

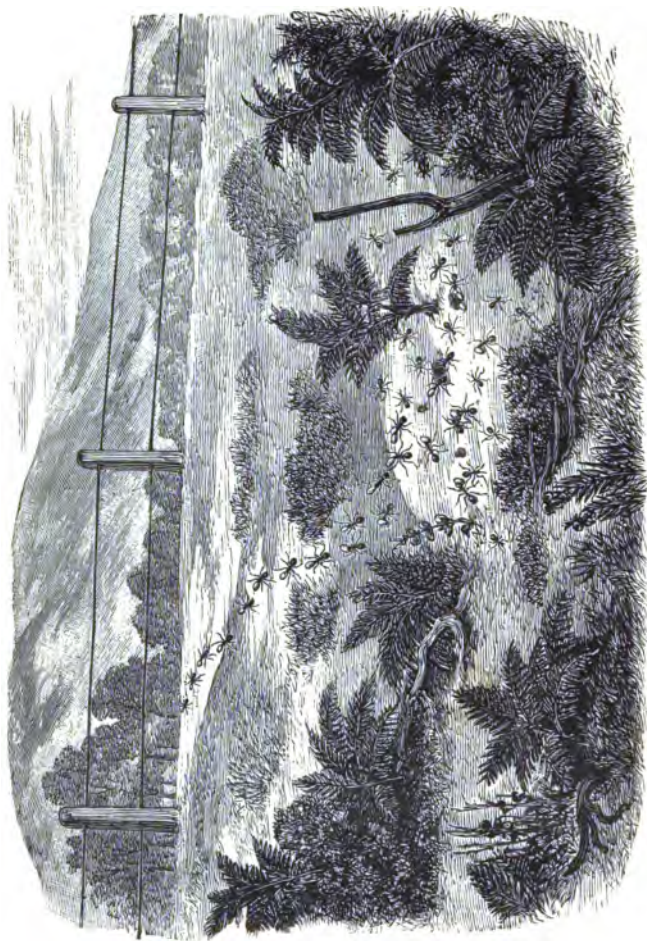


ANTS AND THEIR WAYS

ILLUSTRATED



W. FARREN WHITE, M.A.



The slave-maker (*F. sanguinea*) attacking the nest of *F. fusca* on Shirley Common.

[Page 175.]

ANTS AND THEIR WAYS

WITH ILLUSTRATIONS, AND AN APPENDIX
GIVING A COMPLETE LIST OF GENERA AND SPECIES OF
THE BRITISH ANTS

BY THE

REV. W. FARREN WHITE, M.A., F.E.S.L.

VICAR OF STONEHOUSE, GLOUCESTERSHIRE

'A little people,' but 'exceeding wise.'—*Prov.* xxx. 24, 25

'Go to the ant' . . . 'consider her ways and be wise.'—*Prov.* vi. 6

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1895

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PREFACE TO SECOND EDITION

THE fact that a large first edition of *Ants and their Ways* has been exhausted is an encouraging evidence that its publication satisfied a widely-felt need. This new edition is issued with but few additions. I have been fortunate in the re-discovery, at Bournemouth, of the species first captured unwittingly by the son of the late Mr. Frederick Smith, the celebrated Hymenopterist, to which species I have given the name of *Formica glabra*. After many a careful search, during frequent visits to that charming watering-place, which may be fairly designated the metropolis of the ant-world, I was rewarded in 1892, and again in 1893, by noticing, in the sunshine on the heather and the gorse, several workers, and, in 1892 for the first time, the queen, with a body-guard of her faithful subjects, taking a constitutional. I was thus able to make acquaintance with this brilliant species in its home. Since the publication of the first edition, I have, in company with the Rev. Canon Fowler, who kindly acted as my guide, met with several extensive colonies of the very rare species *Diplorhoptrum fugax*, near Sandown, in the Isle of Wight, and was made happy in witnessing the harvesting instinct in the delicately

