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## ART. III.—ANTS AT HOME AND ABROAD.

CHILDREN of the sun, the ant tribes cluster between the tropics, and are there largest in size and greatest in numbers. Receding northward and southward, the ants gradually diminish, according to the temperature of the locality. In England, thanks to the all-important Gulf Stream, although situated far northward of the tropics, the climate remains warm enough to sustain several species of ants. None of them are of any very great size, by far the largest being the common Wood Ant, or Horse Ant, as it is sometimes called. Even this is quite a small insect, while the pale yellow House Ant—an importation, as I believe—is so tiny that it is scarcely perceptible, as it glides on swift limbs about our rooms.

What are the ants? They belong to that wonderful order of insects called the Hymenoptera, which includes the bees, the wasps, the ichneumon-flies, and the gall-flies, as well as the ants. The reader must bear in mind that the Termites, often called "white ants," are no more ants than they are butterflies, and do not even belong to the Hymenoptera, but are allied to the dragon-flies. Many of the Hymenoptera are social insects, living in communities, and working in concert. Chief among them are the various hive bees, the social wasps, and the ants. All are wonderful beings, carrying out the principle of division of labour to a degree that is only equalled by civilized man; but the ants are pre-eminent among them for the singularly intellectual powers they exhibit. In all cases, however, these intellectual powers belong only to the workers, which are females with arrested development. In point of fact, all these social Hymenoptera are insect amazons, the few males and females only existing for the purpose of perpetuating the race.

We will first take the common Wood Ant (*Formica rufa*) as an example of ant-life as manifested in England, and then proceed to the larger and, if possible, more interesting species which inhabit hotter climates.

There are few woods where the nest of the ant may not be found. It is divided into two distinct portions, *i.e.* the part which is above ground, and that which is below. The former is of limited size. It is a mound composed of leaves, bits of stick, straw, and similar materials. Fir-woods are favourite habitations of this ant, as the long needle-like leaves are admirably adapted for the rude building which the ant makes. It must be remembered that the ant tribe, though admirable burrowers, are very poor builders, their structures being

exceedingly loose and fragile. A very large specimen of the ant mound will be about eleven feet in diameter, and three feet or so high in the centre. If one of these mounds be opened in summer-time, a remarkable sight presents itself. At first, all is turmoil, but after a few minutes three distinct kinds of ants are visible. First, there are multitudes of wingless ants, about the fifth of an inch in length. These are running fussily about, and many of them are bearing in their jaws some object of which they are taking the greatest care. Most of them are carrying oval objects of different sizes, but all grey or white in colour. Then there are a number of ants which are furnished with long, milky-white wings. Some of these winged ants are very nearly half an inch in length, while others are about one-third of an inch long.

The large winged ants are the perfect females, who are intended to be the founders of fresh colonies. The lesser ants with wings are the males, while the workers have no wings, nor ever will have them, because wings would be very much in the way of their work. Even those which possess wings only use them once in their lives, and then for a very short time. These wings, by the way, are marvellously beautiful. To the unassisted eye they present a milky appearance, because the eye does not possess sufficient magnifying power to separate the colours which adorn them. But the microscope shows that they are highly iridescent, different shades of azure, crimson, and green fitting over their surface as the light falls on them. As a rule, the males and females remain within the nest for a long period, and it is very difficult to detect them in the act of leaving the nest. There seems to be some sort of common understanding among the nests of a considerable district, that they should all take to wing simultaneously, as otherwise it is not easy to account for the vast swarms which are occasionally seen. They have been repeatedly mistaken for actual clouds, and one instance is mentioned where they had surrounded the spire of a church. The spectators thought that the church was on fire, the effect of the sun-rays upon the innumerable translucent wings being exactly that of flame, the dark bodies representing the smoke.

The late Mr. Frederick Smith, of the British Museum, who knew more about ants than any living man, wrote of the Garden Ant (*Formica nigra*) thus: "In the month of September, 1855, I observed at Dover immense clouds of this ant pass over the town towards the sea. Subsequently, on passing along the beach, I observed a line of their floating bodies extending from the town at least a mile towards St. Margaret's Bay; the line consisted of males and females, and was about a yard broad." The wings of both sexes, though ample in point

of size, and capable of buoying their owner in the air, are very feeble, and incapable of a long flight, or of making their way against the wind. Consequently, like the locusts, which are equally feeble of flight, they can only drift with the wind, and if they come upon the sea or a broad river, they are sure to fall into it and be drowned. Their numbers are also greatly thinned by the swallow tribe and other insect-eating birds, as well as dragon-flies, each of which can eat nearly as much as a swallow. It is very fortunate that all the females do not survive their aerial journey, for if they did so, the country would be entirely overrun with ants.

There are two points of structure in the wing which ought not to be passed over, as they are examples of the beautiful adaptation of means to end, and of instinct to structure, which we find throughout the whole animal kingdom. All the Hymenoptera have four transparent wings, which, though separated when at rest, are joined during flight, so that they look and act like two wings instead of four. This junction is obtained by means of a row of little hooks arranged along part of the upper edge of the hind wings. Exactly opposite them the lower edge of the front wings is turned up so as to make a fold or flap. As soon as the insect spreads its wings for flight, and presses them downwards, the points of the hooks glide over the surface of the front wings, and catch in the flap.

Now, though the Creator of the material universe, with its countless suns and their attendant planets, God permits no waste, and takes as much pains to avoid wasted power in an ant's wing as in all the stellar and solar systems which the telescope can only indicate.

