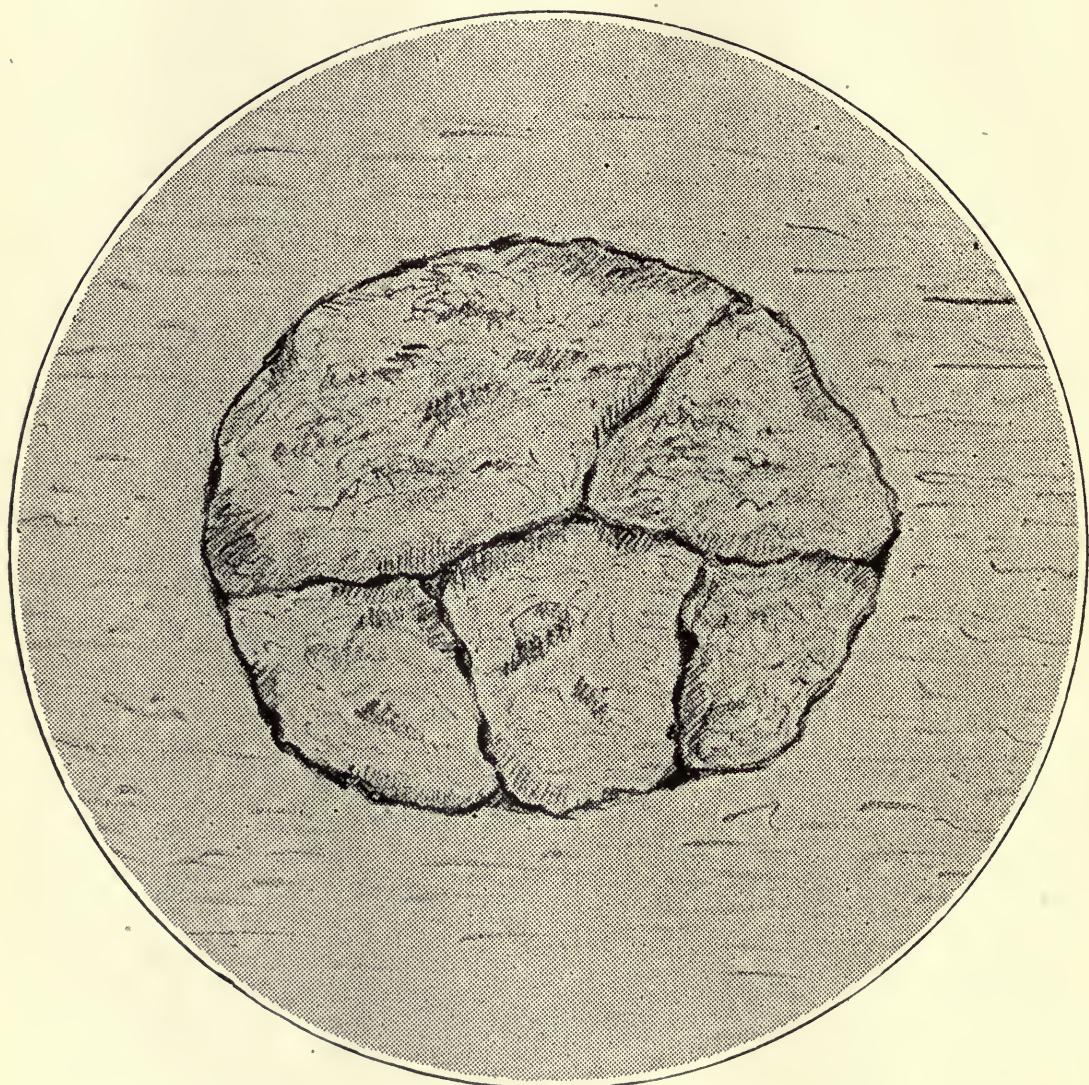
Six o'clock coming and the dinner bell ringing I gave up further watch for the day but first took occasion to mark the location of the spot that I might resume observations the following day. I made a diagram also of the five pieces of rock and the way they were fitted into place.

The next day was quite cool and unfavorable for the presence of wasps. However, I remained about four hours, two hours before and the two hours after lunch, near the site of the nest, without the satisfaction of noting the reappearance of Mrs. Ammophila. I repeatedly examined the "masonry" work of the closed hole to see if it had been visited and the nest entered while my attention was

possibly diverted to some other part of the grounds, but at the close of the day the entrance of the hole was exactly as the wasp left it the evening before.

During the forenoon of the next or third day of observation I repeatedly visited the location of the nest but found the "masonry" intact. It had not been disturbed. The day was quite warm, really hot enough to meet the requirements of almost every living thing that revels in high temperatures. Immediately after having my lunch I made another trip to the lot. As I bent over to examine the closed entrance of the nest I disturbed a little fly that was flitting around the place, not moving more than a foot or so at a time. It was one of the species mentioned in the account of the first day's observation. I concluded that the presence of the little pirate indicated that Mrs. Ammophila had come back or was expected home with her game, and probably I would now have an opportunity to see what kind of caterpillar she would have and how she disposed of it in the nest, etc. However, a lively buzzing about my head notified me of the error in my conclusions, and that the fly was waiting for another wasp—the one that was flying around me. From the position of the fly and the actions of the wasp I thought she must be making a nest close by. I soon detected the spot, not more than eighteen inches from the nest of the Ammophila. I had almost stepped upon the entrance while the owner was down in the hole. I moved a step or so away. The wasp seemed satisfied with the extent of my compliance with her request to get out of the way of her operations, for she soon lit on the ground and went down the hole and later backed out with a scrap of dirt or rock, dumping it within an inch or so of the entrance. She made one or two more trips of this kind, then stood outside and kicked the stuff backwards, scattering the fragments away from around the entrance. She at no time took to the wing in removing or handling the stuff excavated. She brought it out with her mandibles but after that disposed of it with her feet. This difference in working was due to the fact that it was a different species of wasp. It was not quite as long as the Ammophila but more stoutly built, body black with a red abdomen and shiny blue-back wings. It was what I took to be a *Priononyx*. While differing in appearance, the species is closely related to the Ammophila, in fact it belongs to the same family in the order of Hymenoptera. While the former always stores her nest with caterpillars, the latter uses only grasshoppers for the purpose.

After taking a few more loads of dirt from the hole she came out and made a brief survey of things and then proceeded to close up the entrance by kicking in the dirt that lay within a couple of inches of the place. She completed the work by leveling the surface so there was no depression or other indication of the presence of the underground nest. Then she flew away. I waited and watched some time for her return hoping that I would



MASONRY WORK—ROOF OF A WASP HOLE

see her bring the game which her kind is accustomed to place in their nest, but she did not come back that day nor did I see anything of her during the next three days. I concluded to open the nest thinking that she had probably already performed that interesting part of the work and that the digging that I saw her doing was the putting on of some finishing touches she thought necessary after storing the food for her progeny.

My excavation showed the hole with the enlargement at the bottom to be about five inches deep on an incline of about forty-five degrees. At the bottom I found a locust, which in this country is improperly called grasshopper. It was not paralyzed but dead beyond question. While holding it in my hand for examination two small legless larva crawled out of the body of the insect. Whether these came from the hatching of the eggs of the wasp or originated from the trespassing of some fly I could not then determine. I placed the locust and the larva in a small box to see what would develop. The result was the hatching of some small flies like those I saw hovering around the wasp while it was at work making its nest.

As the Ammophila had made no return to her nest I concluded to open it. I found the hole to be nearly four inches deep but with no enlargement for the cell at the bottom. It was quite evident the nest had not been completed as there was no caterpillar or other insect in it. After leaving the nest she herself may have become the victim of some insect-eating bird or other animal.

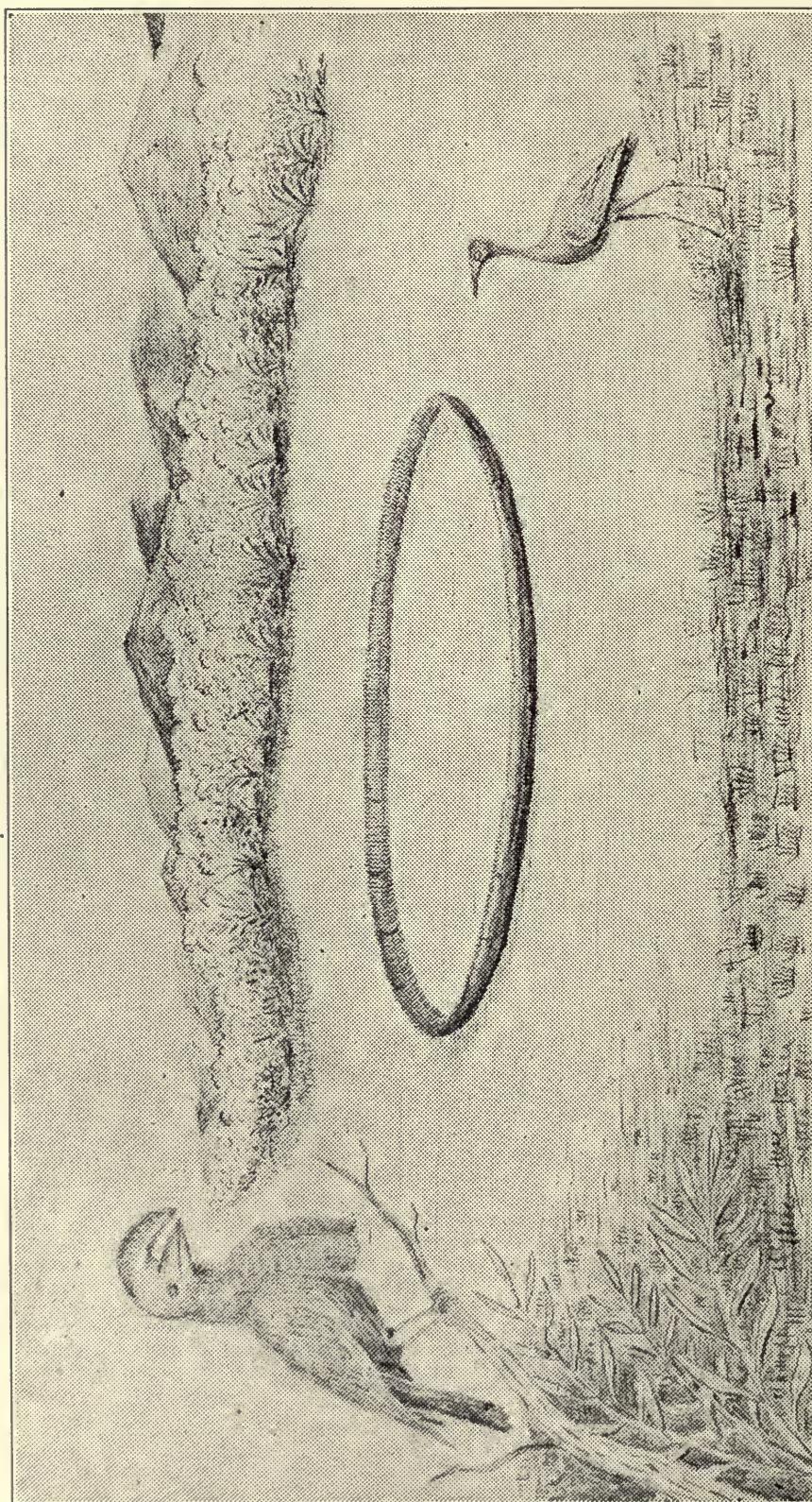
A few weeks later I had the satisfaction of witnessing one of the same species of wasps mentioned above, a *Priononyx*, taking a captured locust to its nest or hole in the ground previously made for the purpose. I was walking on a road in the suburbs of Napa when a large insect carrying an object larger than itself came slowly flying across the road. Striking my knee in its flight it dropped its load at my feet and flew away. I at once saw that the object on the ground was a locust. It was either dead or paralyzed but bore no mark of injury, which caused me to conclude that it was a victim of one of the Spex family of wasps. If I were right in my judgment I felt certain that the collision with my knee was but the beginning of an interesting incident, all features of which I might be a witness owing to the favorable conditions if I should be patient and quiet.

I had not long to wait before a dark-colored wasp, a *Priononyx*, came circling about my person a foot or so from the ground, evidently in search of the game she had dropped a few moments before. I stepped back a short distance to give the wasp a clear field in her search. She was not long in locating it. After a brief examination she straddled the insect, seizing it at the base of

its antennae and started off on foot. Obviously she chose the easiest method of handling the "hopper." The long legs of the wasp raised her above the body of the locust and she walked along with the victim with ease and surprising speed, taking the same direction that she was following when I first saw her.

I was certain that I was now about to see the burial operation which I had frequently read about, but never so fortunate as to witness. The wasp carried or dragged the locust about a yard then dropped it. According to the recorded habits of the species she was now going to the nest to see if everything was as it should be before bringing in the game, therefore the nest of the *Priononyx* was not far away. This proved to be the case; by watching the wasp closely, following her steps to the border of the beaten track of the roadbed, I soon saw her approach a hole in the ground which was a little larger round than a lead pencil. She circled around it a few times in flight then lit on the ground and walked about the hole in a quick nervous manner, after which she went down into the nest, then came out. Apparently after satisfying herself that she could without interference bring home her prize she flew back to the locust for the last time and brought it to the entrance of the nest, where she left it while she went down the hole head first. While below she must have turned around, for in a few seconds her head appeared above the hole, when she seized the locust by the antennae and dragged it down out of sight. In a few moments she came out and began to refill the hole by scratching in the loose dirt about the entrance with her feet, throwing it behind her. She continued the work until the hole was filled and the surface leveled with the surroundings and all evidence of the presence of the nest was removed. Her work now being finished her interest in the place seemed at an end, for she flew away and was seen no more.

If I had excavated the locust at once I would undoubtedly have found an egg of the wasp fastened to the body of the buried insect. If excavated a week later I would probably have found that the egg had hatched and that the larva of the wasp was feeding on the body of the locust. However I did not disturb the nest, but walked on thinking about the anxiety, care and intelligence manifested by the wasp in approaching the nest and almost human cleverness in handling the bulky captive. In contemplating similar actions by humans they would be considered as acts of intelligence, exhibiting prudence, forethought, sagacity and aptitude. When we find an individual though as low down in the scale of life as an insect showing all this why should it be attributed solely to instinct and not to some degree of rational power?



BRAZIL WATER LILY
In center—Brazil water lily (*Victoria Amazonia*), the largest leaf that grows. Richard Spruce, an English botanist of fame, says it sometimes reaches a diameter of twelve feet, and while not certain, thinks it is of annual growth. The birds are of species common in the locality of the lily growths. The one on the left is the Umbrella bird, and the crane-like bird on the right is one of the Trumpeters

CHAPTER XI

WONDERS OF THE LEAF

Its Function in Plant Growth and Its Important Relations to Humanity and All Other Forms of Life

*I think that I shall never see
A poem lovely as a tree.
A tree whose hungry mouth is prest
Against the earth's sweet flowing breast;
A tree that looks at God all day
And lifts her leafy arms to pray;
A tree that may in summer wear
A nest of robins in her hair;
Upon whose bosom snow has lain;
Who intimately lives with rain.
Poems are made by fools like me
But only God can make a tree.*

—Joyce Kilmer.

The leaf of a tree, shrub or plant is such a common feature in Nature's productions that it is an object universally recognized on sight, but acquaintance with its origin, growth, its function in plant life, its marvelous mechanism and its relation to all animal life are perhaps matters not so commonly understood. We have constantly under our vision so many leaves, green and fresh in the spring and summer, and dead and dessicated in the fall and winter, that the most of us appreciate them only for the beauty they give to Nature and the comfort they may afford us in the former seasons, and regard them as a nuisance, if we think of them at all, in the latter. Another condition probably contributing to the lack of general knowledge of the leaf is the absence of the spur of necessity. In a country like ours where the soil is as productive and climatic conditions so favorable to plant life, insuring annual recurrence of abundant crops, we have little occasion to think of, worry about, or inquire into the source of our food supply, quantity or quality. The only anxieties we have in the matter are confined to the exertions and expenditures necessary to acquiring the quantity we must have to sustain our existence or appease our appetites.