sculptured species, *Tetramorium caespitum*, at Branscombe, on the Devonshire coast. The diligent workers, I noticed, filing into their nest with grass-seeds in their mandibles; and in disturbing their habitation I found many seeds scattered among the *débris* of what I took to be their granary. I should add that the late Rev. J. Traherne Moggridge says in his attractive work on *Harvesting Ants and Trap-door Spiders*, that this species has been observed at Mentone and Cannes occasionally collecting and carrying in seeds. The instance I have given is, I believe, the first of the harvesting instinct having been witnessed in our own country.

The present work owes its origin to a series of papers which I was requested to prepare for the *Leisure Hour*, and which appeared during the year 1880. Since that date additional material illustrating the marvellous history of the 'little people' has accumulated through the researches of Sir John Lubbock,¹ Dr. McCook of Philadelphia, myself, and others. Dr. McCook has published two volumes, one which appeared in 1880, constituting a monograph of the habits, architecture, and structure of *Pogonomyrmex barbatus*, the agricultural ant of Texas; and the other, in 1882, giving the remarkable history of the honey ants of the Garden of the Gods, and also of the occident ants of the American plains. I would also call the reader's attention to the *Synopsis of British Heterogyna and Fossorial Hymenoptera*, by Edward Saunders, Treasurer of the

¹ Sir John Lubbock has gathered together his papers on the subject, and has published them, with additional matter bearing on the social Hymenoptera, under the title *Ants, Bees, and Wasps*, as one of the

Scientific Series.

Entomological Society, reprinted from the *Transactions* of the Society for December, 1880—a valuable contribution to the study of the British species. In this work he adopts a specific characteristic for the female of *Formica aliena* which I had brought forward in one of my papers, and which had been recognised as distinctive of the species by my late friend, Mr. Frederick Smith of the British Museum, formerly President of the Entomological Society, an eminent Hymenopterist, to whose unwearied kindness and invaluable assistance I shall ever remain indebted. He, some twenty years ago, first stimulated my interest in the study of British ants into active exercise, and ever encouraged and aided me in my pleasant and profitable investigations, until his much lamented death in January, 1879. I have since secured possession of the greater part of his valuable collection of foreign *Aculeate Hymenoptera*, in which is numbered about six hundred different species of ants from almost every part of the world, as well as nearly two hundred and seventy species of the allied families *Mutillidæ* and *Thynnidæ*, popularly called Solitary Ants, and classed by Mr. F. Smith under the *Heterogyna*. Mr. Smith's manuscript lectures, with their practical and pictorial illustrations, have tended also to enrich my happy experiences of the wonders of the formic world.

I have been thus explicit in directing the attention of the reader to these sources of new entomological wealth, that he may be prepared to find in the present publication, not merely a reprint of my former papers, but rather the outline of an old picture filled in with fresh lights and shadows.

The author desires to place on record his appreciation of the value of the illustrations which so enhance the interest of his work, and which with but few exceptions were engraved from the well-executed drawings of his wife: these exceptions being Fig. 34, in preparing which she availed herself of a skilful sketch by Miss E. E. White, and Figs. 39-43, which were taken from original diagrams by the late Mr. F. Smith.

If the reader can glean from the perusal of this imperfect attempt to give form and colouring to one of the most marvellous provinces of the wondrous empire of the King of Glory, some portion of the untold pleasure it has brought to my own mind in making it, I shall be more than satisfied, especially should the perusal lead to a more emphatic and practical recognition of the truth of the inspired declaration — ‘The works of the Lord are great, sought out of all them that have pleasure therein.’

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ANTS AND THEIR WAYS

'A LITTLE PEOPLE,' BUT 'EXCEEDING WISE'

CHAPTER I.