I have mentioned that the ant only flies once in its life, and that the duration of flight is very short. Bees and wasps are perpetually on the wing, and are obliged, not only to fly to considerable distances, but to carry food to the nest. Therefore, the hooks of the bees and wasps are very strong, and shaped very much like pickaxes, with one point being greatly thickened just where the strain is greatest. But the hooks of the ant are very slight and feeble, and somewhat resemble the "pot-hooks," which, in the days of my childhood, used to be the introduction to the art of writing.

Now comes another point. I have already mentioned that the worker ants have no wings, because these organs would be very much in the way when the insect traversed the multitudinous galleries of its subterranean nest. But the female possesses four ample wings, and yet, in the course of her future life, the whole of her time is passed underground. What, then, is she to do with her wings? She is forced to rid herself of them, and to remove them before she begins to form

a new colony. But how does she do it? Until quite lately, it was thought that the ant bit them off. As this periodical does not permit illustration, I can only say that the structure of the insect renders such a feat impossible.

Suppose that any of my readers had wings growing out of their shoulder-blades, such as sculptors and painters give to conventional angels, would it be possible to bite off these wings? It would be quite as possible to bite off one's own ears. More than thirty years ago, I determined to watch the ant for myself, and take nothing on hearsay.

Towards the end of autumn, occasional winged females might be seen, having completed their solitary flight, and returned safely to earth. Their first care was to rid themselves of their wings; the ant always did so in the same manner. First, she forced her wings forward as much as possible, and in so doing turned them partially sideways. She then ran forward, and suddenly stooped, so as to bring the tips of the wings against the ground. As a rule, both pairs of wings snapped off close to the body, but now and then those of one side would persist in adhering, and several attempts had to be made before they were cast off.

So much for the mode—now for the means. If the reader will examine the wings of an ant—the Wood Ant is the best, as being largest—he will see that the strong nervures which connect the wing with the thorax are deeply scooped on the inside, the scoop looking as if it had been made with a gouge. When the wing is used for flight, and the pressure is directly downwards, the scoop scarcely weakens it at all, but when the insect reverses its wings and presses them sharply against the ground, the strain is thrown on the weakened portion, which immediately gives way. We all know the great strength of a girder when set on edge, and force applied downwards. But if that same girder be laid flat, a comparatively small force will break it. These future queens are still helpless, and can do nothing until they are met by a worker. She knows instinctively what to do, and guides her mistress to a hole in the ground, where they disappear. How the new nest is formed, and what system is adopted for constructing the extremely elaborate series of galleries and chambers, is at present unknown.

Nor is it at all an easy matter to investigate the interior of a nest, for the ant is no builder, and the partition walls are so fragile that the whole structure crumbles to pieces at the touch of spade or trowel. It is not difficult to make a "formicary" with glass sides, so that the ant can be seen at work. But ant-life in so confined a space is necessarily artificial, and can give but little idea of the real nest.

I have, however, been fortunate enough to examine, though

for a short time only, the interior of a large Wood Ant's nest in full working order. It was done in this wise. One of my friends, a good practical naturalist, held many consultations with me, until we elaborated a plan which we really thought a very clever one; and perhaps it was, as far as it went. Only, as events turned out, it went a very little way. The nests of the Wood Ant are greatly cherished by gamekeepers, as the insects, in all their stages, afford excellent food for pheasants. So my friend obtained leave for us to try our experiments in a very strictly kept preserve, where a number of ant-hills were to be found. We then procured a large piece of thick plate-glass, so large indeed, that both of us together had some trouble in carrying it from the vehicle into the preserve. Having previously chosen a fine specimen of an ant-hill, with an open space round it, we stood one on either side of it, set the glass edgewise on the top of the hill, and then drew it backwards and forwards, just as masons saw stone. We continued our work until we had not only cut completely through the ant-hill, but had sunk the glass deeply into the ground. When we had cut our way so deeply that the upper edge of the glass was beneath the top of the nest we went away, so as to give the insects plenty of time for repairing damages.

I may here mention that when an observer wishes to make practical experiments upon an ant's nest, several precautions are necessary. He should wear boots—Wellingtons are the best—and either tie the trousers firmly round the ankles with a string, or confine them with a strong india-rubber band. The hands must be also protected by gauntleted gloves, which are secured in similar fashion at the wrists.

In a few weeks' time we returned to the preserve, armed with spades, trowels, and note-books. Then we cut away the whole of the nest on one side of the glass, carrying our excavations downwards as far as the glass reached. Thus, we were enabled to look into the interior of the nest through the glass, and a most wonderful sight it was. There were galleries, shafts, connecting passages, and chambers, all filled with ants. There were the winged ants, which scarcely stirred a foot when the light shone in upon them. There were quantities of "ants' eggs" in some of the chambers, and larvæ in others. And, hurrying through the passages were thousands of workers evidently discomposed and alarmed at the intrusion of light into their dwellings, and most of them carrying off the "ants' eggs" into the recesses of the nest.

Then I began to make a sketch of the busy scene, but found myself checked by an event which neither of us had foreseen, though we ought to have done so.