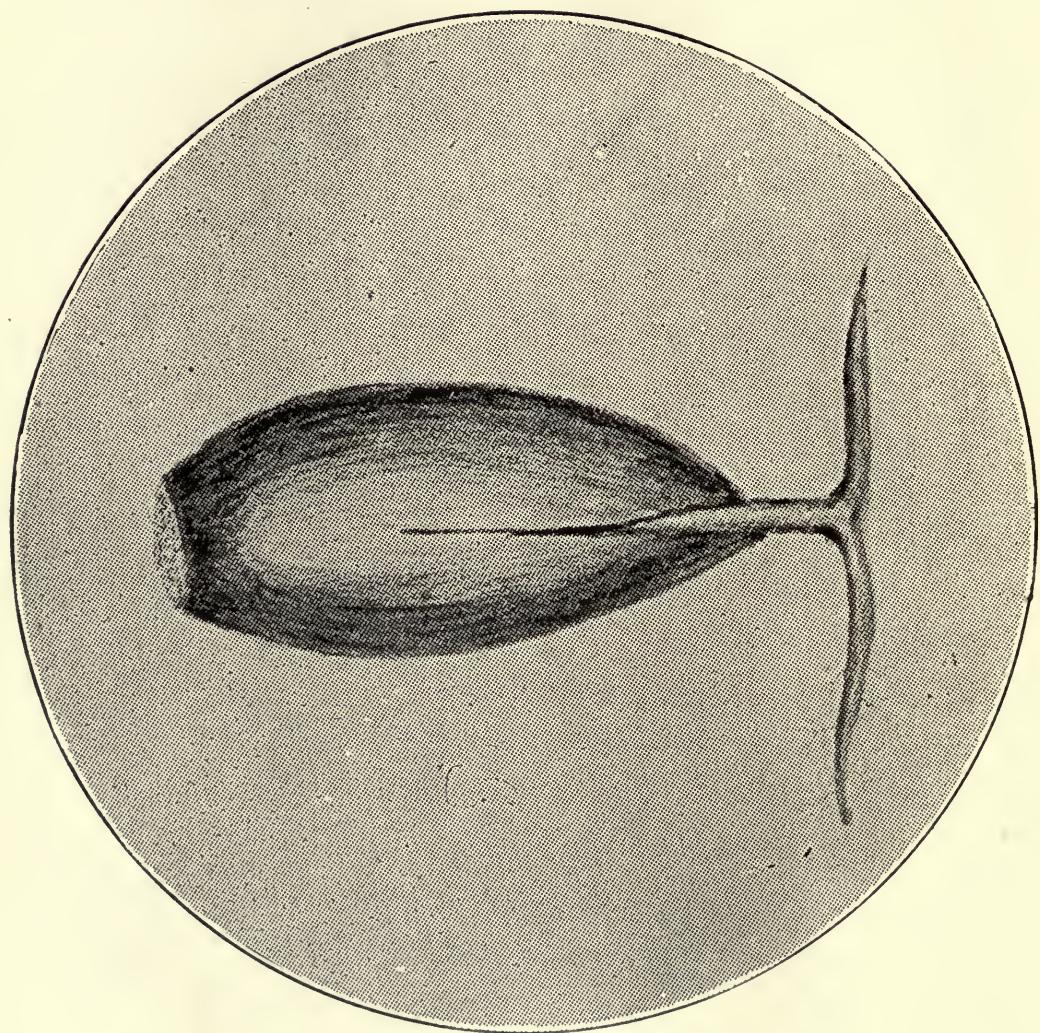
However, in such parts of the globe subjected to droughts causing total failures of crops with ensuing famine, the unfortunate people inhabiting the districts have an object lesson, most severe and destructive in its operation, showing how all life belonging to the animal kingdom is wholly dependent upon productions of the vegetable kingdom for the maintenance of existence.

In the bodies of all animal life, including mankind, there is a continual wastage going on in the life cells, which must be renewed by taking into the system those certain chemical elements existing in what we know as food, required to repair the waste, or

sooner or later death occurs by what we call starvation. The peculiar as well as important fact in this matter is that animal life cannot assimilate the necessary chemical elements, chiefly oxygen, nitrogen, hydrogen and carbon, in a form acceptable to the requirements of the life cells without the aid of the vegetable kingdom.

Protoplasm with which the life cells are filled is composed of the chemical elements just enumerated, and is the physical basis of all life of both kingdoms. Members of the animal kingdom being unable to elaborate protoplasm direct from the elements, Nature has provided that the vegetable kingdom shall assemble them with others that may be required, and manufacture them into compounds varying in character and form. These are recognizable in succulent plants, grain, seeds, fruits, etc. Another peculiar feature is that the vegetable kingdom members cannot work up these "compounds" from the elements direct, but must find them in the air, the water and the soil in gaseous and soluble combinations. For example, the carbon is derived from carbonic acid gas that forms a slight portion of the atmosphere in which we live. This gas, which is a combination of carbon and oxygen, is taken into the plant principally through the leaves. The nitrogen is taken principally from the earth, but also from the air, where it is always mixed with oxygen, as it is also in the soils with the addition of other elements in the form of nitrates that are soluble, for the roots of the plant cannot assimilate or take up solids. The hydrogen is also in combination with oxygen forming water. The plants after taking these up, use as much of them as are necessary for the increase of their protoplasmic cells. The surplus furnishes the material for cell walls and substances such as seeds, providing for the reproduction of their kind, and bulbs, rootstocks, cotyledons or seed coats for the nourishment of the young plants at the outset of their existence, also for the resin, turpentine, sugar, tannin, etc., so useful to the human family. The unused excess consisting largely of oxygen and some carbonic acid is returned to the air.

When we consider that these fruits, grains, bulbs, etc., are produced by plant life in such enormous quantities, away beyond what is necessary for reproduction of its kind together with the fact that all animal life would perish for the lack of food supply without this surplus, do we not distinctly see in



A SPROUTED ACORN—Beginning of the oak tree. The germ of life lies in the apex of the acorn. When awakened by moisture and heat it sends out a sprout which branches or divides—one limb descending into the earth to supply the root system, the other limb shooting upward and eventually becoming the trunk of the tree.

this, purpose and plan of the great Designer, and a fundamental feature of the scheme of life?

Yet I can understand how some people who have given but little thought to the operation of the laws of Nature or study of natural history would remain unimpressed, without further explanation that carnivorous or meat eating animals find the necessary chemicals in proper combination in the flesh of smaller or weaker vegetable feeding animals, which become the food supply of the larger or more powerful forms. Thus man eats beef and mutton which may be the principal part of the food sustaining his existence, while the steer that makes the beef and the sheep that becomes mutton in the meat market, obtained their growth from the grains and grasses of the vegetable world. Whatever the character of nourishing food to man or beast may be, trace back its history and it will be found to have originated from the vegetable world.

The vegetable kingdom while holding the fate of all animal life, in turn is dependent upon the waters of the earth to maintain its existence. The individual members must have water to aid in the manufacture of food-stuffs for animal life; it is required to dissolve the chemicals in the earth so the little roots of the plants can absorb them. The plants and trees, except those of aquatic growth, find the water in the soil. The water comes from the rainfall, and as every school boy knows, the source of the rain is the ocean and other bodies of water which yield it by evaporation from their surfaces; thence it is conveyed to and distributed over the land through the agency of the ever moving atmosphere. It is also a matter of common knowledge that three-fourths of the surface of the globe is water and the other one-fourth is composed of land, but few people notice the interesting and remarkable feature in this matter of proportion of water to land, which is that the water surfaces contain the proper area, to furnish the supply of water or rainfall necessary to support natural vegetation on the land area.

Nature operates this wonderful scheme on an immense scale, but not always with that nicety and regularity in distribution of rainfall on land to avoid the complaints of farmers of "too much" or "too little," as the case may be for a satisfactory growth of their crops. For vegetation in the natural or wild state, however, its operation is amazing in its grandeur, perfection and harmony. It does not require much thought to realize that through any material reduction in the proportion of water to land, if such a thing were possible, the entire face of nature on this earth would be changed. Our wooded nooks and vales shorn of their foliage would no longer be places of beauty and pleasing retreat. Our fertile fields would cease to be productive and the grassy plains and hill-sides would be made bare. In short our lands would become as a desert wherein would stalk famine and death for all organic life.

There is little profit in speculating upon the improbable, if not impossible, things relating to life, beyond the lesson we may draw in acquainting ourselves with the existence and working of the laws of nature and the part they bear to the Almighty's great scheme of the universe.

From what we have learned from the study of life and the origin of species it is possible that in the beginning primary life was exceedingly small and that the first forms were indistinguishable as being either vegetable or animal. We have such forms still with us bearing some animal characteristics at the same time exhibiting as strong vegetable features, and where to place them in classification has been something of a puzzle to scientists. Accepting the theory of evolution as sound doctrine it is easy to understand how this primary life may have given a start to what we now style the animal and vegetable kingdoms. In the millions upon millions of years that have followed since the division and the beginning of the two kingdoms animal life from the simplest form has developed into the complex beings we now see; and likewise plant life from minute and insignificant forms has developed the trees, vines, shrubs, plants and grasses that have made the earth habitable, contributing to the shelter of man and beast as well as yielding them pleasure, food and other comforts.

Though the dependence of animal life upon the vegetable kingdom for its existence must have been recognized by man since the dawn of intelligence and civilization, it is only since the discovery and invention of the microscope in a comparative recent age, that man, by the use of this wonderful instrument has been able to unravel the secrets of the organism of plant life and the function of the leaf with its miraculous mechanism operating therewith.

Ordinary leaves of vegetable life are of many shapes and sizes; each species of plant including trees, shrubs, etc., having a form peculiar to itself. The long slender pine needle and the broad leaf of a Brazilian illy, six feet and more in diameter, with upturned edges, are representatives of extreme examples. In defining a leaf, the stalk or petiole by which it is attached to the stem or branch of the plant to which it belongs is known as part of the leaf, although the leaves of some species of plant life are without stalks or petioles. Such are said to be sessile, the base of the leaf being directly attached to the stem without any extension from the blade. Besides the ordinary leaves, strictly speaking, there are others, which botanists take note of, that serve different purposes, where they serve any. These are the bud-scales, flower petals, scales of bulbs and the rudimentary forms sometimes found on tubers. However, it is the common leaf, the functions of which fill so important a part in the scheme of life.

An exceedingly interesting matter connected with occurrence of leaves is the peculiar systematic and mathematical order and pre-

cision of their attachment or insertion on the stems or branches. There are three modes, but no species of plant uses more than one. The different systems are known as alternating, opposite and whorled.

In the first or alternate, one leaf after another occurs along the stem, or perhaps more accurately stated, a single leaf from each node or joint. In the second or opposite system there are two leaves at each stem node, opposite to each other, and each pair of leaves occur at right angles to the other as they are produced by the growing stem, so that looking down a stem it would appear as if it bore four ranks of leaves. The last or third mode is the whorled, where more than two leaves spring from a stem joint, the places of attachment being uniformly spaced, that is, when there are five leaves in a whorl they will be located one-fifth of the circumference of the stem or stalk apart.

No two of these modes are ever seen on any one species, but several different families of plant life may have the same system. However, the systems, except in the "opposites" vary in the order and number of leaves circling a stem and the differences are uniform for each species. The variations in the "alternating" are most remarkable in their mathematical arrangement and division of space in the attachment of the leaves to their stems or branches. When this peculiarity came to the notice of that great naturalist, Darwin, he marveled at it, but said he could give no explanation.

The arrangement of leaves in this system with all its modifications is spiral. This will be readily detected by taking a stem well studded with leaves and noting that the first leaf above the leaf directly in front of you is located part way around the stem and the next leaf in order is still higher and farther on around, and so on until you find a leaf attached to the stem directly above the one from which you started. The variations referred to as occurring in this mode are in the number of leaves and the times around the stem until there is reached a leaf attached directly above the starting point; and in these numbers and circles comes the wonderful mathematical features.

The simplest and very common form is with the growths where leaves are attached on opposite sides of the stem, but each succeeding one above the other. Counting the leaves in this arrangement the leaf on the opposite side is one, and the next leaf in order located directly above the starting point, completing the circle around the stem, is two. This system is styled two-ranked, as only two leaves are attached to the stem in making the spiral turn complete. There being only two leaves, the space of attachment horizontally is one-half the circumference of the stem apart; though vertically, or the distance in height between the leaves, may vary considerably. The arrangement is also expressed by the fraction $\frac{1}{2}$.

The next in the series is the three-ranked or three leaves in one spiral turn around the stem, and attached one-third of the

circumference apart; and expressed by the fraction $\frac{1}{3}$.

Now it would seem as if there might be growths with four, five or six leaves with one turn, but none such exist, for nature controls this matter with mathematical system. The arrangement of all other series is in accordance with the peculiar law that each succeeding series is composed of as many turns and number of leaves as there are turns and leaves in the two preceding series. Therefore you will find the next in the series is expressed by the fraction 2-5, the numerator and denominator of which are the sums of those of the first two of the series. These figures indicate that there are two spiral turns and five leaves in the series and also that spaces of attachment of the leaves are two-fifths of the circumference.

We have for the first three series 1-2, 1-3, 2-5, and following the law mentioned in the last paragraph the next series should be the sum of the numerators and denominators of the last two fractions, to wit: 3-8, and that is what happens, three spiral turns and eight leaves three-eighths of the circumference apart.

The next arrangement is 5-13, following the same method of addition. Then follow 8-21 and 13-34, which is about the highest commonly noted and is as far as we need go to explain this peculiarity. Observe that these last also are the sums of the numerators and denominators of preceding fractions.

The structure of an ordinary leaf consists of green pulp, known in botany as parenchyma, through which, extending to all parts, is a fibrous frame of harder growth called ribs and veins. The veins are so styled for the reason they are hollow tubes connecting with the ribs and main stem or petiole of the leaf, also tubular, which besides stiffening and supporting the green softer part, give passage to the saps that flow back and forth from the trunk of the tree to the leaf. The veining of a leaf is called venation, and varies in accordance with the origin of the plant, but is so consistently uniform therewith that a mere glance enables one to identify the class to which the plant belongs.

The shapes and forms of leaves are many, and seem to serve no other purpose than to render ready identification of the various trees and plants, or make ornament and shade. One might think the Oriental palm tree with its large broad leaves would throw more shade than a tree with smaller leaves, but where do we find a denser shade than that of our live oak with its small leaves? But there are exceptions where the shape and form have a special purpose. Among which may be mentioned the hollow tubed leaves of the pitcher plant which, when partially filled with water, become traps for insects. Then there are the extraordinarily shaped leaves of the Venus Fly-trap plant which works something after the manner of a steel trap. When an insect alights or touches the inner face of either of the hinged lobes of the leaf they suddenly close together capturing the intruder, but what is more remarkable the leaf

secretes a digestive fluid which is said to be similar to the digestive fluids of animal life in its chemical composition, and the leaves remain closed until the softer parts of the victim are digested, or in short plain words, eaten by the plant. There are four or five other insect-killing plants of different forms, one growing in our Sierras, possessing the habit of capturing, killing and devouring flies and other insects. Other somewhat remarkable exceptions are the enlarged and thickened leaves of the agave and certain members of called leaves is the storage of nourishment and water that, not unfrequently, have been the means of saving the lives of men and beasts who, through some misfortune or miscalculation, were without food and drink.

The botanists say the tendrils of climbing plants, the sharp thorns, like those on the honey-locust tree, and the concentric layers of the onion and tulip bulb are but leaves in a modified form. In the case of tulips and similar bulbs, the special service of the so-called leaves is the storage of nourishment elaborated by the leaves above ground for the growth in the following year of the plant and flower and production of new bulbs. In doing this the old bulb is almost entirely absorbed. The bulb found in its place is wholly a new one. If the soil and climatic conditions are favorable several new bulbs will be produced.

The small leaves that form over the buds of branches for their protection in the winter are called bud-scales. In some cases after fulfilling that duty they fall off when the blossom or foliage develops. The bud-scale of the lilac, however, after the protecting service is ended, becomes an ordinary leaf, and with the dogwood it eventually becomes a showy part of the flower.

Leaves have the power of movement, but it is rather insignificant except in comparatively few species. Nearly all kinds can and will return to their natural position when twisted round so as to be upside down, if not too rudely done. The most common movement is among plants the leaves of which change their position at evening for the night and resume a daylight position in the morning. Then there are some plants known as sensitive plants, for the reason that when lightly struck, or jarred, the small leaflets suddenly close and fold up along the stem. But the most remarkable instance of independent movement is described as occurring with a plant growing in some parts of India, commonly styled the Telegraph plant. Each leaf stem, or petiole, bears three leaves; the middle, or terminal leaf is somewhat of the shape of a small leaf of a peach tree. This droops at night and rises with the beginning of the day. The other two leaves, which are very much smaller, under certain conditions of temperature keep up an incessant movement not unlike the flopping ears of a fly-bothered animal.