The interest that clings to the study of ants—Their classical association—Their biographer of the last century—Their prehistoric origin—Their connection with amber—The ancestry of the white ant—The formation of amber—Dr. Livingstone and Sir John Kirk on the copal gum of Africa—The Kauri gum of New Zealand—The fossil resin of Galicia.

AN entrancing charm undoubtedly clings to the marvellous history of ants, most appositely designated by the inspired naturalist as 'a little people,' but 'exceeding wise.' From the time of Solomon to the present the movements and economy of this Lilliputian race have awakened in the observant mind feelings of the deepest interest, well-merited respect, and unfeigned astonishment. Whether it be in the record of revealed truth, in the chronicles of heathen mythology, in the pages of historians, in the songs of poets, in the enchanted ground of elf-land, amid the graphic records of travellers' experiences, in the letterpress of the British essayists, between the attractive covers of serials and periodicals, in the columns of newspapers, in the archives of governments, in the popular literature on natural history, in the more systematic registration of the wonders of natural science, and in the faithful observation and patient

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investigations of the diligent student of physical phenomena, the power of their influence is felt, and the marvel of their presence is realised.

Would the classic Jove accede to the petition of Æacus, king of Cænopia, to re-people his kingdom, which had been depopulated by a pestilence, with a thrifty, industrious, and valiant race? According to his expressed desire, we learn from the *Metamorphoses* of Ovid, the ants in an old oak-tree were changed into men, called by their monarch, myrmidons, from *μύρμηξ*, a Greek word signifying *an ant*. According to Strabo, however, 'they received their name from their industry, because they imitated the diligence of the ants, being continually employed in cultivating the earth, at first having no other retreat than dens, and the cavities of trees, until Æacus brought them together and settled them in more commodious habitations.'

Gould,¹ the biographer of those races of the little people inhabiting our island home, who published the results of his careful observations about one hundred and forty years ago, when little more than one-seventh of the species of the ants now recognised as British were discovered and distinguished, thinks that the warlike myrmidons must have been descended from the red ants, because of their sting. In contradistinction to this opinion of the worthy ant-chronicler, I would suggest that since the ancestors of the myrmidons were black, and inhabited the oak-tree, the beautiful and fragrant jet-ant, *Formica fuliginosa* (*Lastius fuliginosus*), which as a rule forms its corridors and apartments in the heart of forest trees, must have been the progenitors of the loyal subjects of Æacus. I should add that, in 1862, I myself saw a strong colony of this brilliant ant inhabiting an oak-tree on Hampstead Heath, and I captured many specimens.

¹ *An Account of English Ants*, by the Rev. William Gould, A.M., of Exeter College, Oxon., Lond. 1747.

The history of the little people dates far back into geological time, long before into man's nostrils was breathed the breath of life. It is noteworthy that in the tertiary formations of Oeningen and Radoboj, no less than eighty-three distinct species of ants have been brought to light by the diligence of scientific explorers.¹

Many species have been found in *amber*. *Amber*, we may well believe, originally existed in a fluid or viscous state, having exuded from prehistoric pine-trees, and was afterwards hardened, and, it may be, subjected to the action of subterranean heat. Various kinds of extraneous bodies have been discovered entombed in this fossil gum. Insects, spiders, infusoria, microscopic fungi, leaves, air-bubbles, bits of metal, grains of sand, and little stones, have been descried in the translucent prison-house. It has been asserted that no fewer than eight hundred species of insects have been found in amber, some recognised as similar to existing species, but mostly belonging to extinct genera.²

I have seen a piece of amber in which I noticed a party of the little people to the number of the mystic seven, and so transparent were the walls of their ancient prison-house that the form, the colour, the attitude of the little creatures were distinctly visible, and so beautifully had they been preserved by Nature's unerring and skilful agency, that you could fancy that they had been incarcerated but the day before, instead of having been placed under durance and cast into their crystal prison myriads of years ago by the irresistible force of gravity, which would cause the sluggish rill of amber-resin to trickle down the gigantic stems of ancient pine-trees which once, it may be, formed part of the forest which now slumbers beneath the Baltic wave. The translucent topaz-coloured stream, thus influenced by

¹ See Memoir by Prof. O. Heer, of Zurich, translated from the original by R. T. Lowe, M.A. (*Annals and Magazine of Nat. Hist.* for March, 1856).