The interior of the Wood Ant's nest is always moist and

warm. Ants, or at all events some species of ant, have the power of keeping their nests not only moist, but wet, though all the surroundings are hot and dry. Dr. Livingstone has drawn attention to this curious faculty. He mentions that in tropical Africa there were certain black, long-legged ants, which ran about upon the rocks with perfect impunity, and in the noontide sun. The stone was so hot that if touched the skin of the hand would be blistered. Beetles and other insects placed upon it could only run a few steps, and then fell dead. This might be expected, as insects in general succumb at a temperature of 120° Fahr., or thereabouts. Yet, not only were the ants uninjured, but the nest, which was only a few inches below the level of the soil, and far from any water, was full of moisture. Dr. Livingstone, who, although not a naturalist, was apt at generalizing, suggests that there might be something in common between the ants of Southern Africa and certain antelopes of the same country, both creatures being able to sustain life in that arid climate, and yet without the possibility of having access to water. Everyone knows that water is simply a combination of hydrogen and oxygen, and Dr. Livingstone offered the suggestion that both the antelopes and the ants might be able to combine the hydrogen which exists in the food which they eat, with the oxygen which is the life-preserving element in the air which they breathe, and so to secure sufficient moisture for the purposes of life.

To return to our Wood Ant's nest. In a very short time, the comparatively cool air which impinged upon the outer surface of the glass caused the moisture to condense in the inner surface, and accordingly the view was effectually cut off. However, I had just time to secure a rough sketch of the plan on which the interior of the nest was formed. There was a series of nearly horizontal galleries, some quite close to the surface of the ground, and others at a considerable depth. Although these galleries extended far beyond the limits of the "hill," there were no entrances except from the hill itself.<sup>1</sup> I have mentioned that when the nest was broken open, the majority of the workers busied themselves about the so-called eggs.

Now, when I was a very little, and a very inquisitive boy, I found myself greatly perplexed. I knew that the eggs which I had at breakfast were very much smaller than the hen which laid them, and I could not at all understand why the ant's eggs should be larger than the ants themselves. On examining

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<sup>1</sup> Shortly after making the sketch, I came across a diagram illustrating the section of a coal-mine, and was quite startled at the almost exact resemblance of the diagram to the sketch. In fact, the mining engineer might have made his plans from the domicile of the Wood Ant.

these "eggs" with a magnifying-glass, I discovered that they were not eggs at all, but silken cocoons, similar in every respect to those of the silkworm.

The life-history of the ant, whether male, female, or worker, may be briefly given as follows: The queen ant lays her eggs, which are immediately taken in charge by the nurses. Being carried to the upper or lower portions of the nest, according to the temperature, they are hatched, and then appear as little grubs, without the least resemblance to the highly developed form which they will soon assume. They have no legs, so that they cannot move about, and in fact, an ant larva bears no small resemblance to a sausage. Dissection shows an internal structure of equal simplicity. First, there is a thin, but exceedingly tough skin; under the skin is a layer of fat, and under the fat a very thin layer of muscular fibres, just strong enough to enable the larva to bend its body. The rest of the creature is comprised of a vast stomach, so that it is really little more than a stomach furnished with a mouth. For its food, it is wholly dependent on the nurses, and I must say to their credit, that out of the hundreds of ant larvæ which I have dissected, I never found one in which the stomach was not full. When it is full fed, it proceeds to envelop itself in a silken cocoon, the slight muscular layer which I have already mentioned just sufficing to enable the creature to bend its body and direct the course of the silken threads of which the cocoon is formed. Considering the small size of the cocoon, the thread is wonderfully strong, and with a little care can be wound off like that of the silkworm itself. There are always three sizes of these cocoons, the largest being those of the queens, or perfect females, the next in size being those which contain the males, and the smallest those of the workers. When the enclosed insects have reached maturity, the nurse ants tear the cocoons open, so as to permit the inmates to escape. The males and females remain within the nest, as has already been mentioned, but the workers are very soon able to undertake their lifelong labours.

When a Wood Ant's nest is once fairly established, it retains its place for many years. Not only this, but the ants travel in the same path, which extend to wonderful distances, and can be clearly recognised, even in winter, because the ants are in the habit of removing every object which would affect their traffic. The late William Howitt told me of ant-roads which he had watched for more than fifty years, and which in his old age were as clearly defined as when he was a boy.

It has long been known that the ants possess many characteristics which are not only shared by man, but which distinguish civilized man from the savage. First and foremost comes



the capability of laying up food for the future. No savage ever provides for the future. He lives not only for the present day, but for the present hour, and as long as he can satisfy the immediate cravings of hunger and thirst, he cares for nothing more. Such races we find in the native Australians and the Bosjesmans of Southern Africa. Such were the Tasmanians, who are now totally extinct, a fate which is slowly but surely overtaking all savages. With regard to the storage of solid food as practised by the ant tribes, we must wait until we can treat of the ants of other countries. But even our own ants possess the power of storing liquid food, and do so in a very remarkable manner. With man, as with all mammalia, milk is the sole food in early childhood; with civilized man, milk remaining the principal, though not the only food for several years. The parents, therefore, must provide a store of milk for their young. They cannot do so directly, because milk cannot be kept for more than a few hours. So they store it indirectly in the form of money, which buys the milk of the dairyman. He again stores his milk indirectly by keeping cows, which afford a supply twice daily. Though I suppose that not one dairyman in a thousand has the least idea of the fact, and probably would not believe it if it were told him—the ants were beforehand with him, and kept their cows not only long before the business of a dairyman could have been invented, but many ages before man took his place on the earth. The creatures which are to the ants what cows are to us are known by the name of *Aphis*, popularly called the "green blight." They crowd upon young plants and tender leaves, and suck the sap by means of a sharp-pointed proboscis. If an *aphis* be carefully examined, two little horn-like projections will be seen on the upper part of the abdomen. They differ in shape and size according to the species, but serve the same office. Scientifically, they are termed "cornicles." If these cornicles be submitted to the microscope, or even to a tolerably powerful magnifying-glass, they will be seen to be tubes, having an aperture at the extremity. From the aperture there exudes almost perpetually a translucent, viscid liquid, which falls in tiny drops, and is mostly received upon the leaves of the plant on which the *aphis* is feeding. Popularly it is known as "honey-dew." To the touch, this liquid much resembles sugar and water, and to the taste the resemblance is quite as remarkable. In point of fact, just as the cow, by the wondrous chemistry of Nature, converts her food into the saccharine milk, so does the *aphis* convert the sap of the plant into the sweet honey-dew. There are very many species of *aphis* found in England, and most of them secrete this honey-dew in abundance. Some of them possess a proboscis which seems almost

