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ANTS' NESTS AND THEIR INHABITANTS.<sup>1</sup>

BY JOHN B. SMITH.

ANTS' nests are found everywhere ; in the woods, in the fields, under the stone-walks of cities and in houses. Not only on the ground, but in the trees ; and not only in the trunks, but among the leaves. They are as varied in design and general structure as are the localities inhabited, and while some species are content to take advantage of a simple cavity under a stone, where they rear their young ; others build great hills full of intricate galleries extending long distances into and under the ground. Volumes have been written on the subject, and many more will be written before either the subject or the public is exhausted. My object this evening is not to speak of the nests of the ants so much as of their inhabitants. These are, of course, primarily the ants themselves, and by disturbing a moderate-sized nest of any of our larger species, the observer will become speedily convinced that the population is not a small one. But not ants alone are found in these nests—there is a very distinct fauna that lives with, and perhaps partly on, the ants, and the species of which are never found elsewhere.

Many hundreds of specimens, principally of Coleoptera, are often found in them, and in Europe nests have been found where the intruders or guests exceeded in numbers the ants themselves. The number of species known to inhabit such nests in Europe reaches well into the hundreds, over a hundred species having been found in a single nest, while in America comparatively few species have been found. There is a reason for that too. Collec-

<sup>1</sup> Read before the Biological Society of Washington, May 29th, 1886.

tors are few anyway, and scientific collectors are very scarce indeed. Besides it requires a good deal of enthusiasm in collecting to attack a large nest of large ants on a warm day when the inhabitants are warlike and capable of inflicting decidedly painful bites, and large colonies are always more prolific both in species and specimens. Collecting thus becomes difficult, and the result is that comparatively little is known of our myrmecophilous fauna. It is too early, therefore, to undertake anything like a complete list of species, and only a brief sketch of what an ant heap often contains is given.

Five groups of myrmecophilous insects can be recognized.

First. Those insects captured by the ants and brought into their nests as part of their source of food supply.

Second. Species found in the nests only in the larval state.

Third. Insects found in the imago or perfect state in the nests, about the larva of which nothing is known.

Fourth. Species often found in ants' nests, but also occurring elsewhere.

Fifth. True parasites on the ants, that feed upon their host or its larva.

In the first group—those insects which the ants collect and care for—the Aphides play an important part. It is well known that the ants seek the plant-lice and lick the sweet excretions; but it is less known, perhaps, that they also collect and rear some species, providing homes for them.

A yellow species of *Lasius*, occurring commonly in the vicinity of Washington and New York, well illustrates this group. The ants make their nests under large stones and close to the roots of trees or shrubs. They carefully excavate galleries around a root or series of roots, and then collect the winter eggs of a species of *Pemphigus* in large numbers—not by hundreds but by thousands—eggs that no entomologist has yet succeeded in finding. These are carefully placed in suitable situations around the cleaned root, and the *Pemphigus*, when hatched, find their food supply ready at hand, and in return are expected to yield sweets to the ants. The winged form of this species leaves the nest and provides for a continuation of the race, and the ants are then compelled to lay in a new supply of eggs.

It would be supposed that the ants would be very careful to keep out all enemies of these, their domestic animals; but there

is one species that gets in and remains in undisturbed. It is the larva of a common "lady bird," *Brachyacantha ursina*. Unlike the larvæ of Coccinellids that prey on arboreal species, this is not brightly colored but sordid whitish-yellow. It is of the usual form of these larvæ, but secretes a waxy substance that exudes in long strings and gives the insect the appearance of being covered with cotton or hoar frost. This secretion seems to be much more palatable to the ants than that of the Pemphigus, and they unconcernedly see the Coccinellid feasting upon the former, apparently concluding that the flavor is improved by passing through the latter. Another larger homopterous species is also found in nests of *Formica integra*, but whether this is used in the same way as the Pemphigus is not known.

Sometimes it happens that a desired species will not live under ground, and this compels the ants to adopt another method, mentioned by Patton some years since. They construct roads to the trees inhabited by the Aphids, and build galleries *around* the plant-lice, effectually protecting and domesticating them.