² *The Medals of Creation*, by Dr. Mantell, vol. i. p. 182.

gravitation, would roll gently down the prehistoric coniferous trunks, up and down which the adventurous and antique little people would be seeking recreation and sustenance, as is their wont in these latter days, would arrest their progress, and secure them before they would be able to escape, and, ere they could extricate themselves from their inevitable entanglement, would hermetically seal them and embalm them for posterity in a crystal tomb.

Further, these little people erected their marvellous habitations according to accurate architectural rule ; formed their subterranean corridors and tunnels upon principles as true as the most intelligent engineering skill could dictate ; ordered their households and trained up their young in the way they should go, so that the end of their being should be satisfied ; carried out their principles of industry, prudence, cleanliness, and forethought according to the all-wise direction of their unfailing instincts ; marching and counter-marching with never-flagging energy, fulfilling the while their allotted task in the great Creator's plan with unerring precision and untiring perseverance, amid the sombre shades of the primeval forests of the tertiary geological epochs, until the amber-weeping trees which had ministered to their sustenance had become their destruction, and their preservation too, when, washed out of the ocean bed by the tempest-tossed wave, they are brought to light in their transparent caskets, and are secured either by the fisher's net or the eager hand of the sea-shore wanderer, after a mighty storm has compelled the restless waters to cast up their treasure.

Amber is principally found on the shores of the Baltic, between Memel and Königsberg. It is also met with in Sicily between Catania and Semito, in Greenland, China, France, Italy, Spain, England, and Ireland. In the last week of August and at the beginning of September, 1882, I picked up, on the beach at Walmer, many specimens of various hues, from pale lemon or straw-colour to a rich

hyacinth-red. I also gained possession of other very fine specimens of this beautiful fossil-resin from the Deal fishermen; in one piece I discovered an interesting species of gnat. One ancient mariner assured me that he used the amber for fuel, and that it burnt with a bright flame, and that he had often seen insects in it.

While calling attention to the ancestry of the little people, I should mention that the *Termes* also (commonly called the 'white ant' because of the constitution of its colony, its habits and economy being strikingly similar to those of the true ant, though it belongs to a distinct class in the insect world) has a still more ancient ancestral history. In my correspondence with Mr. Frederick Smith, a great authority on the subject of the present work, and to whose unwearied kindness in forwarding my investigations into the constitution and marvels of the ant-world I again bear my cordial testimony, I find the following intelligence, 'Termites are found in a fossil state in many parts of Europe, and they have been found in England also, in coal-beds. Then, again, they are found in amber.' The fossil species found in England is named *Termes grandævus*. It is, therefore, an indisputable fact that the 'white ants' lived before the beautiful oolitic Cotswolds were upreared, and when the coal which we use for our comfort and convenience was not yet formed, but when the mighty vegetable growth to which it owed its origin fringed the extensive inland seas of the carboniferous era, and was doubtless, in a measure laid low through the destructive agency of this little people.

There is a class of theorists on the nature and formation of amber who maintain that it is an animal substance similar to beeswax, and secreted by a peculiar kind of ant inhabiting pine forests. The error—which it manifestly is—may have arisen from the fact that bits of a resinous substance similar in appearance to amber, and which has been distilled from fir-trees, are sometimes found in the