absurdly large when compared with the size of the insect. It measures from base to tip very nearly three times the length of the body, and at the base is enormously thick, so that a side view of the aphis is really ludicrous, the proboscis passing underneath the body and extending far beyond it. Most persons, when these aphides are first pointed out to them, think that the proboscis is a tail, and a very long one.

Honey-dew is to the ants what milk is to us, and not only do they lick up the sweet juice from the leaves, but they drink it as it exudes from the cornicles. Sometimes they come upon an aphis which is not producing honey-dew. In that case, with their antennæ, which are evidently the conversational organ of the ant tribes, they gently tap the extremity of the cornicle. These little taps are quite understood by the aphis, which soon pours out a modicum of the needed liquid.

Not only do the ants supply themselves in this manner, but they actually carry the aphides into their nests and scoop out chambers for them, just as the dairyman keeps his cows in stalls. They even go further in their storage of liquid food. Towards the end of autumn they ransack the trees in order to search for the eggs of the aphides, which produce honey-dew. They then carry off the eggs, and place them in the recesses of the nest. In the following spring, when the young leaves are beginning to show themselves, the ants carry the eggs back again to the tree, and place them on the tender leaves, which will afford them abundance of sap, convertible into honey-dew.

In the summer of last year (1882) a vast swarm of the Hop Aphis passed over Kent and Surrey. The swarm was estimated at some three miles in length, and looked like a variegated cloud as it passed through the rays of the sun. Part of this swarm settled upon an aspen-tree in my garden, covering the leaves so completely that the whole of the under surface of each leaf was one mass of aphides. The ants, however, found them out almost as soon as they arrived. So did the ladybirds and the lace-wing flies; and in three days or so there was not an aphis to be seen. This was rather a misfortune as far as I was concerned, for I was trying to rear some newly hatched Mantidæ, and the only food which the little creatures could take consisted of the aphis.

There is at least one species of ant which lays up liquid food in a still more remarkable manner. This ant is a native of Mexico and Colorado, but must necessarily be mentioned here. It is the Honey Ant, and is scientifically termed *Myrmecocystus Mexicanus*. It is naturally a slender, long-bodied, and long-legged insect; but there are a number of individuals

which are set apart as living honey-pots. The ants have no power of secreting wax, like the bees; neither can they, like some of the wasps of the same climate, form cells of clay, which are baked as hard as earthenware under the tropical sun, and therefore able to contain honey. So, a certain number of the workers are told off, and then wounded in some curious fashion which totally stops the process of digestion. They are then perpetually fed with honey, so that the abdomen becomes enormously swollen, and looks much like a very large white currant. When honey is required for the purpose of feeding the young, these living honey-pots give out the sweet liquid from their mouths as it is needed.

The honey-ants are actually used as articles of commerce, and sold by measure. They are brought to table with the dessert. The abdomen being so weighty, the insects cannot crawl away, and are eaten by the simple process of putting the abdomen between the lips and nipping it off with the teeth. Only the largest and best-looking ants are used for this purpose, the others being pressed, and a sort of mead produced by the fermentation of the sweet juice.

#### WE turn now to Ants Abroad.

It is a remarkable fact that many admirable entomologists, including Hüber, Latreille, and Kirby, have repudiated the statements in the Book of Proverbs, that the ant "provideth her meat in the summer, and gathereth her food in the harvest." Now, the Holy Scriptures were never intended to be handbooks of physical science, so that even if Solomon or Agur (who lived several centuries after Solomon) had written of the ants according to popular opinion—like the rising and setting of the sun—no slur could have been cast upon either Solomon or Agur. But they were right, and Gould, Latreille, Hüber, Kirby, and others were altogether wrong. For an Englishman it might be excusable to doubt the storage of grain, and to think that the cocoons had been mistaken for seeds. But that such acute observers as Latreille and Hüber should commit themselves to such a denial is really astonishing, inasmuch as the Harvesting Ant (*Atta barbara*) is a native of France.

Now I must ask the reader to call to mind the description of the parallel galleries which was given in the history of the Wood Ant.