Whatever peculiarity of shape and size leaves may have, power of movement they possess, or special service in supplying forage, shade, or storing nourishment for future generations of its own kind, the principal and or-

inary purpose of leaves, in conjunction with the roots, is that of maintaining the existence and growth of the plant to which they belong; and in this function they exhibit the intricacies of a machine shop and the wonders of a chemical laboratory. But before we enter into the details of this relation it is necessary that we should review the principal features in the growth of plant life to secure a better and clearer understanding of the subject.

Growth of a plant signifies increase of its substance and its size generally involving some change in form. All the details of what takes place are not fully known, although the main principles involved have been pretty well established by scientists. They tell us that the active element of all life is protoplasm, a fluid form, and all manner of growth depends upon the multiplication or increase in number of the cells possessing this vital force. Through the agency of the nucleus, which each cell contains, the protoplasm multiplies itself by division of the cell contents into two parts, each of which, upon maturing, continues the process of division. The multiplication of the cells represents an increase of substance or what we call growth.

The walls of the cells are of a different material which in the tree and shrubs are elongated and become what we call wood. The walls gradually grow thicker and stiffer. The harder the wood, the thicker and more dense the cell walls. There are other cells and ducts for the passage of the tree saps which also increase in number in keeping with the increase of the cells of protoplasm. These also represent an increase of substance. So it is apparent that the tree or shrub in addition to protoplasm elaborates another growing agency, for the cell walls are mainly composed of what is called cellulose, a different combination of the chemical elements, that becomes the principal part of the structure of every tree.

For the formation of these growing forces the tree or plant absorbs from the soil and from the air and water certain chemicals heretofore enumerated. The chemicals are in gaseous and soluble form and usually are assimilated in quantities in excess of immediate needs and these excesses go to form sugar, tannin, resin, and many other commodities, according to the species. Excesses are also stored away in different parts of some plants in soluble forms of sugar, or as dextrine, or as starch, for use as seasonal or other conditions may demand. A part is stored in nuts and seeds and is used in providing a supply of nourishment for the young seedlings for the first few days of their existence. In some vegetable growths, as in the sugar maple tree, sugar cane and sugar beets, the excess stored is appropriated by man and becomes the sugars of commerce.

In the history of the operation of the life forces or growth of a tree, say an almond tree, the beginning is the seed, the common almond of which the lovers of nuts are so fond. The germ of life with its dormant protoplasm and nucleus lies in the little bud-like form between the two meaty parts of the nut that we eat.

WILD LIFE IN CALIFORNIA

Why this germ should be able to hold its active power dormant for years, or why under the influence of gentle heat and moisture it awakens into life, biologists have, so far, been unable to give us a satisfactory explanation. But, as everybody knows, an almond placed in the soil at the proper season will "sprout" and in the due course of time the sprout will become a tree which upon maturity will itself produce almonds.

The sprouting or germination of the seed means that the cells of protoplasm have commenced to multiply, which, as heretofore stated, signifies an increase of substance. For the first few days the material for the growth is supplied by the meaty parts of the seed or nut enclosing the germ bud. The rapidly increasing cells first form a shoot that takes a downward direction into the earth and is the beginning of the root system of the tree, and another shoot is formed which grows upward, which ultimately becomes the trunk of the tree. Within a few days the first shoot has sent out little rootlets and the upward shoot has produced a couple or more of leaves. By this time the supply of growing material stored in the meaty parts of the nut has been used up in forming so much of the infant tree. However, it is a matter of indifference to the youngster, for now being equipped with leaves and roots it is independent of its nursing bottle, for with the new appendages, leaves and roots, it can draw from the air, the earth and the moisture therein the elements it requires for its future growth and existence.

With all exogenous trees, of which the almond is one, the most rapid increase or multiplication of cells, up to a certain limit, is on the growing end of a shoot. At the same time there is also a lateral increase of cells by which the circumference of the shoot is enlarged.

The lateral growth by which the increase of girth occurs is best exhibited in a cross section of a tree trunk, which shows that with the close of the first year the protoplasm vacated the cells it had occupied after taking a rest during the winter. With the appearance of spring it moves outwardly and renews its work of cell building, which is continued until the ensuing winter; this manner of proceeding lasting during the life of the tree. The dormant and active periods being plainly marked by what are called the annular rings. A similar action takes place in the formation of the bark of the tree, only the protoplasm moves inwardly in cell building. The vacated cells in the trunk of the tree become a part of the hardwood, while those of the bark constitute the dry and dead-like parts. The soft and outer part of the trunk, the sap wood, which is cut off or eliminated in the sawing up of a log for boards or timber is the part last occupied by the protoplasm and is technically called the cambium layer.

By the continued addition of cells on the growing end or tips of the stems and lateral expansions of cells of the branches and trunk, and similar extensions and expansions among the roots, in the course of time, a tree is

grown. As may be inferred from the foregoing, this tree is composed of a multitude of cells with thickened walls of cellulose. These cells from the roots to the leaves are so connected that in the growing season there is constant circulation and interchange of materials. Remarkable and puzzling as may be the force that sends the solutions from the roots in the earth, sometimes hundreds of feet up, to the leaves that grace the top of the tree, even more mysterious and wonderful is the conversion by action in the leaves of the solutions into the various forms resulting in chlorophyl, protoplasm, cell walls, sugar, starch, resin, etc., and the return to various parts of the tree or plant of certain of the substances for its growth or storage.

Apparently from all accounts the most important and active agent operating in the leaves is chlorophyl, the green substance that gives the color to them. However, it is inoperative without the action of sunlight on the leaves. The surface of the leaves, especially the underside of most kinds, is filled with minute openings, so small that, except in a few cases, a microscope is required to see them. All of these openings to the inner part of the leaf are guarded by a pair of lips or valves, which open and close as the character of the operations going on in the interior of the leaf require. In the interior part of the leaf, or that portion between the surfaces, are numerous cells and air spaces, to which the raw material gathered by the roots is sent and distributed there by the leaf veins.

The gaseous elements, such as carbonic acid and the air with its oxygen and nitrogen, are drawn into the leaf through the small pores or openings mentioned. These elements are important and the most extensive of the contributions to the substances manufactured by the leaf. The openings are also used at times by the workshop in the leaf as vents through which to discharge all excess of oxygen or other gases that arise in the operations carried on there.

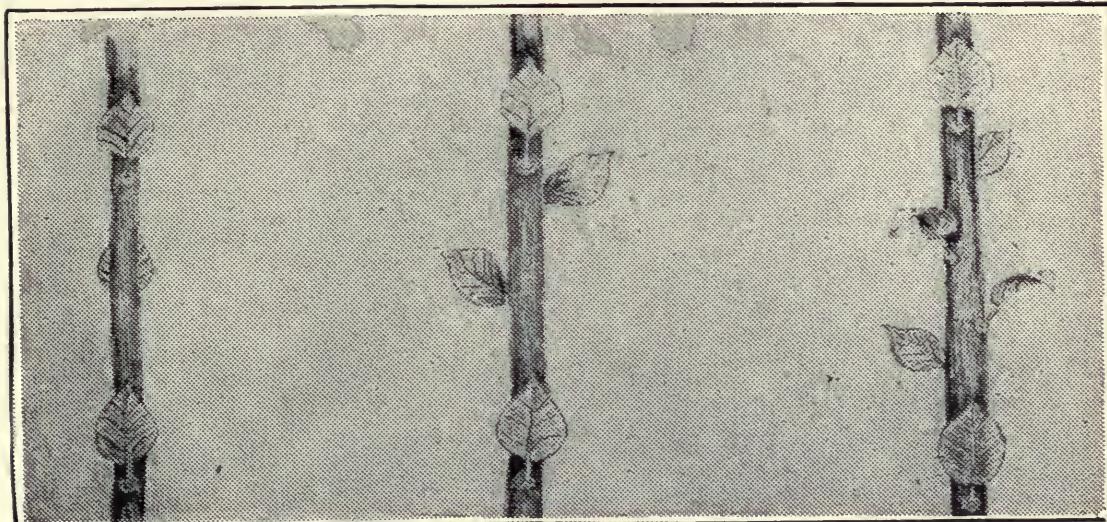
Asa Grey, the American botanist, in summarizing his description of plant growth, says: "The living parts of a tree, of the exogenous kind, are only these: First, the rootlets at one extremity; second, the buds and leaves of the season at the other; and third, a zone consisting of the newest wood and newest bark, connecting the rootlets with the buds and leaves, however widely separated they may be—in the tallest trees from two to four hundred feet apart. And these parts are all renewed every year. No wonder, therefore, that trees may live so long, since they annually reproduce everything that is essential to their life and growth, and since only a very small part of their bulk is alive at once."

While the facts given have been fully established, it must be said that all the mysteries of the wonderful work shop in the plant or tree leaf have not been revealed, especially in relation to the activities and powers of the chlorophyl. But as it is only within the last seventy-five or one hundred years that the history of the growth and life of vegetable

forms has been worked out to the extent of our present knowledge, it is possible that scientific research of the future will produce other wonderful facts, disclosing a closer analogy in the life histories of the animal and vegetable kingdoms.

However, there are wonders of tree life that will in all probability remain puzzles for the human mind until the end of time. Why the protoplasm and the chlorophyl, which to all appearances are the same in all plant life, operating in one kind of leaves produce one

kind of substance and in another kind something entirely different, and why a single cell of protoplasm seemingly alike in all vegetable forms, and which in fact is the unit of all life, has when in one seed the potential power of producing a majestic oak that may live for ages, and in another seed its power limited to the production of a humble weed with an age of no more than weeks, will probably remain something as mysterious and unfathomable as the problem of life itself.



AT LEFT—Leaves spaced one-half of circumference, two leaves and one circle around the stem. This system is expressed as 1-2

CENTER—Spaced one-third of circumference, three leaves and one circle; expressed as 1-3

RIGHT—Spaced one-fifth of circumference, five leaves and two circles around the stem. Expressed as 2-5

CHAPTER XII

THE BATTLE OF LIFE

Some of the Troubles with which Organic Life has to Contend, and the Lessons they Afford Mankind

Sometimes when contemplating the problem of human life, especially when I meet a man with dejected countenance who in mournful tone declares he feels like a "living tomb," I wonder if there is not something amiss in his educational training. Our institutions of learning include in their general purpose the object of making honest, truthful and moral citizens of our youth, but do they make sufficient effort to instill into the minds of the young that the life that lays before them is something not to be looked upon as a future of unalloyed pleasures? Does the system prepare the minds of the young men and young women for the time when they step out into the world to meet the vexations, discouragements, obstacles, snares, misfortunes that lay in the pathway of every human life?

Perhaps it is thought that youth should be given these important lessons on life at the home circle or fireside. But I am afraid the home is as remiss as the school. It is unpleasant to dwell upon the disagreeable things of life, but how much easier it is to meet and overcome difficulties when forewarned of them. No soldier could win success unless trained how to deport himself in battle, how to withstand the shocks from opposing forces, and how to avoid and overcome the enemy's obstructions. It is the courage, force and zeal the soldier exhibits in sweeping aside all opposition and striding on to victory that makes him a hero and an object of admiration.

Likewise man should be trained from early youth how to meet the adversities of life he surely will encounter as he tries to make a place for himself in the world. The higher his ambition for the comforts of life, knowledge and fame, the more thorough must be his training and greater his efforts, but greater will be the glory of his victory.

Nature produces life in various forms from the simplest to the most complex, but to maintain existence demands of all certain activities. This unavoidable requirement may work harder with one than another and more severely at one time than at others. It may occasionally involve the necessity of great effort as well as conflicts of serious character. Moreover, all life is subject to adaption to climatic and soil conditions; that is, the life of the tropical zone could not maintain existence if transferred willingly or unwillingly to the arctic, no more than life reared in the latter could prosper in the extreme heat of the Equator; plants adapted to rich deep soils of

the valley will not thrive in shallow, rocky, dry land of the hillside.

Nature made no exception in the operation of these laws. They apply to all forms of life in both animal and vegetable kingdoms. To illustrate, first taking plant life; the seed which contains the germ of life of the plant, shrub or tree finds a place in the earth. With proper heat and moisture it will germinate, sending roots into the ground and stems into the air above. Its life has begun and its struggle for existence as well. If the seed fell into soil favorable to its growth and surrounding conditions were favorable to its needs, the ensuing growth will have found a locality adapted to its purposes and it will have greater vigor and strength and power of resistance in its conflicts with other life forces and even the elements that will from time to time attack it. If this growth should be the beginning of an oak tree, it will be a tough little youngster, although, like all life in the infant stage, it will have its weaknesses and may die from the effects of the hard knocks that it is liable to encounter. However, Nature endows the baby oak with more strength and hardihood than is apportioned to many other kinds of infant trees. In this stage of its life it is liable to be crushed flat by the foot of man or beast, still be able to recover its upright position and live, though possibly bearing the scars of its misfortune through life in a mishapen trunk. There are many other things it will have to contend with, some of which may threaten its health if not its existence. The browsing beast may be disposed to vary its food with the tender shoots and fresh leaves of young oaks; the larvae of butterflies and moths, caterpillars that have a penchant for oaks, so numerous at times and so voracious their appetites that they strip even mature trees of their leaves; the aphids and other forms of minute life that besmear the foliage with gummy secretions and clog the pores thus interfere with one of the most important functions of the leaves; the members of the Cynipidae family as well as some other insects that sting the bark and leaves, producing swellings, oak balls and other galls on stems and leaves; the wood boring insects that make their way through the bark and into the tree making wounds most serious to its life, though the oak is less afflicted from this source than fruit trees which are not infrequently killed by borers. Now should the oak live through all these vicissitudes, escape injury or loss of limbs from the blasts of Old

Boreas or lightning strokes and reach the limits of growth, a majestic representative of organic life, there is still man with his cruel ax and new fangled saws who may terminate its career by felling the proud tree, dismembering its limbs and cutting it up into firewood or timbers and boards as his needs may require. Escaping from such ignominious end it may live on to old age still bearing the burdens of life, chief of which is the support of parasitical relations, mistletoe and mosses that fasten themselves to the old tree and remain a drain upon its resources as long as it lives. Finally no longer being able to resist the attacks of its enemies, the inroads upon its vitality are manifested in decay and decrepitude and it becomes weak and tottering, like the highest representative of animal life, man, who succeeds in living a score of years beyond the average age allotted to his kind. The end is that which comes to all forms of life of both kingdoms alike, death.

Other forms of the vegetable kingdom are no less subject to vicissitudes of life, and very many have a greater struggle to maintain their existence, especially that branch of the flora known as annuals, through the lack of rainfall, excessive cold, attacks of insects which devour the roots as well as others that feed on the leaves, stalk and fruit.

As to life experiences of members of the vegetable kingdom, sufficient has been said to show that those forms of plant life which succeed in maintaining an existence and reaching maturity—those that escape from their enemies, or are not seriously injured in their conflict with them, are objects of good fortune and at the best their lives are not without conflict, but subject to uncertainties, misfortunes and disasters.

However, to continue the inquiry of the subject we must take up for consideration the life experiences of representatives of the principal branch of the animal kingdom. To this end we will first consider some of the features of the life history of a class that inhabits the waters. Perhaps at first thought we might look upon fish as being care free. They seem to have no routine of employment, no harvest to gather in providing future food supply, no habitations to create and are, almost without exception, without family cares and not possessed with the slightest regard for their offspring. Other than the annual performance of laying eggs in perpetuating their kind and of securing their daily food, the fish family have little else to do and would appear to have been allotted an ideal existence, according to the way some unthinking persons look upon the purposes of life. But appearances are not to be relied upon in search of truth. The fish have their troubles and struggles in maintaining an existence, more so, perhaps, than many of the other forms of life.