nests of those ants who forage up and down the pine-trunks. For instance, the *Formica rufa*, or the hill-ant, so-called from the heap of little sticks and pine-needles it collects together, in order to roof in its many-chambered and extensive habitations, and sometimes known as the wood-ant, because it as a rule dwells in aromatic pine woods, is generally found exploring the bark of the Scotch firs in its neighbourhood. We can readily understand that when it encounters any of these resinous exudations on the point of being detached from the bark, or in its voyage of discovery to and from the nest meets with a transparent tear of resin just fallen to the ground, it secures the prize, and either alone, or assisted by a willing comrade, conveys it to its nest. This it does, not, I believe, for the purpose of food, but for use or ornamentation in the construction of its wondrous habitation. In India I have learnt that the ants' nests erected near the coast are ornamented with garnets, which glitter in the sand that forms the bounds of the sea. I have discovered ninety-four pieces of a hardened resinous substance, some of which are very similar to amber both in consistency and colour, in a nest of the wood-ant at Weybridge. In one bright, translucent, amber-coloured globule there appears to be an air-bubble, and in another a small fragment of a pine-needle.

I should add that Livingstone, the great missionary and explorer, in his last journals, describes how in Africa he has watched the gum exuding from the copal-tree, and trickling down the trunk, and, as it reaches the ground, overtaking and overwhelming the passing insect. This faithful record may afford a similar illustration to that of the encased pine-needle above referred to, of the phenomenon of the formation of amber with its enclosed objects of interest.

On this subject, in answer to a communication from me, Sir John Kirk, M.D., H.M. Consul at Zanzibar, thus writes, 'As to amber, it is not found in East Africa; but I think

that chemically it could be easily distinguished from other resins, as also it might be probably by its electrical qualities. All *animé* comes from East Africa, where it is called *copal*—I have given a series of notes upon its origin in the *Proceedings* of the Linnean Society—it is the produce of *Trachylobium hernemanicum*, but the trees that yielded the *animé* are dead, the resin has acquired its qualities by ages under ground, for the modern resin differs, although the produce of the same tree. You will see a good series of copal (*animé*) in the Museum at Kew; they were given by me to that institution.'

With reference to his own private *collection* of the resin, he says, 'in it are many ants,' and some of the specimens containing the little people, he assures me, are 'very beautiful.' 'It is now,' he continues, 'almost impossible to procure specimens with insects; in Zanzibar they are picked up and shipped to London, so that on the spot my men cannot get them.'

As the copal-tree in Africa, so the Kauri-tree in New Zealand, affords a pleasing illustration of the formation of amber, and the incarceration of its captives in their transparent environment. The Rev. T. S. Grace, an able missionary from New Zealand, recently told me that he had seen the gum from the Kauri-tree frequently containing insects.

At Walmer I came across the landlord of a small inn who had been many years in New Zealand, and he showed me a magnificent specimen of Kauri gum. It was very like the straw-coloured amber I found on the beach. It was as transparent as glass, and measured $11\frac{1}{2}$ inches by $10\frac{1}{2}$ inches. It was dug up from the ground, and nowhere near a Kauri-tree. This tree, I was informed, is most valued by the natives as timber. Those trees from which the gum exudes are found beautifully mottled, like the maple, when felled, cut and fashioned by the skilled artisan for use or ornament. I have recently acquired possession of a fine

specimen of a fossil resin from Galicia, of a light brown colour, through the transparent sides of which I can trace many insect organisms, and one ant of a dark brown colour, with a reddish tinge, in a beautiful state of preservation.

CHAPTER II.

Morning walk to Blackheath—First sight of the little people at home
—Representatives of two tribes under one roof—Ancient names
for the ant—Many species found under stones.