In this category should come those species of ants which are enslaved by the owners of the nest. The history of that species which captures ants of other species, reduces them to slavery and becomes so absolutely dependent upon its slaves that it perishes from hunger if they are taken away, is well known, and offers one of the most interesting phases of insect economy. It is only mentioned here to complete the category.

The second group, containing those insects found in the nests only in the larval state, is a peculiar one, containing insects of several orders. One of our earliest beetles, *Cetonia hirtipes*, lives exclusively in ants' nests in its larval state; but as imago flies about and feeds on the sweet sap of trees, or in fall upon ripe fruit. In Europe allied species of *Cetonia* have similar habits. The larva of a group of leaf-beetles (Chrysomelids) have also been found exclusively in ants' nests. In this country the genus *Coscinoptera* has been so found, and probably the larvæ of several allied genera have similar habits. The imagos have the habits of the other Chrysomelids and are found on leaves.

It is worthy of remark, perhaps, that all these Chrysomelid larvæ thus far found with ants belong to that group which construct hard cases of excrementitious matter for their protection. It would seem that the difference in habit between the exposed

leaf-feeding species and the protected subterranean feeders would have produced either a modification of the sack or have caused its loss in the latter case, but there is no essential difference between those living above and those living under ground.

The odd-looking, spinous larva of *Microdon*, a dipterous species which has been twice described as a mollusk, is also found here only, while the flies themselves sport in the sunshine as do the others of their kind. A number of other Diptera larva are also found, many of them still undetermined.

Even the Lepidoptera have a representative here, and the larva of *Helia americalis* is found in the nests of *Formica integra* in great abundance.

What purpose these larvæ serve in the economy of the nest, and what they feed on, is a mystery. Why the soft, fat coleopterous and dipterous larvæ are not devoured by the ants, is still to be discovered. The present theory is, that they feed upon the decaying or fermenting vegetable matter in the nest, and being thus useful as scavengers, are tolerated by their hosts. The mature insects seem to be of no use to the ants, and they make no effort to retain them.

The third group, containing insects that are found in the ants' nests in the perfect stage and nowhere else, is by far the most numerous. It comprises species of many orders and of widely divergent families, the Coleoptera being largely in the majority as yet. A few of these true myrmecophilous species have been found in all stages. Mr. Schwarz has found *Euparia castanea* in the nest of *Solenopsis xyloni*, a small ant not one-twentieth of the bulk of its guest, and making small hills only. The upper portion of the hill is sometimes packed full of the beetles, and in the lower stories are found the larvæ.

Most of the species are known in the imago state only, and it has long been and is still a puzzle to entomologists where the immature states of these insects are passed. They are truly myrmecophilous, being found only in ants' nests, and usually confined to a particular species, *i. e.*, a species does not, except in rare instances, inhabit the nest of more than one species of ant. On the other hand each species of ant has its own peculiar fauna of guests, so that it is possible with a series of guests at hand to tell precisely from what ant's nest they were obtained.

These truly myrmecophilous species are again capable of sub-

division into two groups: *a.* Those species from which it is tolerably certain that the ants derive some benefit; and *b.* Those of which nothing at all is known.

The only benefit that is known to be derived by the ants from any of the species is in the shape of a (probably) sweet secretion. Prominent among these are the species of *Cremastochilus*, most of them of immense size compared to that of the ants with which they live. These insects have a glandiferous surface at the hind angle of the thorax covered with a thin plate, and several specimens have been observed where this plate has been gnawed off by the ants to facilitate their getting at the secretion of the glands. These species, as stated, are of large size, and whole squads of ants have been observed in the task of preventing the escape of an individual that had apparently become tired of its quarters.

This practice of the ants has been but recently discovered, and nearly created a new species. The hind angles of the thorax are characteristic in form, and systematists have used them to separate the species. When the first specimen was found without any angles at all, of course it was thought that here was an entirely new species, and only the fortunate discovery of other specimens in which the angles were only partially eaten off, or missing only on one side, prevented a synonym or two.