As in the infantile stage of plant forms, the most critical period in the life of most fish is babyhood. Generally speaking, the parent fish lays thousands of eggs each season, but only a few of them escape the ravenous jaws of other fish and other enemies. The baby

fish that are hatched from the few eggs that escape such fate, if in inland waters, at once seek the shallow margins or other protecting spots where they begin the struggle of life. As a rule the waters supply an abundance of food while in this stage and their greatest concern is to avoid the numerous forms of life that are seeking their little bodies for food. It is estimated that only an exceedingly small percentage of the fish hatched live to reach the size and age of maturity. It would seem as if every fish were ready to swallow its neighbor size permitting, and which in turn is in constant danger not only of being swallowed by some larger fish, but being made food of by birds and land animals, including man. Thus it is, under the constant menace of death, that the majority of the fish kind live out their career. The finny denizens of the great depths of the ocean waters, of course, are practically immune from attacks from others than their own kind,

If fish have any compensation for the vicissitudes attending their existence or possess anything analogous to what we call the pleasures of living, it must be in eating, and only this, if we interpret the gratification of insatiable appetites as yielding pleasure.

In addition to the dangers from inhabiting the same waters with cannibalistic relations, many species of fish have other troubles to contend with, chief of which is the affliction of parasites. A notable instance is observable in Klamath Lake, in Southern Oregon, where the large trout common in its waters have their mouth parts attacked by a worm-like animal, probably a species of leech, which affixes itself to the inner parts of the fish's mouth and sucks the life juices of its host. The big fish does not quietly or tamely submit to the proceeding, for which it is made uncomfortable by the presence of the parasite it comes to the surface, flopping violently as if trying to shake loose this intruder. It commonly succeeds in ejecting it, throwing it to a distance of ten or fifteen feet. When near enough the action is discernable in all its details from the land or boat. The observer may be startled by the sudden flopping of a big fish on the surface of the water near by, and if his eyesight is quick and sharp and the fish successful in its efforts to free itself of the obnoxious pest, he will see the unwilling flight of the leech; or if he misses that he cannot help seeing the spot where it falls into the water indicated by the circles of tiny wavelets caused by this disturbance.

Perhaps a more exceptional trouble to which the fish tribe may be subjected is the pollution of the waters which they inhabit. Possibly we can more fully appreciate what this means in its effect on the inhabitants of polluted waters by considering the result to a community of our own kind if the atmosphere in which we live, and which is much the same to us as water is to the fish family, should suddenly and without notice become impregnated with sickening or poisonous gases.

An incident, rather extreme in character, illustrating the result of pollution of waters recently came under my observation while on

WILD LIFE IN CALIFORNIA

a visit to a neighboring town. One morning while crossing one of the bridges over the river there, in looking down upon the water, I saw a most unusual sight, the surface of the stream from bank to bank and for several hundred yards, as far as the bend in the river permitted my vision to extend, was covered with dead and dying fish. I estimated there was a fish for each one and a half square feet of surface. In many places there would be four or five dead fish in that space. It was something of a surprise to me that the stream could yield such a quantity of fish in the limit of space mentioned. There was nothing to indicate a concentration, though probably there were more fish inhabiting that part of the river within the city limits owing to the sewers of the city emptying into it supplying more or less food. The fish were nearly all of one species, catfish, apparently of an average length of ten or twelve inches. There were a few carp and some smaller fish locally called white fish, also known as "split-tails" owing to the sharp forking of the tail, the upper lobe being considerable longer than the lower lobe.

I was informed by a resident that similar occurrences of dead fish had happened twice before in the preceding three months. As to the cause, this man had no explanation, but from other sources I learned that a certain manufacturing establishment located on the banks of the river was engaged in turning out some form of war supplies, in the production of which there accumulated some waste solutions which were periodically emptied into the river. The periods of disposition of the waste solutions agreeing with occurrences of the dead fish, the responsibility for the wholesale killing was laid to the manufactory. As the fish possessed no food value of any importance their destruction in this way was not regarded as a serious matter, but rather as an unavoidable affair incidental to the war needs of the government. On the other hand if the fish of the river that escaped from the disaster could have given expression to their views of the incidents their protest would probably have recited the great dangers and difficulties the members of their class ordinarily have to contend with in working out the cycle of their existence, which is enough for them to bear without having to suffer such an overwhelming affliction, and concluding with an appeal to the laws of the state for protection from a repetition of the slaughter.

At the risk, possibly, of making this essay seem somewhat monotonous, in carrying out the point I wish to make, I shall now consider some of the troubles of bird life that seem to harmonize with nature's general plan of existence for all organic life on this sphere. Unlike the fish, birds as a rule possess parental interest in their offspring. The labor, anxieties and care attending the rearing of the young to the stage of life when they can provide for themselves, embrace duties and sacrifices which are no insignificant additions to the list of difficulties which the piscatorial family have to work out in the course of their existence, the greater part of which the

majority of bird life is also subject to. Birds have so many enemies that their entire existence from nestling to the end of life is passed under a continual fear of attack. A great percentage of unnatural mortality in bird life is attributed to the cannibalistic and savage character of some forms of their own kind, hawks, owls, etc. While foxes, cats and many other animals, including snakes, would not be far behind in the amount of death percentage chargeable to them. Finally, the acts of mankind towards the feathered family have been of such murderous and unfriendly nature that all its members fly and seek to hide themselves from bipeds, big or small. A great many birds, if they maintained a black list of their enemies, would head it with man, as being the most deadly and inconsiderate and even cruel, for much of his killing is done in what he calls "sport." If a person wants any evidence of how birds regard this condition that follows them through life, they have only to take note of their actions when feeding. If the bird under observation happens to be a seed feeder, it drops in its flight to the place where its desirable food may be. Instead of immediately starting to feed, as a rule it will first stretch its head up and look in all directions for the presence of an enemy. If it should happen to detect one within a distance that implies danger, the bird will not only recognize the enemy but the menace to its welfare as well, and will depart without eating. Should the "coast be clear," however, the bird with lightning like rapidity will snatch up a seed, then while working it in its mandibles to free it from its husks stretches its head up, looking this way and that, alert that no enemy shall take it unawares. This action is followed with every seed the bird picks up. By close observation of bird habits, wherever undertaken it will be noted that much of the birds' time is passed in search for danger. Perhaps it may be said they have by experience strongly developed the principle of "safety first." A bird may be perched in some tree top or other prominent place and singing as if most happy and contented with its condition in the world, at the same time both of its eyes are open and quick to detect the approach of danger.

Yet with all this handicap in working out their existence the feathered family seem to enjoy life and are tenacious of it. None of the cares, sacrifices or dangerous duties of life imposed by nature are shunned or slighted, but are carried out in a spirit of loyalty, contentment and apparent happiness, not unworthy of emulation by the highest members of the animal kingdom.

For all of the balance of the members of the Vertebrate branch of the animal kingdom in a wild state from the little shrew up, there is a continuous menace of death, and the numerous vicissitudes of life to which they are subjected vary but little from those described. The dullest mind with little thought can recall how man seeks to exterminate all species of animal life which he regards as being destructive, or obnoxious;

how the larger animals relentlessly prey upon the smaller, and the smaller upon the smallest; and how the majority of all four-footed animals are hunted, trapped and slaughtered for food, skins and fur by man. With domestic animals the conditions are not so severe. True, such as are bred and reared for human consumption have limited terms of existence, measured by their condition of fitness as food, but other domestic animals like the horse, cow, dog, cat, etc., that assist man in procuring the necessities of his life, or serve him as a companion or guardian of his person or property, pass an existence more free of troubles, cares, disappointments and misfortunes, than all other members of the animal kingdom.

Nature, however, does not permit even these few representatives of life forms to pass an existence entirely free of trouble, for with all their easy conditions of life the most fortunate may enjoy, there is disease, accident, result of passion, to which they are still subject.

The leniency of nature, especially as relates to the dog and cat, may be an exception wisely designed as an object lesson to those of mankind inclined to rail at her scheme of life and who would remodel it into one without care, want and conflict and with absolute peace and harmony. Even the dog's life with its few cares and vicissitudes would be an elevated existence compared with what that life would be under such an order of things. There would be no homes, for they would involve cares and vexations; no factories, for they would engender trouble; no professions or businesses, for they would necessitate labor to acquire and maintain. Ignorance would replace knowledge; indifference and stagnation would be substituted for science and progress, producing life without aim, purpose or desire.

However, it is not my intention to discuss the question, whether or not Nature's scheme of life could be improved by the elimination of its dangers, vexations, cares, conflicts, etc. What I have written is for the object of recalling to unthinking minds that these things, objectionable as they may seem, are inseparable and in a sense unavoidable in all forms of life, including mankind. It has always been so and probably will continue so until the end of time, with some modifications as the mind of man broadens and develops in his conception of things, with higher regard for his obligations to and his relations with, not only his fellows, but all other forms of life.

According to the estimates of those writers best qualified to judge the nine branches of life that compose the animal kingdom embrace five hundred and twelve thousand five hun-

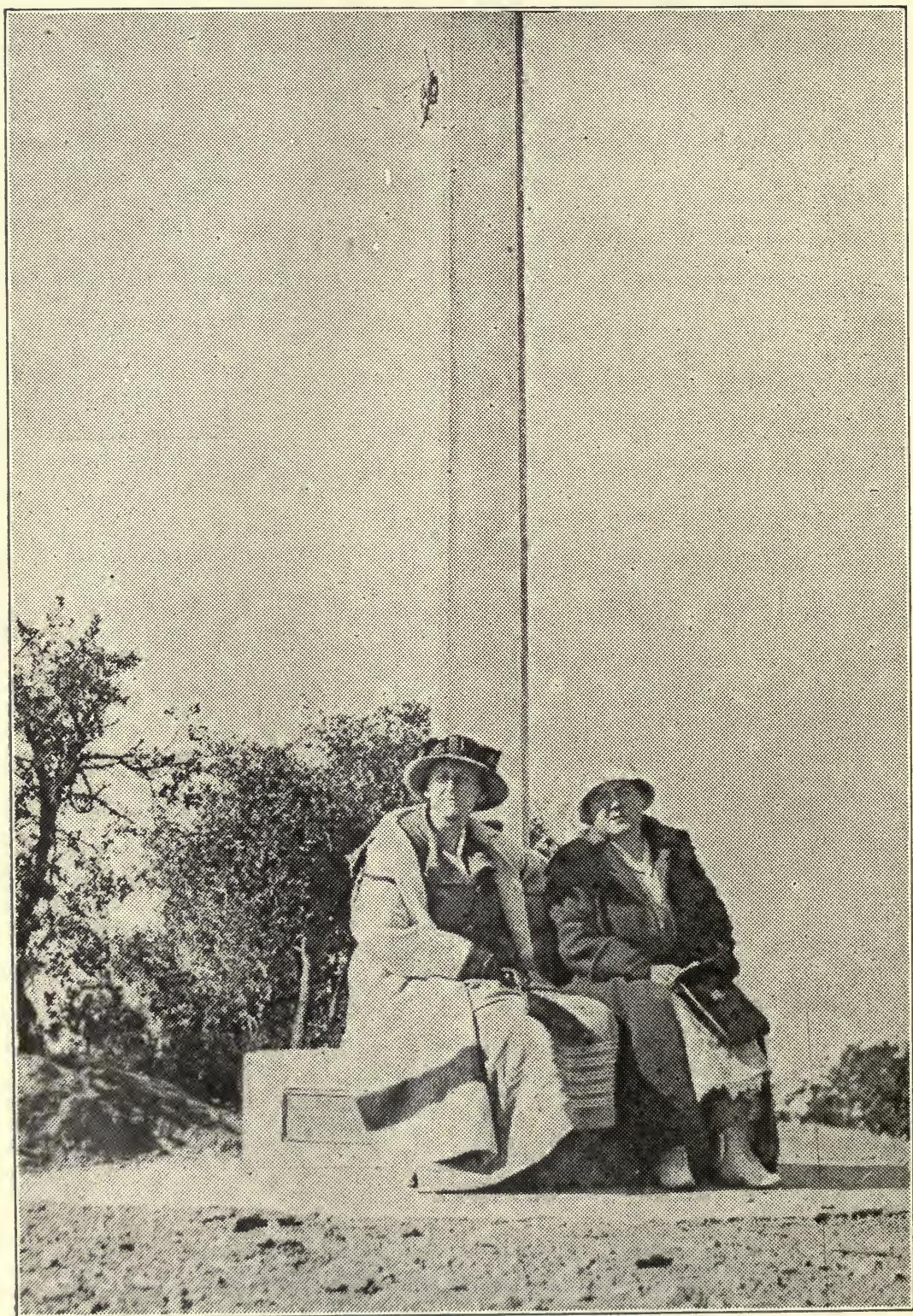
dred species, of which man is one. By reason of his superior intellect and habits man is regarded as being in a division of life apart and in advance of all other forms, but physically he is only a variation, inferior in strength and endurance, compared with many of the mammals to which he belongs. He was created on the same general plan, with organs functioning on the same general principles, as with the mouse, fox, horse, dog, elephant, or other vertebrates. For this reason, if no other, man is subject to the operation of the laws of nature the same as the balance of the animal kingdom, from which there is no escape or exception in his favor. But nature dealt more liberally with man in giving him a superior intellect, by the proper operation of which he avoids or reduces to a minimum many of the objectionable features attending life. However, the responsibility of its use and operation is placed wholly on man himself. It depends largely upon the individual, how he exercises the great intellectual gifts of reasoning, judgment and perception, whether his life shall be made a pleasant or unpleasant career, a success or failure.

In one sense life is war and the man who spends his time brooding over misfortunes, who is cast down by failures, who bewails his lot in life because of losses or accidents, or who lets his griefs unduly sadden his life, is like the soldier in battle who lays down his arms or flees at the first onset of the enemy. His conduct casts a gloom on his surroundings and he becomes an object whom people seek to avoid even though they entertain feelings of pity for him.

When man discovers his place in nature's great scheme of life, and realizes that he is only one among millions of his own and other forms of life, all subject to the same laws, and learns that the hard knocks in life are not wholly accidents but incidental to operation of nature's great scheme, and develops the courage and strength of character to face them, he will have laid the foundation for genuine enjoyment of life, as well as put himself in the way to command the respect and esteem of his fellows, which alone is one of the most satisfying, solid and enduring comforts attending life.

Human life has its genuine pleasures and its enjoyable compensations for its troubles and hardships, but they are not commodities, purchasable, like goods on the shelves of the merchant's store, but things that are free to all, yet are obtainable only by proper conduct and unselfishness in our relations with our fellows, by being temperate in all things and loyal to the laws of nature and society.





MONUMENT ON SUMMIT OF MT. DIABLO

CHAPTER XIII

WILD LIFE

Found in and about the Grounds of Diablo Park Residents and Visitants

In a previous chapter I gave considerable space to detailing observations made while tramping through Diablo Canyon. It is now my purpose to relate some matters of interest noted while rambling over the club grounds and golf course in the park, or valley, below.

Diablo Canyon is the great gash in the southwestern side of Mt. Diablo. Therein gather the waters forming the creek that once flowed down through the park grounds at the foot of the mountain. I said "once" for now and a number of years past the waters flow only in the creek bed of the canyon proper, as a dam was built across the canyon near the place of its opening into the valley, or park. The waters thus impounded form a pretty little lake, making a very attractive spot for lovers of water sports. Gamey black bass inhabit its depths and families of the long-legged great blue heron are annually produced in the neighboring tree tops.

In the course of time long before man located here and piled up the big bank of earth and clay across the canyon to stay further flow of the stream, the waters had cut a deep meandering channel for a mile and a half or so through the alluvial land of the park valley. The banks of this channel, or creek-bed, are thickly lined with growths of oaks, willows, alders, etc., most of which are of extraordinary size. This is especially true of the first two mentioned. In fact the supposedly largest live oak tree in the state is growing on the banks of this creek. It measures 24 feet in circumference, is 80 feet high and has a spread of 125 feet. The trees and wild shrubbery bordering the stream bed constitute a feature greatly contributing to the natural beauty of the park and grounds of the Mt. Diablo Country Club.