THE lines of my first discoveries in the ant world radiated from London, and I would urge the reader to accompany me in imagination to the pleasant neighbourhood of Blackheath, and enjoy a healthful ramble through sunny field and sombre wood. The morning air is invigorating and exhilarating. It is in the month of January, 1861. The bitter frost is gone; the pools, however, are still ice-bound, and the rivulet, gathering strength from melting snow, gurgles through the meadows, for Nature, smiling, is for a while casting aside her wintry garments. The welcome sun shines gloriously, and wakens into songs of gladness the feathered warblers in the leafless hedges. The hare bounds gracefully across our path; the frightened game flutters with the well-known scream from woodland cover. The sunlight reveals lichens and mosses creeping over the gnarled trunks and bare arms of British oaks. The *fungi*, too, we notice, helping to adorn and beautify; and see how beneath the gentlest pressure their blossom goes up as golden dust. We very soon come upon an extensive colony of the little people I am in search of, and not one colony, but many; a raised turf-mound indicating the position of each colony. Spade in hand, we enter several of their

sloping grassy habitations, in which we find them safely sheltered.

The teeming population is rather drowsy, for it must be borne in mind that the little people generally sleep throughout the winter months. Our violent and unceremonious entrance, and, to them, our violent and unaccountable attack, together with the sudden exposure in consequence to the life-giving energy of the sun's cheerful rays, cause them to start up and look about them, thinking and hoping perchance that all is a dream; but no! all is reality; the attack is repeated, and both themselves and their winter quarters are removed by means of what to them would appear a lever of curious shape and monstrous size. Some being crushed the while, dismay spreads throughout the colony; not a few run hither and thither to ascertain the cause of the fatal intrusion upon their privacy. They gaze in wonder at the two grim giants working the implement of aggression; terror-stricken, they seize their tender offspring in their arms, and endeavour to carry them out of harm's way. The efforts of the many are, however, unavailing; they are safely captured, taken prisoners, and, together with their young, their farm stock, and the many chambers of their curiously-fashioned domicile, placed in a receptacle with which we had provided ourselves. The colonists, numbered by hundreds, if not by thousands, with their countless little ones, their cattle, and the corridors, the saloons, the dormitories, and the nurseries of their well-appointed, marvellously-constructed messuage, were, on my return from my successful raid, deposited for the sake of observation in a glass vessel, not twelve inches in diameter and in depth. The assertion of Solomon is thus amply vindicated, that the subjects of our contemplation are a little, a very little people.

To make, however, assurance doubly sure, let us take two in our hands and examine them. Our surprise is awakened when we find that they differ in colour—one

being yellow and the other red. Careful investigation assures us that they are representatives of two distinct tribes of the little people, the yellow far outnumbering the red, and though we find them both living amicably under the same roof, yet occupying distinct though adjoining tenements, with separate apartments, entrances, and establishments. They do not always live thus in friendly juxtaposition; far oftener apart. I have found them occupying the same hillocks on the glebe land, Stonehouse. The name of the yellow ant is *Formica flava*,¹ and of the red, *Myrmica scabrinodis*. Both species are common. The mounds of the *Flava* may frequently be noticed in meadows, on the sides of railway cuttings and embankments, and on the grassy slopes and summits of hills, where I have often seen them adorned with the sweet perfumed thyme.

An ancient name for an ant is *Pismire*. Shakespeare, in *King Henry IV.*, puts these words in the mouth of Hotspur :

‘Why, look you, I am whipped and scourged with rods,
Nettled and stung with pismires, when I hear of . . .
Bolingbroke.’

Pismire, I understand, is a Danish word, from *puid* and *myre*, signifying such ants as live in hillocks.

The common name, however, for ant is *Emmet*. When exploring in the neighbourhood of Stonehouse, I came across a Gloucestershire peasant lad, and interrogated him as to his knowledge of ants. He had never heard of them. I then showed him some of the little people who had formed their habitation in a hillock in the very meadow where he was tending his cattle. He exclaimed, evidently recognising them as old friends, ‘They be emmets; I’ve seen them running up and down yon bank.’ *Emmet* is derived from the Saxon *æmet*, *æmette*, and so ant, and signifies those that live under stones and old ruins, since,

¹ According to Smith. Saunders, in his *Synopsis*, following Fabricius, calls it *Lasius flavus*; the genus *Lasius* answering to Smith’s second division of *Formica*.

instead of raising hillocks, and constructing their houses in and beneath them, so that, in consequence of the sloping sides of their turf-covered roof, the rain of heaven falls away, and they themselves are kept dry, they oftentimes arrange their homes beneath the shelter of old walls and stones, which of course answer equally as well the desired end.