The Harvesting Ant gathers in the autumn the seeds of various grasses, stinging-nettle, shepherd's-purse, speedwell, and other plants, and carries them down to the lowermost part of the nest, which, as has already been mentioned, is always warm and wet. Consequently, the seeds begin to germinate. As soon as they do so, the ants bite off the young

shoot, and then transfer the seeds to the upper chambers, which are hot and dry. Most of my readers are probably aware that the greater part of a seed consists of starch, which is intended for the nourishment of the young plant. The germ, however, being destroyed, a chemical process takes place, and the starch is converted into sugar. In point of fact, the ant has made malt, and has anticipated John Barleycorn by countless centuries. Malt is made by steeping barley in water until it begins to shoot. It is then transferred to a chamber which is so hot as to kill the young plant, and is kept there until the dry heat has converted the starch into sugar.

There is another species, called the Agricultural Ant, which lives in Texas. This creature goes far beyond the Harvesting Ant, inasmuch as it actually cultivates its food-plant.<sup>1</sup> The ants prepare the soil by making a mound of finely-pulverized earth, on which they permit no other plant to grow except the "ant-rice," a species of *Aristida*. It is believed that they not only watch and tend the plant, but that they sow it besides, as it is difficult on any other supposition to account for the invariable presence of the ant-rice in the artificially prepared mounds. These mounds are variously shaped, but are usually about ten feet in diameter, and perhaps a foot high in the centre. The labour of weeding these mounds must be very great, owing to the rapid growth of vegetation in that country. Dr. McCork remarks that it is very curious to see these mounds established amid the wild sage and other vigorously growing plants. "The weeds had crowded up as closely as they dared, and in imaginative moments I could almost fancy that the bulky things were looking down with covetous eyes upon the forbidden grounds, from which they were held back only by a wholesome fence of the little insects, whose energy was continually saying to them, 'Hitherto shalt thou go, and no further.'"

There is another characteristic of civilized man which is shared by ants; *i.e.*, the keeping of domestic servants.

These servants, or slaves, as they are often called, are very seldom of the same species as their mistresses, and almost invariably are of much less size. One species of slave-makers, the Rufescent Ant (*Polyergus rufescens*), has been waited upon for so many generations, that it can do nothing useful for itself. In point of fact, it is much in the condition of the nobles in the middle ages, who prided themselves on their inability to use a tool or even a pen, leaving the former to the working-classes and the latter to the clergy. They would only condescend to the lance, sword, and battleaxe, and thought

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<sup>1</sup> The scientific name of this ant is *Pogonomyrmex barbatus*.

that their only business was fighting. Such is the case with the Amazon, or Rufescent Ant, which, however, go still further. The nobles in question could at all events feed themselves, while the ants cannot do so. Their jaws are only constructed as weapons, and if they be placed amid plenty of food, and without servants to feed them, they die of hunger. Sir John Lubbock kept a nest of these Amazons for four years, and never once saw the ants feed themselves.

Hüber found, however, that a single slave was sufficient to wait upon fifteen of its mistresses. He had put about thirty of them in a box, together with earth, honey, larvæ, and pupæ. They did nothing, and in two days half of them were dead. He then introduced a single slave. She at once reduced the place to order, fed her mistresses, scooped out one chamber for the larvæ and another for the pupæ, extricated some young ants that were matured within the pupæ, fed them, and kept the whole colony in health.

If a new nest be formed, the Amazons cannot find their way to it, and have to be carried by the slaves. Strangely enough, they can find their way when they want to attack a nest for the purpose of procuring fresh slaves. Hüber once watched a small party of these ants on a marauding expedition. The party occupied a space some ten inches in length by four in width. After going for some distance along the road, they went through a hedge into a pasture-field, keeping their ranks unbroken in spite of the grass and other obstacles, and made for the nest which contained their prey. Some of them fought with the defenders, while others broke through the sides of the nest. The whole of them then poured through the breach, and they presently emerged, each carrying in her jaws a larva or pupa. Sometimes one of these marauding parties will consist of two thousand individuals or more, though a small body of a hundred or so will take the field.

Some of our British ants are slave-makers, the most conspicuous in this respect being the Red Ant (*Formica sanguinea*). This insect somewhat resembles the Wood Ant but may be readily distinguished by its blood-red colour. It is tolerably common in the New Forest, where its habits may be watched. Several nests have been found at Shirley Common, near Croydon, and the Rev. W. F. White gives some interesting accounts of them in his "Ants and their Ways."

It is known to take as slaves no less than four distinct species of other ants, and it is really a wonderful fact that these diverse creatures should all know how to do the work of their captor's nest. There are with this ant, as with most species, large and small workers, the former acting as soldiers, while the latter perform domestic tasks. The large workers of the

Red Ant are exceedingly fierce, and if the nest be disturbed will attack the intruder with great fury. The nest is made in banks, especially where it can be backed by a gorse stump. Mr. White, who watched a raid upon the nest of another species, the Ashy Ant (*Formica fusca*), states that the assailants confined themselves exclusively to the larvæ and pupæ, without meddling with the perfect insects. The Fuscas did their best to carry the pupæ into a place of safety; but they were so afraid of their foes, that when one of them approached, the intending rescuer dropped its burden and abandoned it to the enemy. The Red Ants would push the Fuscas out of the way, but never hurt them.

The common Wood Ant is also a slave-maker. Mr. Bignell of Plymouth, who is well known for his acquaintance of ant-life, was witness to a raid by the Wood Ant upon the common Garden Ant (*Myrmica scabrinodes*). One of them had captured a winged female of the Garden Ant, and was trying to drag it towards the nest.