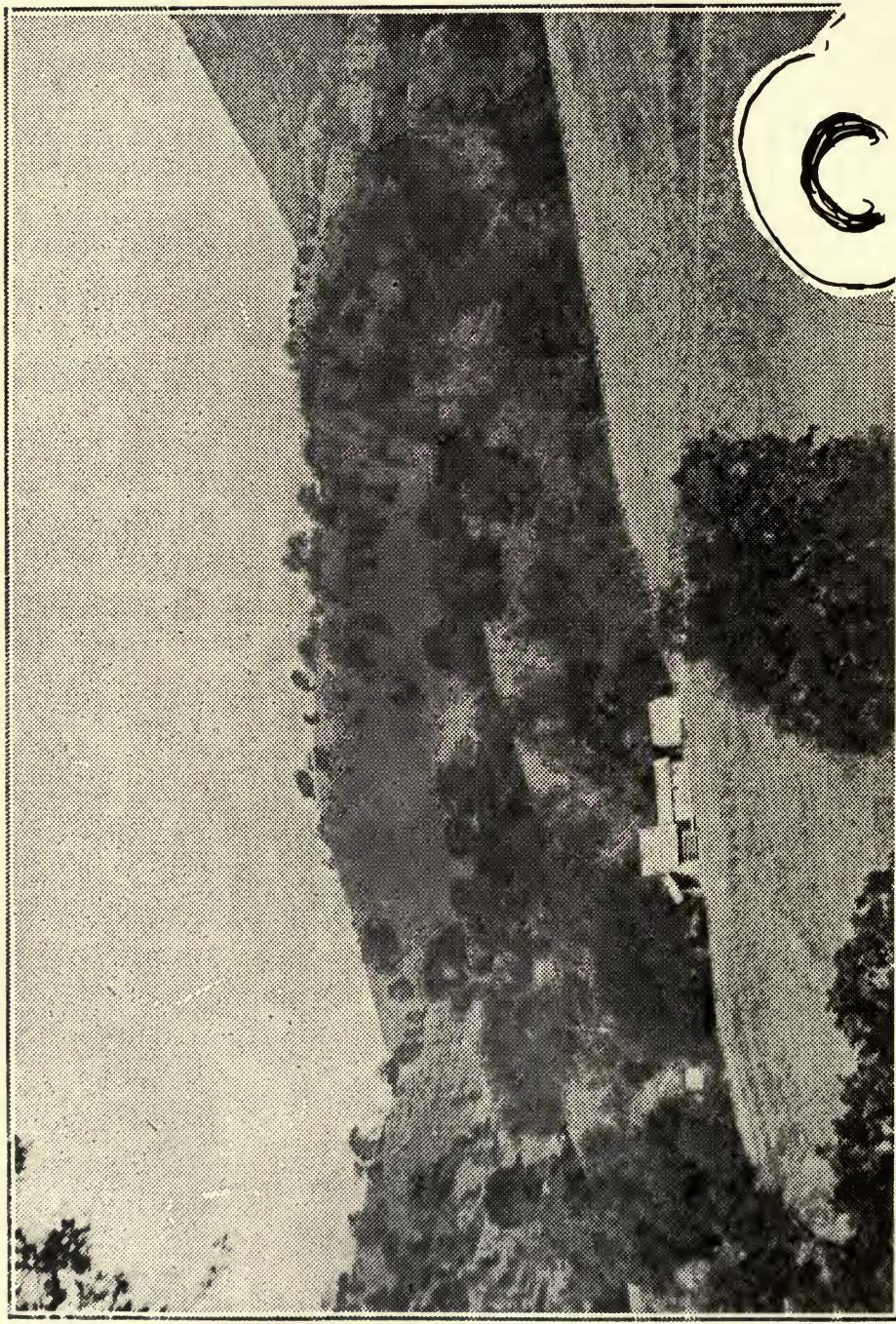
The most active agents in undoing the work of the green-keepers in keeping the greens and fairway of the golf course smooth, clean and free of obstructions are the colony of gophers that infest the grounds. In one section of the fairway, between number one and two greens, nearly 3000 of the rodents had been shot, trapped and in other ways killed in a little more than two years' time, when the green-keeper tired of recording the captures, so we know not how many have been slain since. However, he says the rate of his slaughter has not been reduced, and to all appearances the gophers are as numerous as ever. A peculiar feature of their activities is that twice a day, about nine or ten o'clock in the morning and three or four in the afternoon, the gophers come out

of their holes for some reason I am unable to explain. Notwithstanding they pass the greater part of their lives underground keenness of eyesight with them does not seem impaired thereby, for when on the surface of the ground they are quick to detect the presence of danger and the man with the shotgun has to be quick in using it if he is to be successful in shooting them.

The gophers have other enemies, among which are snakes. For some weeks in the summer of 1919 a large gopher snake made its headquarters in a section of the golf course that was thickly infested with the rodents. No one ever saw the snake actually catch a gopher, but there were club members who were sure it lived on gopher diet, and interfered with the intentions of snake haters who would have killed it just because it was a snake. I saw the reptile once stretched out snake fashion by a freshly made gopher hole with its head raised about four inches over the hole. As the time of day was about eleven o'clock in the morning I concluded it was possible that the snake was acquainted with the hour-habits of the gopher in coming out its hole, and the snake remaining motionless in the position described for the several moments I watched it, was a circumstance that seemed to me to justify the thought that it was waiting for the appearance of a gopher.

Not long since one of the club officials was working in his front yard when he discovered a large gopher coming across the road toward him. Thinking to frighten the animal so it would possibly leave the vicinity of his lawn and garden he rushed at it. Greatly to his astonishment the gopher did not turn tail and flee, but stood its ground and bared its hideous chisel teeth. When the man got near enough to kick the beast, he was fairly startled, for before he could use his foot it took the initiative in making attack and in a most vicious manner jumped at him. Then the man and gopher "mixed it," the former kicking but missing the mark and the latter as frequently jumping and failing to score. Thus they battled for what seemed minutes, until the superiority of the man was finally demonstrated, the gopher failing to recover or revive after receiving a blow from the toe of a heavy shoe that sent it flying several feet through the air.

I have seen a number of gophers in the course of my outdoor life out on the surface of the ground but never very far from their holes, into which they always made quick retreat at the slightest indication of danger.



GENERAL VIEW FROM DIABLO COUNTRY CLUB GROUNDS, SHOWING ROLLING
NATURE OF COUNTRY AND GROWTH THEREABOUTS

I should as soon expect to be attacked by a ground squirrel as a gopher. The incident just related, though however surprisingly strange it may seem, was witnessed and corroborated.

Coons, skunks and ground squirrels are about the only other wild animals to be found or seen about the park. Of the first mentioned, it is seldom one is so bold as to show itself during the daytime. Occasionally one is seen prowling about the place in the night-time, but indisputable evidence of their being among the inhabitants of the park are their numerous footprints made in the dust of roadways and paths. One of the employees of the Club, who was quite expert in trapping animals, last season caught a number of coons, one of which was an albino. The ordinary markings of a coon are gray body and black and white face, but this particular animal was all white and the parts that were commonly black were the whitest. The other parts were almost a yellowish or a dirty white. These changes in the color of the animal so altered its general appearance it was some time before anyone identified its true character when exhibited at the club.

Skunks are an extremely unpopular race of animals. So much so that very few people know what they look like. If one can be induced to lay aside his prejudice it is then possible for him to appreciate the fact that these animals are unusually attractive in appearance. If it were not for the obnoxious smell that they occasionally distribute about places and at times when least desired or expected, they would be called or classed as being among the most beautiful of all our wild animals. They are shapely and strikingly marked in black and white, and carry themselves with grace, dignity and an independence that seems inspired by a consciousness of the possession of a weapon of defense and offense, for which the rest of animal life has a wholesome respect, if not fear. I have never been able to put a skunk to flight in a more rapid pace than a deliberate walk and even then the order of its moving off was always a matter of its own choosing. From what I have seen of the habits of these animals I think there is no danger of a person being assailed in the manner which they are so commonly thought to act, unless they are first attacked. They are not vicious and are easily tamed but probably will never make popular pets.

A half-grown one remained about the grounds of our place at Diablo for several days. It would come up to the back door and eat out of the same dish with four young cats. The cats and skunk got along together without the appearance of the slightest disagreement. The morning when I first detected the presence of the animal, by slowly edging up to where it was feeding I was able to approach within six feet of it. It then began to exhibit signs of objection to any further attempt to closer familiarity on my part. It backed a short distance with its head and face turned my way, then suddenly it jumped a few inches toward me with its front paws sticking out straight and striking the ground with them,

to let me know it was getting angered. Several other kinds of animals express a rising and dangerous temper by striking the ground with one or both of their front feet, but I was somewhat surprised to observe the skunk acting in this manner. It made several such jumps at different times during the day while I was endeavoring to cultivate its acquaintance and trying to take its picture with my camera. It was when I pointed the instrument at it that it displayed the most temper, and I confess to a little nervousness, but nothing happened. However, I saw the little animal but once thereafter.

Besides annoying some of the families residing in the park grounds and who keep chickens, the greatest damage for which these animals are responsible is digging little holes in the lawns and putting-greens of the golf course in their search for grubs, or larvae, to be found in damp soil. Though occasionally there is just cause for complaint for their pollution of the night air, which ordinarily is so soft, pure and enjoyable. Since the pelts of these animals have become so valuable and so many have been trapped hereabouts, there has been but little to complain of even in this matter.

About the most numerous of all wild life in and around the park or club grounds are the ground squirrels. This seems quite remarkable from the fact that ten years or so ago a war of extermination was declared against the rodents after the discovery that they were carriers of the disease germs known as the bubonic plague. They were shot, asphyxiated and poisoned by agents working systematically under the direction of government and county officials, to say nothing of what the owners of infested land did to the squirrels to protect their crops. These campaigns at the time seemed effective and were carried on season after season until it was difficult to find a squirrel in the localities where the offensive operations were conducted. Through inability to secure or enforce cooperation of the land-owners with the officials, the infested sections were not thoroughly gone over. A colony here and there was passed by. These, with the few that escaped the deadly fumes of carbon bisulphide, the poison and the shotguns, have been sufficient to restore the numbers of squirrels in some of the depopulated districts where the war of extermination has not been rigidly maintained. This part of Contra Costa county appears to be one of these districts.

Going over a low hill near the last green of the golf course I suddenly intruded upon a colony of fifty or more squirrels out feeding, playing or sunning themselves in a space of not more than an acre of ground. One old squirrel quickly gave utterance to several loud, sharp squeaks, which an imaginative hearer might have interpreted as "Beat it! Beat it! Beat it!" Whether the interpretation was correct or not, whatever it said was an effective signal of warning, for in less time than it takes to say it, every squirrel was scurrying to a hole. Under such circumstances the animals do not seem particular about what hole they

go into. When rather closely pressed I have seen them take to the large, deep cracks in adobe land.

The ground squirrels are a serious pest to the farmers in many parts of the state, in that they consume quite a percentage of the crops before they can be harvested. They also damage stock ranges in some sections by their numberless burrows and by feeding on the grass seeds. Government officials conducting the war on the rodents have collected some very interesting statistics in relation to this matter. In sections of the state where they had been operating for several seasons, they secured statements of the owners of several farms showing the gross receipts of farm products for a term prior to the beginning of the attempt to exterminate the squirrels, and then statements from the same farmers for the term following or after the lands had been thoroughly cleared of the pests. The gain to the farmers was surprisingly large and fully demonstrated that they had been suffering losses that could be obviated by exterminating the squirrels.

The genial climate of the Park district has not been overlooked by insect life common to our part of the country. Such orders as seem adapted to the conditions here are generally to be found well represented in large numbers. As a consequence the grounds are at times visited by various insectivorous birds. Flocks of blue birds are to be seen at almost any hour and nearly every day upon some part of the fairway of the golf course. What particular insect, or insects, they feed upon I have, so far, been unable to determine. Recently while watching the actions of some of these birds I saw a bird suddenly fly upward from the ground in chase after a large locust or what is commonly styled a grasshopper. The remarkable thing about the incident was the unusual height to which the insect flew and its darting first one way and then another in its effort to escape its feathered enemy. Though the bluebird was quick on the wing and closely followed the dips and turns of the locust, the latter finally succeeded in avoiding it and escaped. The actions of both bird and insect seemed to be prompted by something more than instinct.

Species of what Fabre styles the Hunting Wasps are very common in the park. One of the most interesting of these insects belongs to the Pompilidae family, which specializes on spiders as game. They are interesting not only for their large size and beauty, but their intelligent actions. Their jet black bodies with orange colored wings and long legs give them a striking appearance, frequently attracting the attention of people not specially interested in insect life and prompting them to inquire as to what they are. After the sun has risen high enough above the eastern horizon to give a temperature agreeable to the wasps, a short walk in almost any part of the grounds at the proper season is almost certain to bring to one's notice one or more of the big fellows either flying around rather close to the ground or walking rapidly about hunting for spiders. While observing

the thoroughness of search they make for victims, under fallen leaves, in cracks and holes in the earth, in bits of accumulated rubbish or grass, omitting no place in which a spider could hide, my mind would revert to the similarity of their actions to those of a good pointer or setter dog working among a bevy of quail scattered and under cover in low brush, ferns and rocks. Both show their eagerness in the hunt, proximity of quarry and excitement that follows by the manner of their agitating certain appendages. With the dog it is his tail, with the wasp it is the antennae on the opposite end of the creature.

The largest of this wasp family will attack tarantulas, and nearly always succeeds in overcoming the huge spiders, though sometimes the latter becomes the victor, in which case the tables are literally turned and the wasp is served up as food for the winner.

A very prettily marked wasp with slender waist and lengthy legs that belongs to the genus *Sceliphron* is another spider hunter that can be seen on warm days by anyone who knows where to look for it. It will take only a certain kind of small grass spider, though spiders of other descriptions may be more numerous. While I do not make this statement as resulting from my own observations I can say I have examined a great many nests of this wasp and I never found any other than the little grass spiders in them.

These wasps are the most common of our "mud-daubers." Their nests constructed of mud consisting of from three to a dozen cells are ordinarily found about sheds and buildings in the country. I have watched them build the nests admiring their mechanical skill, especially when considering the paucity of tools to work with. The work is wholly done with their mouth parts aided by their legs, particularly their front pair. The same parts are used in gathering the clay or mud. I found a place this summer that yielded the kind of material the wasps wanted in the construction of their nests, and I passed considerable time on various occasions observing their actions at the mud hole and their manner of gathering the mud. Sometimes there would be as many as five or six wasps in the muddy depression. After selecting a spot from which to dig up their loads the wasps would scrape up the moist earth with their mandibles, pushing it under their "chins" where the stuff was held by the pair of front legs until pellets as large or larger than goose shot were accumulated. Apparently the load was then seized with the mandibles, and with the aid of the front or anterior pair of legs carried away to the place where the cells were being constructed. I think I was most interested in the variation of the actions of the different wasps in making selections of the mud they needed. Some were quick to find it, others took more time, while a few were so particular that they ran all around the depression, testing this place and that seemingly being very difficult to satisfy. In the meantime the first mentioned would make a trip or two, as they returned directly to the spot from which they had been taking the

wet clay. While gathering the material some of them kept up a humming or buzzing noise which they seemed to make in some other way than with their wings. I could not detect the slightest vibration of their wings. However, my failure to note any movement of the wings, did not fully satisfy me that those appendages were not the instruments used in producing the noise.

While observing the actions of the little winged visitors to the mud hole, I saw only one other species of the mud-daubers there. It was blue-black and somewhat smaller than the pretty yellow and black wasp whose operations have just been described, but its method of work in gathering the material was not unlike that of its larger relative.

The red-headed woodpeckers are among the most numerous birds about the club grounds. They can be seen at almost any hour of the day and in almost any kind of weather, making their peculiar dipping flights about the park or from one oak to another. Their harsh but not disagreeable notes continuously greet the ear. They are busy birds, when not pilfering in the almond and fruit orchards they are hammering holes into the dead branches of the big oak trees. The rapidity of the blows remind one of the operation of a machine hammer. The only people who regard them with any unfriendly feeling are the orchardists who charge the birds with taking more than their share of the nut and fruit crops.

For some years past the yellow-hammers, or flickers, have been very numerous here, but for some unaccountable reason very few are to be seen this year. This bird belongs to the woodpecker family but is considerably larger than its red-headed cousin. When present in such large numbers they were commonly regarded as a nuisance. They were not only destructive to fruit on the trees but were continually boring holes under the eaves of all the houses. As the holes were large and numerous the owners of the houses were not pleased with the unornamental work of the birds. No more effort to drive the birds away was made last season than had been attempted in the previous years; so their departure for other scenes and to other parts seems to have been wholly voluntary, but like the cat they may come back.