At the foot of one of the slopes of Stinchcombe Hill, in the autumn of 1876, I found a colony of *Myrmica scabrinodis* under almost every stone I saw, and there were many scattered over the greensward; and in company with one colony I discovered two specimens of a very rare ant, which I had never found before. The following year, when investigating the same interesting ground with my elder son, I came upon a strong and independent colony of this same rare ant. My young companion having turned over a stone, called out, 'Here are some black ants!' and to my surprise and pleasure, there were disclosed several passages lined with these little colonists, the light reflected from their polished bodies giving them the appearance of so many black beads. The name of this ant is *Myrmecina Latreillii*, and it possesses the singular instinct of feigning death on being touched. Strange to say, I found one of this rare species in 1879 in a ripe strawberry in my garden. I should mention that within a radius of about six miles from Stonehouse I have discovered no less than nine distinct species of ants living under stones, bearing the following names: *Formica nigra*, *Formica fusca*, *Formica flava*, *Formica aliena*,¹ *Formica cunicularia*, *Myrmica scabrinodis*, *Myrmica lævinodis*, *Myrmica ruginodis*, and *Myrmecina Latreillii*.

As I have found *Formica flava*² and *Myrmica scabrinodis* residing in different parts of the same hillock, so I have found them peacefully located under the same stone near

¹ According to Smith. Saunders gives these as *Lasius niger*, *Lasius flavus*, and *Lasius alienus*.

² Or *Lasius flavus*.

Stonehouse, and also in the charming neighbourhood of Lynmouth and Minehead, the different species, however, maintaining perfectly distinct establishments under the common roof. When dislodging the stone and disturbing the two colonies, the two species, pouring out of their respective chambers to ascertain the cause of the disturbance, have not unfrequently come into contact, and a desperate conflict has ensued, the unhappy consequence, possibly, of a misunderstanding having sprung up as to the occasion of their discomfort, and each attributing it to the unwarrantable interference of its near neighbour.

CHAPTER III.

The ants a little people—Examination of the head of *Myrmica scabrinodis*—Its antennæ and those of other species—The eyes of ants—Blind ants—The *Ecitons* of the Amazon Valley, and the driver ants of Africa—The special functions of the compound and simple eyes—The experiments of Sir John Lubbock as to the effect of light and colour on the vision of ants—The conditions under which they were made and the assumption on which they are founded considered—Artificial *formicaria*, and how their construction affects such experiments—The author's *formicaria*, and how they are adapted for securing trustworthy results—Ants do not dislike the light, but welcome it as necessary to their well-being—A record of the author's observations bearing upon the subject—Ants are attracted by the light because of the heat with which it is associated.

To proceed to a more detailed examination of these two representative species. There is now before us a specimen of the red ant (*M. scabrinodis*). It is larger than the yellow (*F. flava*), and yet we find it to be only about two lines, or one-sixth of an inch, in length. A little people, therefore, our friends the ants surely are, for it should be observed that there are British species less than a line in length,¹ none exceeding eight lines, and throughout the whole ant world we find very few which are longer than one:

¹ *Myrmica* (*Diplorhoptrum*) *fugax* and *Myrmica domestica*, *hoptrum domesticum*). According to Saunders' *Synopsis*, the former is *Solenopsis*, following Westwood, and though the latter said to belong to the same division by reason of certain characterist. Mr. Saunders identifies it with the *Monomorium Pharaonis* of Linnæus.

² The extraordinary size of the imprisoned queen of the white ant, which sometimes is found to measure six inches or more, does not invalidate this statement, since it is an abnormal development.