Although so much less than the Wood Ant, the Garden Ant is a fierce and active fighter, and the Wood Ant had the greatest difficulty in overpowering her. They were so fiercely engaged that when Mr. Bignell picked them up and put them into a box they did not cease fighting. When he opened the box at home, they were still fighting. Then he put some chloroform into the box and they died fighting. He then set them on a piece of cardboard, and I had the pleasure of making a careful sketch of the curious group.

One of my brothers saw a combat between three Wood Ants and a single Garden Ant. The latter had disabled one of her foes by seizing an antenna in her jaws, and resisted all attempts on the part of her assailants for twenty minutes. What the ultimate result of the fight was I do not know. Thinking that three to one was rather unfair, my brother drove off one of the assailants. He is a schoolmaster, and as the bell rang at that moment, he was unwillingly obliged to leave the combatants.

Perhaps the fiercest fighter among the British ants is the brilliantly coloured and delicately formed little *Formica exsecta* "They advance in serried masses," writes Sir J. Lubbock, "but in close quarters they bite right and left, dancing about to avoid being bitten themselves. When fighting with larger species they spring on to their backs and then seize them by the neck or by an antenna." They also have the instinct of acting together, four seizing an enemy at once, and then pulling her different ways, so that she on her part cannot get at any of her foes. One of them then jumps on her back, and cuts, or rather saws off her head. In battles between this ant and the much larger *F. pratensis*, many of the *F. exsectas* may

be seen on the backs of the *F. pratensis*, sawing off their heads from behind."

This interesting species seems to be confined almost exclusively to the neighbourhood of Bournemouth. It may be known from the Wood Ant by its smaller size, and the bright red head and thorax of the workers and queens. The male is black. The nest is somewhat similar to that of the Wood Ant, but is smaller and mostly formed of dry grass.

The most formidable of the ant tribes are the Ecitons of tropical America and the Drivers of Africa. But fortunately for the human inhabitants of the country, they render invaluable services to man. Indeed, were it not for the Ecitons, it would be difficult for civilized man to retain his position there. The original inhabitants of the country are snakes, rats, scorpions, gigantic cockroaches and venomous centipedes a foot long, spiders, and the hated chigoe fleas which burrow under the toe-nails, and which unless they are carefully taken out will even occasion the loss of the toes. No one in that country thinks of going to bed until the feet have undergone a rigid examination. As man persists on thrusting himself and his dwellings among all these creatures, they take up their abode in his houses, where their presence is always annoying and often dangerous. Fortunately, the Ecitons, or Foragers as they are sometimes called, act as scavengers, making their appearance just before the rainy season. As soon as they are observed approaching the house, every box is opened and every drawer pulled out so as give the ants a free access. The human inhabitants then leave the house, and do not return until the ants have disappeared from it. After they have gone not a living creature can be seen in it, and from snakes to chigoes, the vermin have been eaten by the ants. One of my brothers determined on seeing how the ants made their attack, and for this purpose left the door open and took his stand on a chair. The first sign of their approach was given by a slight rustling sound, like that of fallen leaves stirred by the wind. Presently a gigantic cockroach was seen to scuttle over the floor, and about a foot behind it was one ant not a quarter of an inch in length. Behind that ant came two, behind them several more, and so on, the number perpetually increasing. Presently the cockroach turned and tried to fly in another direction. He had been met by another pioneer ant, which was backed up by others just as the former had been. Presently, whole streams of ants poured in a similar manner into the house from every hole and crevice, so that it was incumbent on the observer to seek his own safety. Had he remained in the house, he would assuredly have shared the same fate which befell the cockroach and its companions.

These roving ant-masses are always accompanied by their officers, who can be at once recognised by their enormous heads. The officers walk on the outside of the column, and do not permit the soldiers to straggle out of the ranks. They also evidently act as guides. It is remarkable that some of these Ecitons are blind, or at all events possess no eyes, so that the mode of their guidance is a mystery.

What an astonishing performance this clearance of a house is! Who informs them of the house, and who guides them to it? Who tells off the single pioneers, gives the order to surround the house, and gives the signal to concentrate simultaneously upon it? Here, in fact, is a complicated military movement executed with a precision of which our best generals might be proud. That orders are given from the rear, just as in modern warfare, is evident, but of what nature those orders are, and how they seem to be transmitted and instantaneously obeyed, is one of the great mysteries of ant-life. Sir J. Lubbock had a microphone of special sensitiveness attached to one of his nests, but nothing could be heard except the tramp of the ants' feet as they ran about. It may be possible that the insects can produce and hear sounds which not even the microphone can make audible to man. Or, it may be that ants possess some mode of communication which is not developed in man, he possessing the gift of language.

Africa possesses foraging ants which in many of their habits resemble the Ecitons. They are popularly known as Drivers, because they drive away every living creature that comes in their way.<sup>1</sup> The workers differ greatly in size, the largest equalling an earwig in length, while the smallest are no larger than the common Garden Ant of this country. I believe that at present the males and queens are unknown. It is said that even the great python snakes have no chance against the Drivers, and that when a python has crushed an animal to death it dares not swallow its prey until it has made a large circle, a mile or so in diameter, in order to make sure that no Drivers are near. This may be true or not, but it shows the terror in which the insects are held. They have been known to enter a pigsty and eat the pigs, whose tough skins cannot resist the sharp jaws of the insect, while, as to poultry, they will clear a henhouse in a night. It is curious that when they devour poultry they remove all the feathers, beginning at the base of the beak and working backwards over the body. They are forced to dig out each feather separately, but their numbers

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<sup>1</sup> The scientific name is *Anomma arcens*. The Greek word *anomna* signifies "eyeless," while the Latin word *arcens* signifies "compeller," *i.e.*, Driver.



are so great that they achieve their task in a wonderfully short time.