There is an immense difficulty in the way of getting at the habits of these inquilines. Not only is it a difficult task in the first place to find them, but when the nests are disturbed everything is thrown out of its usual course, and ants and guests disappear in the same galleries under ground, from which it is impossible to dislodge them. Artificial nests have been constructed in Europe, and it has been observed that the ants appeared to lick certain bristly tufts in *Claviger*, which have been assumed to be secretory organs. A number of the species in our fauna have similar tufts and they probably serve a similar purpose. They appear in all parts of the body and are very variable in extent. Many species, however, still remain about which absolutely nothing is known, and which have no structures which may be assumed to be secretory. Many years ago it was observed that *Claviger* was fed by the ants, and more recently Lespes, a Frenchman, confined a nest of ants, and with them some specimens of *Lomechusa*, a *Staphylinid* which makes a practice of carrying its abdomen

elevated. He observed that the ants seemed to coax the beetle to lower its abdomen within reach, and whenever this was done they at once pounced on these tufts of bristles which are in this species situated at the base of the abdomen. He fed the ants with sugar and water, and observed in one instance that a beetle approached a feeding ant, made an antennal communication, and that thereupon the ant turned, opened its jaws and permitted the beetle to lick from its mouth the sweets upon which it had been feeding. This observation requires verification, but there is nothing improbable in it.

In the Coleoptera the great family Carabidæ is entirely unrepresented among the Myrmecophili. The Staphylinidæ, on the contrary, have by all odds the largest representation, with the Pselaphidæ closely following. Others of the Clavicorns follow next in order of abundance, while of the other families only occasional representatives are found. It has been observed that in nests where many species are inquilineous the specimens are usually abundant, while those nests containing only one or two species contain also a very small number of specimens.

A number of species of other orders also occur in such nests, but are not sufficiently well determined to admit of reference here. The American ants themselves have never been worked up, and many of the species are still undescribed, and this adds to the difficulty of listing the Myrmecophili.

In regard to habit these species also differ. Some are found only in the main nest, while others are in the van with the advance guard. *Formica* (*Camponotus*) *pennsylvanica* inhabits old logs and stumps, and builds long covered galleries from one stump or log to another. In these galleries *Lomechusa cava*, one of its inquilines, is found in the greatest numbers.

If an ant's nest be so disturbed that the inhabitants seek other quarters, the inquilines also leave the spot and follow their hosts, without which it seems they cannot exist for any length of time. Hostile as the ants are as a rule, therefore, to other insects, they yet make a large number of exceptions. Even *Eciton*, that ferocious ant whose forays Bates has so well described in his "Naturalist on the Amazon," has its inquilines. These ants build no permanent nests but rather temporary camps which they leave at the slightest provocation, and on all their wanderings their inquilines follow them like herds of cattle. This observation has been

but recently made by Wm. Müller, who carefully observed an army on one of its forays.

Some of the ants, which like many species of *Formica* build over-ground or surface nests, leave their quarters at the approach of cold weather and construct a winter nest some distance off under ground. The inquilines may be found in the old nest for some little time after the ants have left, but eventually they also leave the nest and are supposed to follow: at any rate they disappear. *Myrmecophili* may be collected at all times, but practically the spring is the only real collecting season. In winter everything is frozen hard and the insects are in the lower galleries and are torpid, or are in the winter nest, which is undiscoverable. In summer the ants are so numerous and so vicious that it is a bold man and a persistent one that braves their attacks long enough to secure a good harvest. The nest must be taken up piecemeal and dumped into a bag to be sifted through a net at the bottom with sufficiently large meshes to allow the insects to fall through. Of course the collector must submit to be nipped in innumerable and often inconvenient places by the enraged ants before he can secure his prizes. It is amusing to watch the rage of these tiny creatures; they run round on the cloth upon which they are sifted, audibly gnashing their jaws, and on the approach of a finger, the forceps or anything else, they rise vertically, with wide open jaws and abdomen curved under the body, ready to nip at whatever comes along. Placing stones in the vicinity of the nest yields some species, but others seem never to leave the galleries, and can only be obtained by destroying and sifting them.