The bird life of our state is well represented here, but of all the birds to be seen in and about the park, the humming birds, perhaps, attract the most attention from visitors of the Club. It is a common thing to see a humming bird, here and there, in almost any part of our state, but it is unusual to find them congregated in such numbers as are frequently witnessed in the flower gardens of the Club, especially when the salvia plants are in blossom. The bright scarlet flowers seem to have more than ordinary attraction for the little birds, for while the salvia is in bloom they show no interest in the other flowers which are there in profusion. I have noticed elsewhere this preference for red flowers manifested by the humming birds; so this instance at Diablo is not exceptional. A large

bed of salvia was located near the front entrance to the club house where members and visitors were passing continually to and fro, but the beautiful little creatures seemed to have little fear of human kind. No matter how many people were about the birds would be darting from flower to flower, or hovering over blossoms seeking their sweets with their long slender bills, or be perched on some projecting leaf or little branch where the glint of the sunlight added to the display of their brilliant coats. It was no trouble to approach within six or seven feet of the birds and sometimes with a little care much less.

While different kinds of humming birds have been noted hereabouts the birds visiting the club gardens appeared to be largely of one species, known as the ruby-throated humming bird.

The blackheaded grossbeak and bullock oriole appear in the park grounds in large numbers every spring. These birds of beautiful plumage remain with us while nesting and rearing their young. Their singing is the most musical of all the bird voices heard here and attract the attention of nearly all visitors.

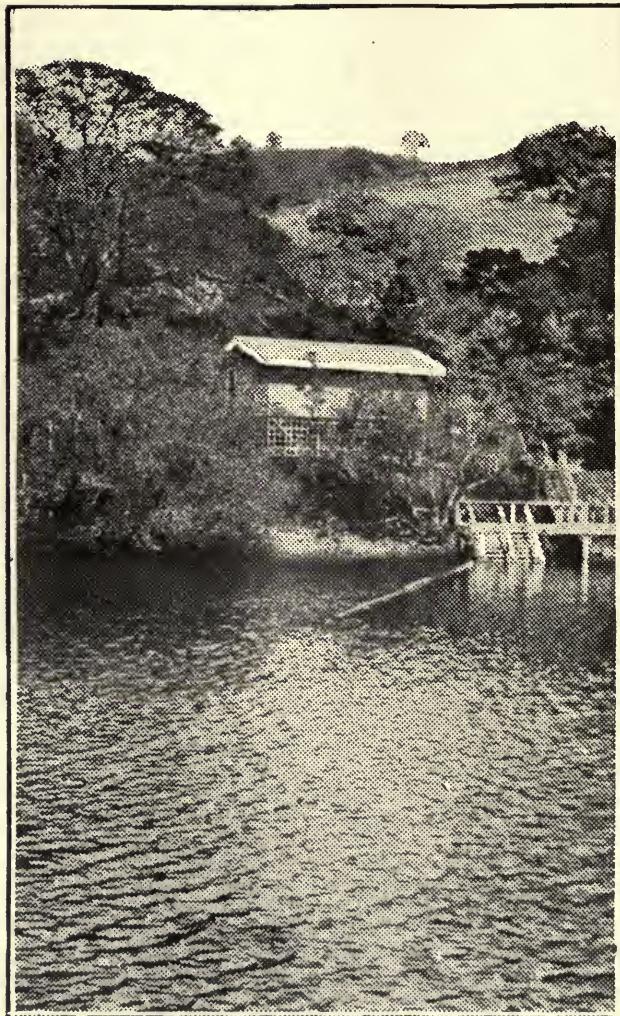
In addition to about forty different resident birds, a variety of other species of the feathered tribe visit the park at different seasons of the year. Of the visitants, the Pileolated warbler, with the scientific name of *Wilsonia pusilla pileolata*, is probably the most notable. Not on account of size, however, for it is a small bird. The feature making its visits conspicuous is the enormous number that gather here. They come in the spring when the flower and leaf buds on the elm trees begin to open, and remain until the blossoming period closes. I have never seen any of the birds about the park prior to the event mentioned, and soon after the elm blossoms wither and fall the birds disappear.

There are quite a number of the elm trees. They were planted many years ago along a roadway of the grounds, for a distance of over half a mile. Apparently the nectar of the tree blossoms attract certain insects which in turn attracts the birds, they being of the insectivorous class. I have observed the presence of the visitors in the spring of the last three years, and on each occasion the number was about the same. Each elm tree would be filled with the little beauties in ceaseless activity from morning until night. The birds would flit from one branch to another and from one blossom to another until it appeared as if every possible flower must be visited time and time again during the day. On several occasions I endeavored to make an exact count of the number of birds in a single tree, but their active movements made it impossible. I could only estimate the number by making several counts in a small portion of a tree. In this way I reached the conclusion that there were at least eighty birds on an average to each of the elm trees. As there were fifty-two trees I concluded there were somewhere near 4000 of these sweet little songsters, that remained all day long in the trees described. At about half-past eight o'clock in the mornings they be-

gan to sing and continued the warblings until a late hour in the afternoon. These daily bird musicales were on a scale that is seldom one's good fortune to be a listener to. A street with blocks of canary bird stores facing each side would no more than rival the bird melody in volume and sweetness that was produced by these songsters in their free and wild state.

These birds are about the size of the Gold Finch or Wild Canary so common about this

part of the country. The black and yellow markings on the males of both species are somewhat similar. In fact the similarity in size and coloring is sufficient to mislead all but students of bird life in identifying the warbler when it visits our section, but its song is very different and when heard at once marks it a stranger. Besides the Gold Finch is a seed eating bird, while the warbler feeds on insects and is classed as a fly-catcher.



LAKE OF THE DIABLO COUNTRY CLUB, SHOWING THE BATH HOUSE
AND PLATFORM

CHAPTER XIV

A PLUCKY WASP

An Example of the Value of Persistent Effort in the Accomplishment of a Difficult Feat

At Brookdale, Santa Cruz county, Calif., on one of those afternoons in the month of April when the freshness of nature and a balmy air call all forms of life into activity, some members of my family started out for a walk, while I remained on the banks of the San Lorenzo, whipping the stream for a few trout for the next day's breakfast. The river bank at this particular locality formed the front door yard of our home. The folks had not proceeded far when they discovered on the roadside a spider wasp that had captured a spider of about twice its size and was dragging it along the ground. Knowing my interest in the life history of members of the wasp family and realizing their discovery was that of an important proceeding in the perpetuation of the species of this particular wasp, I was quickly summoned. Laying aside my rod I joined the party at the roadside.

On this spot the road was graded two feet or more below the level of the ground on either side, leaving almost perpendicular banks of earth. The run off of storm water had cut or worn somewhat of a gully along the base of the bank on the north side in the bottom of which was gravel and cobble stones. Here and there in the face of the bank there were holes with about the diameter of a lead pencil. The relation of these details are necessary to a clear understanding of the description of what was taking place.

When first discovered, the wasp, which was one of those with blue black wings and a dark red body about three-quarters of an inch long, was dragging a large, limp and apparently lifeless spider towards the roadside bank in which were the holes mentioned. The wasp was walking backwards, dragging its victim by one of its legs over the rough bottom of the little gully. Reaching a certain point under one of the holes, it immediately started backing up the bank with its load.

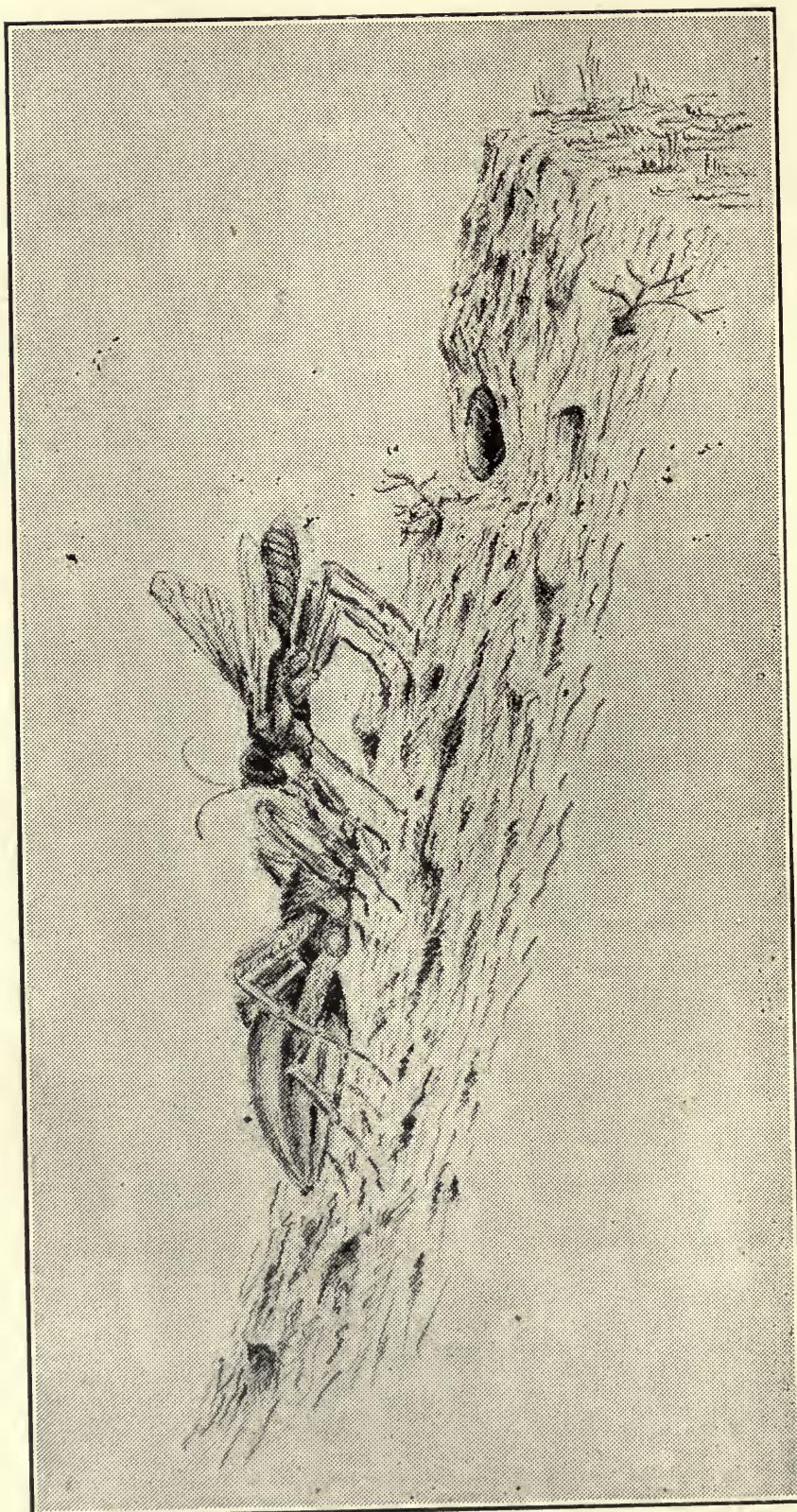
To us, somewhat acquainted with the habits of wasps, it was apparent that its objective was one of the larger holes about eighteen inches up from the base of the bank; but it did not seem possible that the little wasp would ever succeed in elevating the bulky spider to that point or even to a less height for that matter. The wall up which it was climbing was filled with little projecting stones and rootlets, which greatly added to the difficulties of the wasp. These obstacles would catch the loose legs or body of the spider and hold it until the wasp by repeated tugging from varied positions would succeed in releasing her prize.

The interferences were overcome one by one until a small shelving projection of earth was reached. Here Mrs. Wasp dropped her load and went running around the face of the small cliff, nosing about as if in search of something, or to get the bearings of her destination. Seemingly she satisfied herself, whatever her purpose may have been, for she returned to the place where she had left the helpless spider, to find that in her absence it had rolled off the shelf and had fallen to the bottom of the gully.

The wasp seemed to know at once what had happened, for she quickly followed down and after a brief hunt found the spider, and immediately seized it by a leg and started up the bank again, going backwards towards the same point as before. This time she reached a spot about eighteen inches from the base of the bank, where the holes previously mentioned were located. One of the larger holes opened among some small roots that projected and hung down from the face of the bank, and in front of the entrance there was a very narrow and sloping shelf. This hole proved to be the entrance to her nest and in which she intended to deposit the spider.

Having dragged the victim up the bank after much trouble and exertion to a place within a couple of inches of the hole and among the little roots, she released her hold while she went to the hole, possibly to see if everything was all right to receive the spider. She entered the hole but quickly reappeared and then started for the place where she had left the spider, but it was not there, for during the absence of the wasp the spider slipped off and fell once more to the bottom of the bank. She did not spend more than a second or two searching about for her game to make sure she had not overlooked it. Satisfying herself it was gone she knew just where to find it, for she flew down to the gully almost to the exact spot where the spider lay.

Perhaps it would add more interest to the story if I should explain here for those who are not acquainted with the habits of the wasp family, that the purpose of the wasp in capturing the spider was to provide food for its young. Upon catching a spider the wasp stabs it with her stinger until it is paralyzed and helpless or is killed. The victim is taken to the nest or cell provided for its reception. There the wasp lays an egg which she attaches to a favorable spot on the spider so the baby wasp as soon as it is hatched can begin feeding on it. Ordinarily as soon as the egg laying is finished the wasp comes out



A PLUCKY WASP—DRAGGING A CAPTURED SPIDER UP HILL TO ITS NEST

of the nest, which if in the earth like the one connected with the incidents of this story, she then scratches in sufficient dirt to plug up the entrance and removes all evidence of the near-by nest. The egg may hatch within three or four days. The larva, however, is left to itself to feed on the spider until it is ready to enter the pupa stage, from which in due time it emerges a mature wasp.

The mother wasp repeats the operation several times in the course of the season. Just how often it is not well known—then her life's work is done.

Now let me return to the operations of our wasp. Reaching the spider she at once seized it as before and started up the bank. Although going backwards she had no trouble in keeping the proper directions. She encountered several obstacles as on the previous occasions, but finally reached her hole, into which she backed. The spider was drawn only partly into the entrance. Here she either purposely released her hold while she went back into the nest to see if everything was all right, or lost it by the spider jamming in the hole. However it was, the spider upon being released fell back and rolled down the bank again. The wasp soon came out and as before seemed to know what had happened, for without delay she flew down to the bottom of the bank and recovered her game. She at once began the labor of taking it up the cliff without exhibiting the least sign of discouragement, but the result of this trip was a failure as with the other attempts.

The tenacity of purpose of this little insect bordered on the marvelous, for she made six more failures before success crowned her persistent efforts. Each of these succeeding trips up the bank with the huge limp body of the spider was like the preceding attempts, except twice the spider in falling dropped down out of sight between some cobble stones. The wasp seemed to be unable to recover it, so we took it out of the crevice and laid it on a smooth place in plain sight, where she quickly found it. Once she took the spider to a place about two inches above the entrance to her nest and hung it in a mass of little rootlets that projected from the face of the bank while she made the inspection visit to her nest preparatory to taking the victim in. When she came back she made the mistake of seizing her prize from below. A few quick tugs loosened the spider and its greater weight jerked the wasp from her foothold, but not her mouthhold, for the two went rolling down the bank together and when they reached the bottom the wasp still had a firm grasp of one of the legs of the spider.

On the final trip the wasp took the victim to the spot two inches above the entrance of her nest and left it as she did on the occasion just related. This time upon her return she did not attempt to move it as she did then, but went to the upper side of the spider and lifted it free of the rootlets and lowered it to a place adjoining the entrance of the nest, where by the aid of an overhanging rootlet she found a temporary resting place for the bulky game while she made another trip to the interior of the nest.

Just why the wasps of this character follow the practice of leaving their game near the entrances of their nests while they make a visit to the interior is not understood, unless it is, as some observers and students of wasp habits assume, for the purpose of seeing that everything is all right for receiving the prize.

Accepting this theory as being correct then our wasp must have found conditions favorable for the reception of the spider, for when she came out she went directly to the prize and seized it, not by the legs as she had been doing, but this time by its hindmost part, the apex of its abdomen. This change of method in handling the game suggested that she knew that the only way the spider could be hauled into the nest was endwise; that by dragging it by a leg would bring the body athwart the entrance, making it impossible to pull it in. It was plain now that she had conquered all the difficulties that had interfered with her depositing the prize in the nest after capture, and further proceeding was a simple matter.

She walked backwards into the hole, pulling the spider after her. As the body of the latter began to disappear it was evident that it was a "tight fit." In fact, it was so tight that for a few seconds it looked as if the bulky prize had blocked the entrance and turned the tables on the wasp by imprisoning her in the nest. But not so, as little by little the spider was disappearing into the hole, gradually moving in response to the tugging of the wasp and finally passing out of sight.