Sometimes it happens that when still out on these foraging expeditions the Drivers are overtaken by the sudden floods which prevail in the rainy season, and would be drowned but for a singular mode of meeting the danger. They form themselves into globular masses, each about as large as a cricket-ball, holding each other tightly by means of their entwined legs. Much air is entangled among the limbs, and the balls are rendered so light that they not only float, but when there is a wind, roll over the surface of the water. The ants wait patiently until the ball is washed or blown to land, and then untwist themselves, little or none the worse for the voyage. The largest ants always occupy the outside of the ball, the "women and children," as the natives call the smaller specimens, being in the middle.

They can even cross rivers by another ingenious device. They select a tree-branch which projects well over the water. They then let themselves down in a sort of chain until the lowermost ants can touch the water. Others crawl down this chain, attach themselves to the lowest ants, and spread their long limbs as far as possible on the surface of the water. Others rapidly follow, and pursue the same plan, until they have formed a bridge, over which the main body can pass. They are in the habit of forming similar festoons on other occasions. Once a nest was discovered, and the natives tried to burn the Drivers out by covering the nest with dry palm-leaves, and setting them on fire. Quickly as such fuel burns, the ants were quicker still, and the greater part contrived to escape up trees, from the branches of which they hung in festoons that quite blackened the trunk with their numbers.

Like the blind Ecitons, which have been already mentioned, the Drivers possess no eyes. Yet they hate light, and always travel after dark, if possible. There is another reason for travelling after sunset. They cannot endure heat, and if they be exposed to the rays of the tropical sun they die almost immediately. They therefore travel under cover as much as possible, and when they are forced to come out into the light and heat they build a continuous arch of particles of earth, agglutinated together by some liquid, which they pour from their mouths. The arch is a very flimsy one, but it is quite sufficient for the purpose of protection.

I have casually mentioned the power of the jaws. On one occasion the head of one of the large workers had been cut off. More than twenty-six hours after decapitation the head seized one of Dr. Savage's fingers with its jaws, and immediately began to bite. Though it was rather a painful experiment, he

allowed the jaws to continue their work. The jaws did not pinch simultaneously, as might have been supposed, but each jaw was thrust alternately into the finger, cutting its way like a scissor-blade and drawing blood at every stroke. Ten hours afterwards the head showed signs of life, while the severed body lived for more than forty-eight hours. So, it is no wonder that the hides of the pigs could not protect them, or that the ants were able to dig out the feathers of the fowls by the roots. The jaws are so long that when closed their points cross each other. It is therefore impossible, when once the Driver has taken hold of its prey, to remove it without destroying the insect; and, as we have seen, even if the body be torn away, the jaws continue to bite just as fiercely as before.

The description of the jaws is taken from some specimens kindly given to me by the late Mr. F. Smith, to whom allusion has already been made. The specimens had formed part of an ant-ball, which was cleverly captured as it floated, and sent to Mr. Smith. Two of my specimens still grasped each other firmly by the legs.

Even with our little British ants, possessing comparatively feeble jaws, it is not uncommon to find the severed head of a slain foe still clinging to the legs, the ant not having been able to loosen the grasp of the jaws.

The reader will remember that the males and queens of the Drivers have not yet been discovered. Exactly the converse takes place with an ant appropriately called *Anergatis*, i.e. workerless. With this curious insect no workers have as yet been discovered. There are the males and females—the former, by the way, being wingless—but the workers who undertake all the labours of the nest belong to not only a different species, but a different genus, known as *Tetramorium*.

The natives of Brazil are in the habit of using the large-headed Ecitons instead of sutures to a wound. They press the edges of the wound together, and then hold an Eciton to it. The insect immediately bites, driving the sickle-shaped jaws through the edge of the wound, and making the points cross. The body is then twisted off, the head being left adherent to the wound. Sometimes a row of six or eight ants' heads may be seen upon a native's wounded limb.

There is another large ant inhabiting Brazil, which is sometimes mistaken for the Forager ants. Its popular name is Saüba (pronounced Sah-oo-báh), and its scientific title is *Ecodoma cephalotes*, the two words signifying "big-headed house-maker." It is not personally to be dreaded, like the Drivers and Ecitons, though indirectly it is often exceedingly mischievous to civilized man. Despite their scientific name

they are not good builders, but they are marvellous burrowers. Some entomologists, therefore, substitute the name *Atta* for *Ecodoma*, as less misleading.

There are, with these ants, the usual winged kings and queens, and a multitude of wingless workers. These latter are, like those of the Driver, of several sizes. There are the ordinary workers, which are comparatively small, and the large-headed workers, which are popularly, but wrongly, called soldiers. The heads of these ants are of enormous size, and are divided into two large lobes, looking much like two eggs placed side by side.

There is a further subdivision of these large-headed workers. Most of them have smooth and shining heads, and are continually walking about, though they do not seem to direct the small workers. The second set has the head covered with hair, and in the centre is a double ocellus, or simple eye, quite unlike that of any other known ant. These individuals seem to be stay-at-homes, but can be made to show themselves by pushing a stick into the nest. Two or three of them will then slowly emerge, look about them, and descend again into the darkness. In spite of their formidable appearance, they do not seem to bite, and Mr. Bates was able to take them in his fingers without being injured. They are about as large as ordinary wasps.