It often happens that two or even three species of ants have their nests under one large stone, and often, too, the Termites, or so-called white ants, have also a colony there. These species seem all to live amicably together so long as they are undisturbed, but when the stone is turned they seem to think that the other species is in some way responsible, and an indiscriminate fight follows. If the Termites are in the field they are the ones that are attacked, and their soft fat bodies offer such favorable points of assault that they are utterly routed and driven into their galleries.

The relation of these true *Myrmecophili*, upon which no excretory organs have been observed, to their hosts, offers a large and interesting field for study and observation.

The fourth class of guests in ant-hills can be regarded only as visitors. They appear to be accidental inhabitants, just as abundant elsewhere, but not at enmity with the ants and tolerated by them.

The fifth class, or true parasites, comprises certain minute Chalcids belonging, like the ants themselves, to the order Hymenoptera, and a peculiar Stylops, one of the most degraded Coleoptera known. The latter is known only through some parasitized specimens of ants from South America which are now in the British Museum.

That the Chalcids are parasitic is assumed from the habit of the others of the group. So far as I know they have never been actually bred.

The Stylopidae are, as a rule, parasitic upon wasps, principally in this country, species of *Polistes* and the occurrence of a species upon an ant is remarkable, for it would seem that the ants would be able to discover the parasite and rid their infested friend of his troublesome guest.

There are a large number of other insects found in ants' nests, such as *Acaridae* and *Poduridae*, but too little is known of their relation to the ants to allow of their being placed in any of the categories that I have mentioned.

The ant-hill fauna of Europe and North America, so far as the latter is known, run tolerably parallel. Similar genera are found, but thus far only one or two identical species. There are, however, a large number of genera found in Europe of which we have as yet no representatives, and on the contrary we have forms of very striking appearance which are unknown to them.

One other point deserves notice, and that is the remarkable resemblance which the guests sometimes bear to their hosts and the modifications that these species undergo that live with different species of ants. *Catopomorphus*, when found among black ants, is black; when among red ants is red; when with small species it is small, and with larger species it also increases in size. In shape and appearance the *Pselaphidae* offer remarkable resemblances, and it requires a knowledge that the insects are there, and a trained eye, to discover them. Mr. Schwarz informs me that on one occasion when collecting in Florida prairie lands he found *Tapinosoma sessile*, a small dusky ant, in enormous numbers. They were everywhere, and covered all the vegetation.

The beating net seemed to contain nothing but ants. It occurred to him to examine the ants a little more closely, and then some of them turned out to be beetles so closely resembling the ants that they had heretofore entirely escaped the notice of collectors. It is an Anthicid, and is still undescribed. Two species of *Temnopsophus* were also found which resemble the same ant in a remarkable manner, and a species of Hemiptera mimics it in a curious way.

Ants' nests are therefore something more than the dwelling places of the ants themselves. They are veritable cities, of which the ants are masters and builders, working not eight but twenty-four hours per day, and with inhabitants of many different kinds with very different modes of life, of feeding and of propagating, and all live apparently in the greatest harmony.

It remains only for me to acknowledge the source of much of my information concerning ants and their guests. Mr. E. A. Schwarz, of the Department of Agriculture, has probably the largest experience of any American collector in searching ant-hills, and his collection of Myrmecophili is probably the finest. He is as liberal with information as he is with specimens, and I take pleasure in admitting that his information and his collection have been freely drawn upon by me.

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## GEOGRAPHICAL AND GEOLOGICAL EXPLORATION IN BRAZIL.

BY JOHN C. BRANNER, PH.D.

WHEN the Imperial Geological Survey of Brazil, under the late Professor C. Fred. Hartt, was suspended, geological work in that empire came to a standstill. After the death of Professor Hartt, Professor Derby, the senior assistant on the survey, was, after a good deal of delay, appointed director of the geological section in the National Museum, in charge of which the extensive collections of the survey had already been placed.

Professor Derby has remained in Brazil ever since, and has succeeded in turning to good account much of the material and work of the old survey. The general government, however, has done but little to encourage geological work—nothing, in fact, except to retain Mr. Derby in his place in the museum, and thus to enable him to accomplish something.