I looked at my watch and saw that it was quarter past three. From previous observation of the habits of other wasps of this family I expected our wasp to lay an egg and attach it to the lifeless body of the immured spider and then return to the entrance of the nest and plug or fill up the hole, and thus remove all outward evidence of its existence. After waiting five minutes I began to think that probably the wasp had been unable to pull the prize all the way down to the enlarged cavity at the bottom of the nest and was actually imprisoned. Ten, twenty, thirty and finally forty minutes passed and no wasp appeared. Was she unable to come out? Knowing her remarkable powers in excavating earth and her strength in limb and body I could not bring myself to that conclusion. I thought it more probable, as it was now nearly 4 o'clock and the chilly air of the evening was coming on, the wasp had merely suspended operations.

So it proved to be, as will be shown by what followed. The next day I visited the scene of operations and found the entrance open just as we left it the previous day, and it remained that way for five days more. The weather during this period was cold, cloudy and rainy. It is well known that wasps of nearly all kinds are partial to warm weather and disposed to remain "indoors" while it is cold and unpleasant outside. Now came a bright and sunny day. Early in the forenoon we went to the nest and found Mrs. Wasp at work sealing up the entrance. She seemed to be working quite leisurely, contrary to the habit of her kind in this opera-

tion. We could not see how she was doing the work, for she was operating from the inside and only a small part of her posterior was visible.

We left the wasp at her work, but returning in about an hour we found the hole completely filled even with the face of the bank, and therefore were disappointed in not having been able to witness this final operation.

Marking the spot for future observation we left it undisturbed for a week. At the end of this period we concluded to excavate the nest and ascertain if possible what had taken place within the depths. By carefully cutting down the bank we found the hole entered the earth on an incline of about 25 degrees to a depth of nearly five inches. We found the remains of the spider in a rather advanced stage of decomposition, indicating that the wasp had killed it at the time of capture instead of paralyzing it. To our surprise we found no larva.

Evidently the wasp had not deposited an egg in the nest with the spider. However, failures of this nature have been noted by several students of the habits and actions of the members of the wasp family. So the seeming neglect of our wasp was not an exceptional case, strange as it may appear that after all the labor and trouble she had experienced in preparing the nest, capturing the spider and hoisting it to the cell she should then fail to perform the one act for which all her work and time expended was the sole purpose.

Another interesting incident witnessed while watching the operations of the wasp was the action of a small fly of the same species mentioned in the stories of the Digging Wasps. From its actions it evidently was watching for an opportunity to deposit some of its eggs on the body of the spider. When the wasp was struggling to place the spider in the hole the fly remained perched on a rootlet near the entrance turning this way and that way so that it could see all that was taking place. When the wasp would disappear in the hole the fly would instantly hover over the mouth

of it, but retreat as quickly when the wasp came out. The behavior of the bold little insect clearly indicated that it fully understood the object and purpose of the wasp as well as recognized her dangerous character. The wasp was so long engaged in the operation of burying the spider that the fly probably became impatient, for it went away before the wasp succeeded in its efforts.

It is well known among entomologists that the method attempted by the fly is one, if not the only one, adopted by its species for the perpetuation of its kind. The eggs of the fly hatch quickly and the larvae appropriate the provisions provided by the wasp. If the egg of the latter hatches the larva also becomes a victim in satisfying the voracious appetites of the growing fly babies.

This wasp belongs to the division known as *Psammocharidae*, all members of which prey chiefly on spiders. There are several species of which the Tarantula hawk, or *Pepsis*, is one. This is a giant among the wasps and preys upon Tarantulas, the giants of the spider race.

Since writing the foregoing I have had the pleasure of reading Phil and Nellie Rau's "Wasp Studies Afield" and found a story of their observation of the actions of a spider hunting wasp in disposing of a spider in a hole in a bank, in Missouri, wherein the conditions and circumstances were quite similar to those related by me. In their case, however, the wasp made twenty or more attempts before it succeeded in getting its victim in the hole. The methods and actions of their wasp were so nearly the same as the Brookdale wasp one might be justified in assuming they were of the same specie.

Priocnemis pomphilus is the name given to the wasp described by the Raus. Not having collected any specimens of the Brookdale wasp I am unable to give the species to which it belongs or be more definite than to say the one observed by me is a member of the *Psammocharidae* family, as is the one noted by the Raus.



CHAPTER XV

INSTINCT OR REASON

Discussion of an Old Question. Incidents of a Remarkable Character Cited to Show a Higher Impulse to Action than Mere Instinct

Whether the actions of all forms of animal life below mankind are guided by instinct or directed through the possession of some degree of mentality as well as instinct, is a question discussed for ages past, and upon which much has been written by distinguished observers and students of Nature's work. For many years of my younger life I was one of the many, if not the majority, of people who looked upon the lower forms of life as being devoid of all consciousness, acting wholly under an impulse of instinct, and it was not until I had reached mature years, and experienced closer contact with Nature, and indulged in deeper thought, that I came to a modification of my views, and finally reached the conclusion that there was a possibility if not probability that all animal life except the very lowest is endowed with more or less mental power.

I take it that when we talk about animal instinct we have in mind the definition given the word by Webster here quoted:

"Instinct, noun, (1) Natural inward impulse; unconscious, involuntary, or unreasoning prompting to any mode of action, whether bodily or mental, without a distinct apprehension of the end or object to be accomplished.

"(2) Zool. Specif., the natural unreasoning impulse by which an animal is guided to performance of any action, without thought of improvement in the method."

Paley said, "An instinct is a propensity prior to experience, and independent of instruction."

Whately said it "is a blind tendency to some mode of action, independent of any consideration on the part of the agent, of the end to which the action leads."

It would seem to follow then that in whatever way instinctive action is manifested it would with individuals of the same species be the same in all cases under the same impulses and circumstance.

Whether or not there exists in the lower orders of animal life any degree of consciousness and power of reasoning, it must be admitted, is a question not yet determined by any findings or observation accepted as a scientific fact. However, I am inclined to the thought that the majority of thinkers are disposed to a negative opinion holding that the acts of the individuals of the lower form of life are wholly instinctive without the guidance of reason.

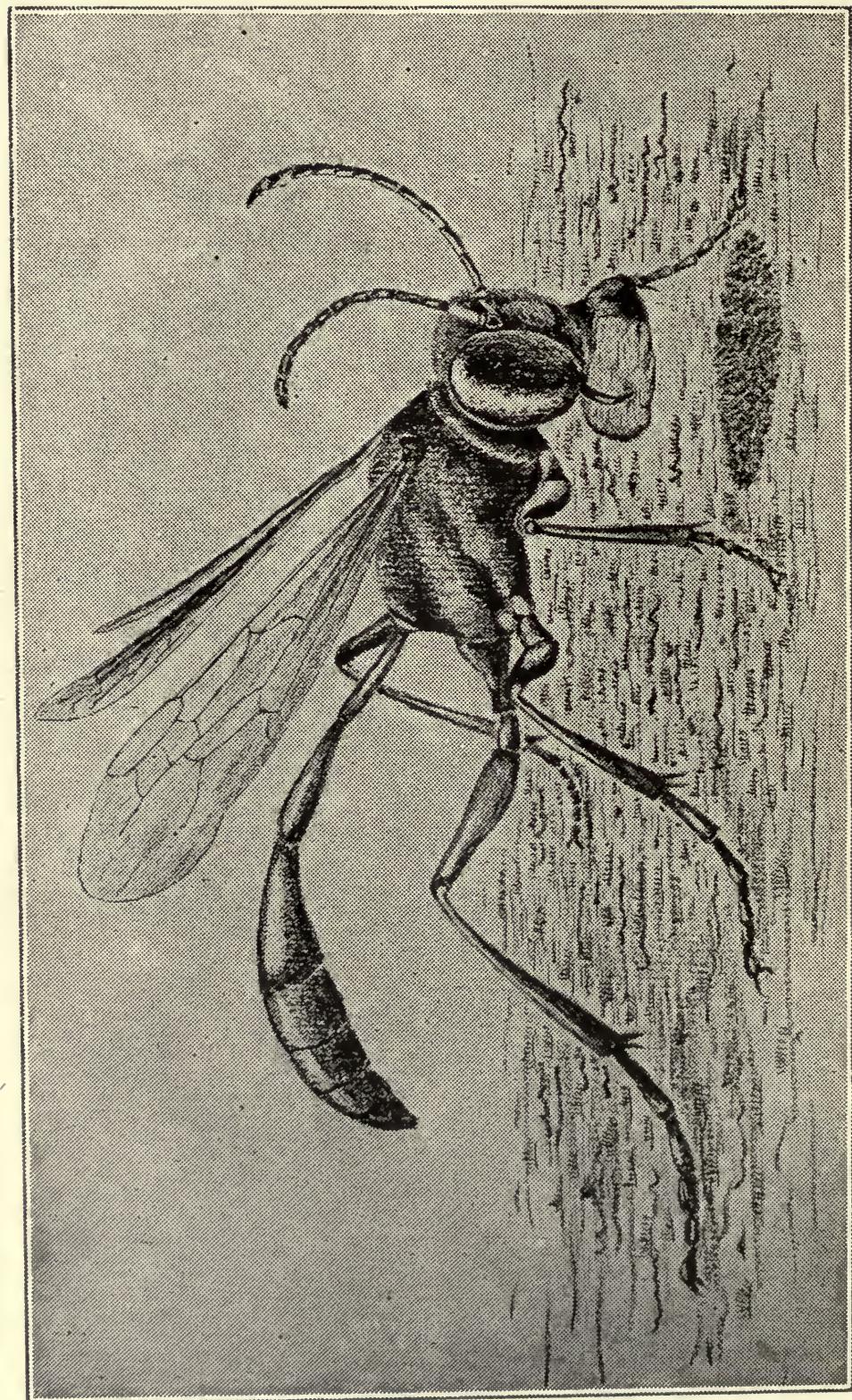
It seems to me that without the power of reasoning the individual could have no consciousness of its being or its existence, no

realization of suffering pain from inflicted injury, nor could it entertain any apprehensions of injury or fear of death.

If I could bring myself to this way of thinking I could resume the use of the rifle and shotgun in quest of game with zest, enthusiasm and that enjoyment of exhilarating sport that comes to all field sportsmen.

Having indulged the hunting passion in me from my boyhood days until very recent years, my opportunity for the study and observation of the habits and characteristics of numerous forms of animal life has consequently been somewhat extended, and the conclusions I have reached and questions raised in my mind are founded upon my experiences and observations, free of connection with any theoretical dogma or sympathetic propaganda of dumb animal protective associations. My conclusions may be of no value. I know they are unscientific, as they are in part no more than deductions based on human experience. Being unable to communicate with animals we can form opinions only from observed actions measured by our own experiences. But this statement should be attended with some modification, for there is at least one condition that may befall many forms of animal life where an individual, afflicted by injury or put in extreme distress, can and does utter sounds that are unmistakable in giving expression to its sufferings, communicating the fact to almost every living thing within the reach of its voice. This truth had much to do in rousing my thoughts and directing them to consideration of this question.

When an animal is badly injured, or is sorely distressed by circumstances that threaten pain or death it usually utters sounds that one may never have heard before, but they are instantly recognized as expressive of agony, distress and fear, and frequently every other animal that hears the sound manifests recognition of its meaning. A jack rabbit that ordinarily makes no vocal sounds whatever, when in sore distress will utter cries not unlike that of a child. There is no mistaking the significance of such cries. The "death cry" of a horse is wholly unlike any sound uttered by it under ordinary conditions, but humans and all other animals seem to recognize and understand its meaning. Similar peculiarities are found in birds as well as animals, something every boy who has robbed birds' nests will verify. How quickly the cry of distress of the mother birds excites all other birds in the vicinity and brings them circling around. This responsive action shows



THE WASP *AMMOPHILA URNARIA* USING A STONE TO POUND DOWN EARTH
TO CLOSE HER NEST—AN ACT OBSERVED BY GEORGE W. PECKHAM, STATE
ENTOMOLOGIST OF WISCONSIN, AND MRS. PECKHAM. From a drawing by J. H.
Emerton, in the Wisconsin Geological and Natural History Survey Bulletin

clearly a recognition of the meaning of the notes of alarm and calls for help.

The cries of distress possibly may not arise from any consciousness of feeling of pain or alarm but be wholly instinctive manifestations incited by the conditions. We have no way of determining, but those of us who are inclined to attribute to the lower forms of life some degree of rationality or brainpower and consciousness of being that exists in humans, are apt to have our sympathies excited, feeling that the signals are something more than simple instinctive utterances by creatures endowed with life but without consciousness. And when we come to consider the feature of **recognition** of the meaning or significance of the cries of distress by other animals and birds are we not justified in assuming that there is less room for difference of opinion? Does not the word "recognition" as used here imply mental action—a consciousness of something unusual taking place—a sufficient power of reasoning to interpret the sounds of distress? And are not the frequent responsive actions manifestations of emotion, affection, sympathy or curiosity, which could only be the result of brain action, involving a show of a certain amount of intellectuality, reasoning and judgment?

More than likely opponents would declare in response to these queries, that they were only "instinctive actions," but when we know that instinctive action is involuntary, an impulse that must find expression in the same way under the same conditions, we find the answer incomplete in explaining or accounting for the varied actions of various animals or birds in responding to sounds of distress. In some instances the responders will attack the cause, some bravely and others with less show of courage, then again some will refrain from attack if the cause is of a character that might endanger their welfare. Here we have an imitation of some of the peculiarities or variation in human character, bravery, prudence and cowardice. It may be said these traits are instinctive. Admitted that some men may be instinctively brave, others instinctively prudent or cowardly—that is, the primary impulse to the manifestation of such traits of character, but the actions following which vary according to conditions must be directed by mind power, indicating rationality. Unquestionably instinct plays a great part in the actions of all forms of animal life and greater in proportion as we descend the scale of life; and in an action prompted by an involuntary impulse (instinct) which ends in some manifestation directed by reason it may be difficult to determine where the former ceased and the latter began, but the fact does not seem to justify the assumption of total absence of consciousness or reason.

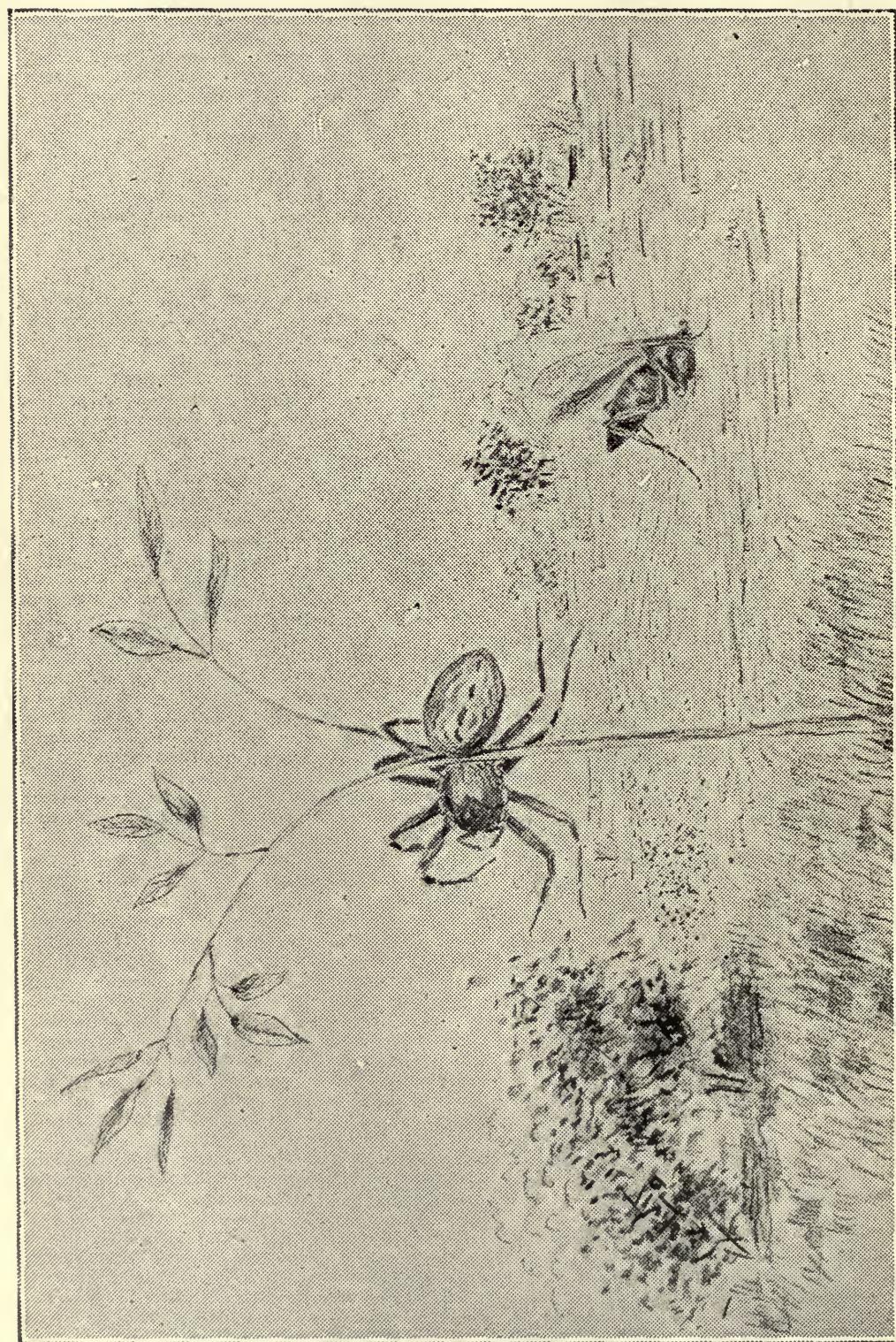
Prof. Kellogg in his interesting book, *American Insects*, asks the question: "Do the termite or white ant, individuals of a community communicate with each other, or is the whole life of the colony so inexorably ruled by instinct that each individual works out its part without personal reference to any other individual, although with actual refer-

ence to all the other members of the colony?" Without directly answering the question he says: "It is pretty certain that termites have a means of communicating by sounds, that the existence of a tympanal auditory organ in the tibiae of the front leg has been shown." If it is established that these insects actually communicate with each other, and their actions seem to indicate that they do, would not such fact imply the possession of a power beyond that of instinct—a degree of rationality—ability to reason? If ruled by instinct alone there would be no occasion to communicate with each other. Each individual would work out its part during life in the colony without engaging in any communication.