The nest is constructed on much the same principle as that of our Wood Ant, namely, a dome with tunnels beneath it. But the Saüba nest is of gigantic proportions, the dome being, on an average, forty feet in diameter and about two feet in height. It is made of pieces of leaf covered with layers of earth, and the mode of procuring the leaves is very curious. Unfortunately for the settlers, the Saüba prefers the leaves of cultivated trees, such as the coffee and the orange, and often kills the tree by the incessant stripping of its leaves. Mostly, the workers ascend the trees and cut off nearly circular pieces, each about as large as a sixpence, and drop them on the ground. Smaller leaves are simply cut off and thrown down entire. The fallen leaves are picked up by relays of workers who carry them to the nest. As these green leaves overshadow the insect, it was once thought that they were employed as shelter from the sun, and the Saüba was consequently termed the Parasol Ant. When the labourers have brought the leaves to the nest, they transfer them to the artisan ants, which lay them in their places. So here we have a division of labour, and even a sort of trades unionism, fully developed in the ants long before man discovered their utility. From the centre of the dome a large perpendicular shaft is sunk to a considerable depth, and from this shaft tunnels of wonderful extent radiate

in all directions. These ants often do very great mischief. It is impossible to calculate upon them or guard against them. One of them which was driven into the shaft of a goldmine, conducted a torrent of water into it in the rainy season so that the water washed away the timber which supported the roof, and laid the whole mine in ruins. In another case, the Saüba burrow passed through the bank of a large reservoir, and so let out the contents and flooded the surrounding country.

There is but one way of destroying these insects, and that is by procuring the services of a professional ant-killer. He brings with him a large gang of negro labourers, as also building material and other apparatus. He then builds a large dome over the nest, filling it as he goes on with charcoal, dry wood, and plenty of sulphur and capsicums. Next, he makes a series of holes near the base of the dome, and having divided the negroes into gangs, he places one negro in charge of each hole. At a given signal the negroes thrust a piece of burning charcoal into each hole, insert the nozzle of a large bellows, and begin to blow. The master takes up some elevated position and watches for smoke coming out of the ground, this denoting an entrance to a tunnel. These holes are stopped with wet clay, and after about four days and nights' incessant work, the whole of the ants are presumed to be dead. The galleries are then laid open and filled in with wet clay well stamped down. The tropical sun soon bakes the clay as hard as brick, and then the place is considered safe from the ants.

There is much more to be narrated of these marvellous insects, but our limited space prohibits mention of more than one species, a native of Sydney, N. S. Wales. It had been long known that some of our British ants buried their dead, but that the insects could employ funeral ceremonies as elaborate as those of man, was not known until 1861, when the funeral rites were for the first time witnessed by a lady, Mrs. Lewis Hutton. She was walking with her little boy when the child suddenly screamed. On running to his help she found that he was covered with soldier ants. She tore them off, killing many and throwing them on the ground. When the child was quieted, she returned to the spot and saw a number of soldier ants surrounding the dead bodies. Presently, four of them ran off and entered a hole leading to the nest. In a few minutes a number of soldiers emerged; they marched two and two with a space between each four. Following them was a body of the workers about two hundred in number. Each group of four went at once to the body of a dead soldier, the two front ants picking up the corpse and the other two falling in behind like mourners; they then started off in procession to a sandy hill at some distance. When the bearers were tired they laid

down their burden, which was taken up by the second pair, the former bearers falling in behind. When the hill was reached, the bodies were laid down, and half the labourers divided into gangs which dug a grave for each dead warrior. The soldiers laid the bodies of their companions in the graves, and the other half of the labourers then filled in the earth. About six of them had refused to obey orders; they were at once killed, a hole was dug at some distance, and they were thrown ignominiously into a common grave.

The most astonishing point in this account is that the ants must have possessed some mode of counting, as they told off exactly the necessary number of soldiers for bearers, and of workers for grave digging.

It is no wonder that Sir J. Lubbock should state his belief that although the anthropoid apes, *i.e.* the gorilla, chimpanzee, and orang-utan, approach nearer to man than do any other animals, the ants have a fair claim to rank next to man in point of intelligence.

J. G. WOOD.



#### ART. IV.—ENGLISH AGRICULTURE, 1876-1883.

IT has needed a series of years of agricultural depression to recall to our minds the full importance of agriculture as a trade to England. Gradually the impression had gained general acceptance that the country owed most of its prosperity and much of its greatness to its commercial progress. "Seed-time and harvest" were supposed to be, by degrees, losing their importance. A nation which was fast becoming the workshop of the world did not need to trouble itself much about products which could be imported at small cost, if required, from America or elsewhere. As it happened, too, the years of "inflation," which commenced with 1869 and lasted until 1876, were also years of large agricultural yield. Rent and wages both rose steadily. The harvests were abundant, the seasons good, and the prices of stock of all kinds showed a steady upward tendency. With the disappearance of the rinderpest, and a series of fairly dry summers, cattle did well. The prosperity of the manufacturing interest caused a brisk demand, at increased prices, for all kinds of farming produce. As usual, we began to forget that things could not always be so. Every farm, as it fell vacant, was the subject of eager competition. The price of land rose with an exceptional rapidity. Land agents and land surveyors took a sanguine view of a situation, of which they found them-