Much has been written in the way of recording incidents of apparent communication between animals as well as between birds and also insects. With the exception of some instances where I have noticed dogs acting as if information had passed from one to the other, I am unable to contribute any incident or fact from personal observation that would tend to sustain the contention, other than that which might be derived from the illustration of the effect of cries of distress. Nevertheless while I think some of the stories are based more on imagination than warranted by facts, I am inclined to the belief that there is truth in some of the observations, and that individuals in the lower orders of life where necessary and useful in carrying out their part in the order of things, have some way of communicating one with another. For the purpose of this discussion it is immaterial what the means of communications might be, whether the agency be touch, sound or something else. All we want to know is that individuals are influenced to acts by the sounds uttered or by actions of other individuals. This would establish the possession of communicative power which signifies the existence of some degree of mentality.

It is no more than speculation to assume that the lower forms of life in carrying out the parts nature planned for their existence are wholly under the guidance of instinct. This assumption must be based on man's experience in involuntary actions, impulsive acts without distinct apprehension of the end or the object. In other words, it is known from human experiences that at times man acts instinctively, therefore it is assumed that the acts of animals must be instinctive. The assumption would be more logical if it were not attempted to make instinct the sole guidance. In fact it must be admitted that it is impossible to account for some of the wonderful actions of numerous beings, especially those well down in the scale of animal life, without attributing instinct as the motive power.

It is not unreasonable to suggest the possibility that animal instinct might be something deeper and broader in its scope than the instinct manifested by humans. Certainly animal life, more particularly as the scale is descended, has greater need for it. We know that in comparison many forms of lower life are endowed with the senses of sight, smell, hearing and touch, so far superior to anything



SHOWING THE MANNER IN WHICH A SPIDER-HUNTING WASP SOMETIMES HANGS ITS GAME UP OUT OF THE WAY OF ANTS WHILE IT IS PREPARING A HOLE IN THE GROUND TO PLACE IT

possessed by mankind that they appear miraculous and may well be unbelievable without witnessing some of the acts demonstrating the truth of it.

However, the endowment of such instinct does not of necessity preclude the possession of some degree of intellect that gives consciousness and impels rational actions.

By vivisection and the study of living frogs, birds, etc., and certain mammals, biologists have acquired much knowledge of the functions of certain organs and actions of the central nervous system in man. The study shows us that all forms of animal life, including humans, are created and maintained on the same general principles from the inception to the end of their existence. It is found that the digestive organs all operate to the same purpose whether in a beetle, fish, bird, rat, horse or man. It is the same with the breathing function and nerve ganglia. It is true there are some creatures so far down in the scale of life as to be devoid, or partially so, of the mentioned organs, creatures so simply constructed as to have no need for them. But when we find forms of life possessing all the organs possessed by man, including a brain, is it not logical to assume that in a general way the use and purpose of the brain in one is the same in all? At the same time it should be recognized that its functional power in the matter of intellectuality and rationality is developed to a much higher degree in man than in any other form of life.

It is true we are not justified in interpreting all actions of the lower forms of life in terms of our own experience and consciousness, but when we witness performances peculiar to individuals of a species manifesting reason, judgment, and care outside of the routine of instinctive acts, in full agreement with our experiences under the same conditions and for like purposes, it seems unreasonable to believe that man alone is the only animal possessing consciousness and the power of reasoning.

Of all the published statements that I have read of observations of the doings and life histories of certain members of the wasp family, the records by Geo. W. Peckham and Elizabeth G. Peckham are the most complete, instructive, reliable and unbiased. In using this latter word I have in mind the publications of Fabre, the famous French naturalist, on the same subject, who could see in the wonderful acts of these little insects only impulses of instinct. Accordingly as he saw them all were endowed with the same skill, accomplishments and peculiarities of work, variations being shown only in different species.

However, the Peckhams say: "In this species (*Ammophila unaria*), as in every one that we have studied, we have found a most interesting variation among different individuals, not only in methods but in character and intellect. While one was beguiled 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 her young could only survive 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."

Bearing out this statement, in the many pages given by them in detailing the work and conduct of members of this wasp family, we find a couple of paragraphs, illustrating their claim from which the following are extracts:

"We had another much less worthy example, one, indeed, that went to the extreme of carelessness. . . Her nest was a very poor affair just beneath the surface, and after the caterpillar was carried in it was visible from above. She filled the hole with loose particles of earth and then scratched the surface of the ground a little in a perfunctory sort of way, as different as possible from the painstaking labor we had been accustomed to see in her sisters."

"Just here must be told the story of one little wasp whose individuality stands out in our minds more distinctly than that of any of the others. We remember her as the most fastidious and perfect little worker of the whole season, so nice was she in her adaption of means to ends, so busy and contented in her labor of love, and so pretty in her pride over her completed work. In filling (closing) up her nest she put her head down into it and bit away the loose earth from the sides, letting it fall to the bottom of the burrow, and then, after a quantity had accumulated, jammed it down with her head. Earth was then brought from the outside and pressed in, and then more was bitten from the sides. When, at last, the filling was level with the ground, she brought a quantity of fine grains of dirt to the spot and picking up a small pebble in her mandibles, used it as a hammer in pounding them down with rapid strokes. Before we could recover from our astonishment at this performance she had dropped the stone and was bringing more earth. We threw ourselves down on the ground that not a motion might be lost, and in a moment we saw her pick up the pebble and again pound the earth into place with it, hammering now here and now there until all was level. Once more the whole process was repeated, and then the little creature, all unconscious of the commotion that she had aroused in our minds, unconscious, indeed, of our very existence and intent only on doing her work and doing it well, gave one final, comprehensive glance and flew away."

Dr. S. W. Williston of Kansas University a year or so before was witness to a similar act by an *Ammophila* and concluded his description of the incident by saying: "the things that struck us as most remarkable were the unerring judgment in the selection of a pebble of precisely the right size to fit the entrance and the use of a small pebble in smoothing down and packing the soil over the opening, together with the instinct that taught them to remove every evidence that the earth had been disturbed."

H. W. Bates relates the intelligent acts of a certain wasp, the *Monedula signata*, which convinced him that they were directed by a reasoning power, and were more than an impulse of instinct. Thomas Belt, another au-

thority, tells how a wasp, the *Polistes carnifex*, cut a large caterpillar in two parts that it might convey the game to its nest more easily. He says: "Being at the time amidst a thick mass of fine-leaved climbing plant, it proceeded, before flying away, to take note of the place where it was leaving the other half. To do this, it hovered in front of it for a few seconds, then took small circles in front of it, then larger ones around the whole plant. I thought it had gone, but it returned again and had another look at the opening down which the other half of the caterpillar lay. When the wasp came back and took the remaining part of the caterpillar, it did not stop to make any survey of the place but flew direct to its nest."

The Peckhams commenting on these incidents say both of the above writers believe that many of the actions of insects that are ascribed to instinct are really evidence of the possession of a certain amount of reasoning power.

Belt also noted in his studies and observation of the work of wasps in building and provisioning their nests that some individuals were much more clever in their operations than others, as must be the case where reason through intellectual power is the directing force instead of instinct alone. Instinct only, was Fabre's hobby and it was his argument that under the same conditions and in the same occupation they would act exactly alike and after having performed one duty of their life cycle, could not be induced to repeat the act. The observations and records of the authorities quoted give numerous facts that are inconsistent with the theory of the French naturalist, and an incident, which I have detailed in a previous chapter, that recently came under my own observation also seems to contradict his theory. This was the case where the stem of a nest of *Polistes* had been broken so that the nest remained suspended by only a fibre. As soon as the wasps discovered the damage they immediately proceeded to repair the stem. In a few hours the work was thoroughly done and the nest was as firmly attached to its base as ever. Now if the *Polistes* were guided by instinct alone they would have possessed no reasoning power to tell them of the damage and danger to their habitation, or inform them what was necessary to avert a disaster. Recognition of the damage implies a certain amount of intelligence and reasoning power. If actuated by instinct alone and possessing no power to reason, how could they know that the nest was in danger of falling and how could they be expected to repair what instinct only impelled or required of them to build once in their lives? As Fabre says in his observation of the work of a mason bee when he attempted to induce it to repair a cell, that having complied with the demands of instinct it had done the thing once and could not be made to understand the necessity of repeating the act.

Fabre in accrediting instinct as the sole impulse guiding the acts of the wasp and bees said that it was a marvelous force and acts under it were unerring, and that in the

proficiency with which certain wasps used their stings in capturing insects as provender for their young they rivaled the skill and knowledge of the best surgeons. They were always unerring in stabbing their victims so as to cause a paralyzed condition and not death, as it was essential that the larvae which were to feed on the helpless insects should have fresh meat.

The observations of the Peckhams in this country do not altogether agree with the conclusions of Fabre. They found almost universally in making a great many examinations that some wasps were more clever than others in inflicting the stab, and that some of even the most skillful wasps sometimes caused death instead of paralysis, and in several cases deaths predominated, and moreover that "fresh meat" did not appear essential to the growth and maturity of the larvae, for they found them feeding on dead insects with undiminished appetites. The variation in skill is what might be expected where intellect takes a part with instinct as the guiding force. In saying this it is not with the purpose of disparaging to show that even a great naturalist may possibly have erred in the interpretation of some of the acts of bees and wasps when making studies and searching for testimony to sustain a preconceived theory held in relation to instinct and reason in the insect world.

The Peckhams in the records of the years of study and observation devoted to the wasp family, tell many interesting facts of the doings of individuals of several species, and next to the story of the *Ammophila* using the "stone hammer," the facts related about the wasp that occasionally hung its game in the crotch of a plant when necessary to protect it from ants while digging a nest, stand out as some of the strongest bits of evidence that at times at least, certain wasps act with intelligence and as if inspired by reason. The wasp credited with the exhibition of so much judgment and care is known as *Pompilus quinquepotatus* who confines her search and capture to one certain kind of spider, the *Epeira strix*. After the capture of a spider it is stung which either causes its death or complete paralysis. The Peckhams say: "A suitable place for the nest being found the spider is very prettily taken care of while the work is in progress. A plant, usually a bean or a sorrel, is chosen, and the spider is hung in the crotch of a branching stem, where it will be safe from the depredations of ants. This precaution is not always taken. We have many times seen the spider left on the ground, although there were plenty of plants at hand."

This story points to another fact that individuals of the same species do not do the same thing in the same way under the same conditions, as must be the case where instinct and not reason is the guiding force.

From another very interesting incident, indicating rational intellect on the part of a *Pompilus Scelestus*, a wasp of the Pompilidae family, recorded by the Peckhams, we take the following:

"It was half-past one when she suddenly appeared near the nest coming backward

through the fence, and dragging a large Lycosid (a spider). This she laid down close by and began to bite at the legs quite after the manner of the wasp we had seen the year before. Her movements were full of nervous excitement, in marked contrast to those of the previous day. Presently she went to look at her nest, and seemed to be struck with a thought that had already occurred to us—that it was decidedly too small to hold the spider. Back she went for another survey of her bulky victim, measuring it with her eye, without touching it, drew her conclusions, and at once returned to the nest and began to make it larger. We have several times seen wasps enlarge their holes when a trial had demonstrated that the spider would not go in, but this seemed a remarkably intelligent use of the comparative faculty. . . . While she was thus employed the spider was attacked by a very tiny red ant that could not by any possibility have moved it. When the wasp caught sight of this insignificant marauder she fell into a fit of wild fury, and bending her abdomen under, seized the ant again and again in her mandibles and flung it backward against the tip of her sting. The little creature finally escaped, seeming none the worse for "the rough handling to which it had been subjected, while the wasp, still trembling with excitement, grasped her spider and rushed off to a distance of several feet, carrying it up on a weed and depositing it there." The wasp then resumed her work at the nest and when in about a half hour it was sufficiently enlarged to allow the spider to be taken into it, she went to the weed where she had hung up her game to protect it from ants, took it down and into the nest, and then closed up the entrance by scratching back the earth that had been taken out in excavating the hole.

A volume might be written embracing the details of acts on the part of individuals belonging to higher orders of life, indicating beyond question the endowment of intellect and that reason to some extent was the guiding force. Such stories might relate more to the doings of domesticated animals and birds, but that fact should not detract from the claim of existence of reason. With the same opportunity for observation in wild life undoubtedly much would be seen that would confirm the belief that the brain in the lower forms of animal life was designed by nature to fulfill in a measure at least the same purposes as the brain in the highest form of life. All forms of animal life above the worm and similar forms are constructed on the same general plan, and supposedly all originated from one

common source. It seems irrational, therefore, to deny the possession of functional power of an organ in one division of life which is so commonly known in all others, and so important and essential to the well-being and progress of all.

Of course I do not credit to animals or wasps any such degree of reasoning or intelligence as that enjoyed by mankind. It ought to be unnecessary to say it. However, it seems plain to me that the power of reason is manifested, in degree, as we go down the scale of life until we reach the very lowest forms where, in the absence of a brain, it is wholly replaced by instinct as a guiding force. Instinct probably warns the worm of an impending danger; it contracts itself, but has not mentality to direct other action to avoid it. Instinct is an impulse to action, and reason the force to guide it when choice of direction is required. In the highest forms of life reason is supreme and instinct cuts a small figure as a guiding force, but this order of things changes as we drop down the scale of life until we reach a point where it is reversed, and where instinct is developed to a degree as amazing in its wonderful scope and marvelous in its accomplishments as is reason and intellect at the other end of the scale in the highest form of life, mankind. I found in one of the books of the eminent English naturalist, Thomas Belt, that the author had been prompted to give his views on this subject after observing a wasp capture an insect, then put it in a place of security temporarily. After describing the actions of the wasp in familiarizing herself with the locality, Mr. Belt says: "Such action is not the result of blind instinct but of a thinking mind; and it is wonderful to see an insect so differently constructed using a mental process similar to that of man. It is suggestive of the probability of many of the actions of insects, that we ascribe to instinct, being the result of the possession of reasoning powers."

In another place in his book Mr. Belt says: "Can it not be contended that such insects (ants) are able to determine by reasoning powers which is the best way of doing a thing, and their actions are guided by thought and reflection? This view is very much strengthened by the fact that cerebral ganglia in ants are more developed than in any other insect and that in all the Hymenoptera, at the head of which they stand, 'they are many times larger than in the less intelligent order, such as beetles.'"

The quotation within the concluding quotation is from Darwin's "Descent of Man."

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