The head of the specimen we find to be of an oval form, slightly heart-shaped where it joins on to the slender throat. There is an eye on each side of the head. The eyes are very far apart, and where, judging from our own physiognomy, we should expect to find ears; and holding the position of our eyes, or rather nearer the mouth, we find a pair of long jointed horns, or feelers, fixed into little

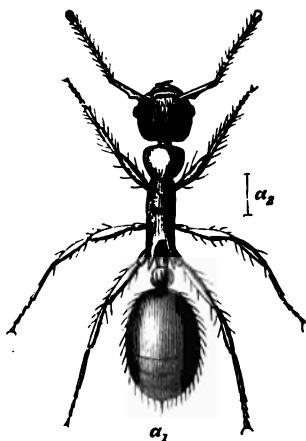


FIG. 1.— α_1 , *Myrmica scabrinodis*, magnified; α_2 , natural size.

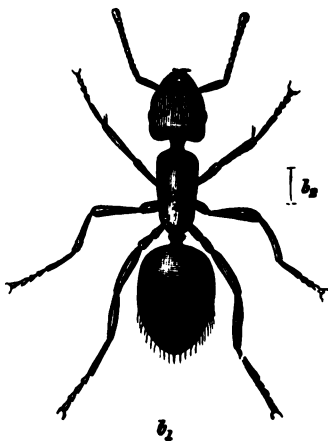


FIG. 2.— β_1 , *Formica flava* (*Lasius flavus*); β_2 , natural size.

sockets not far from each other, each horn consisting of two parts, that nearer the head being the shorter; the other, which is much longer, having, as a rule, eleven divisions, fitting into each other like little cups, and looking like a string of polished beads, the last three joints being formed into a club. These antennæ, as they are called, can be moved in any direction at the will of their little owner. They do not in any way hinder sight, since they are placed inside the organs of vision. The shorter part of the antennæ, which is undivided, is called the *scape*, while the divided limb is called the *flagellum*. In the *M. scabrinodis* the *scape* of the antennæ is not attenuated

at its base, but abruptly elbowed, and forming an acute angular lobe. It is a marked characteristic of this species, and clearly distinguishes it from the two allied species, the *Myrmica ruginodis* and *Myrmica lævinodis*. The rare ant

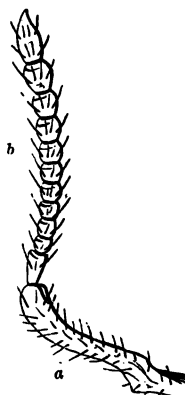


FIG. 3.—Antenna of *M. scabrinodis*, magnified; a, scape; b, flagellum.

Myrmecina Latreillii has also an elbowed scape, but it is smaller, and of a black colour, with the antennæ and legs only reddish. There is another very rare species of *Myrmica* similar to the three before mentioned, but of a darker colour, which can be readily distinguished by the presence of a little horn on the scape, and which for this reason has received the specific name of *Lobicornis*. This I have found on Shirley Common, near Croydon, and also on Brendon Common, on the borders of Exmoor, the haunts of red deer. In 1878 I discovered in the last-named locality an independent colony under a stone, and in 1880 another in North Wales within sound of the pleasant music of the Aber Waterfall.

If we examine the eyes above referred to under a microscope, we find that the cornea, or outer surface, is formed of a fine network of lenses similar in arrangement to the hexagonal cells of the honeycomb. The eyes are immovable, hence the number of lenses, answering to as many eyes, to enable the little people to see in as many directions. And not only cannot they, as we, turn their eyes hither and thither, but they do not possess the power we enjoy of altering the form of the lens so as to adapt the sight to meet the object of vision; the cornea and optic nerve being always at the same distance, they are unable, therefore, to see near objects; hence, I believe, with others, one of the reasons why they are furnished with the sensitive and delicate antennæ is, that they may, like

a blind man with a stick, feel where they are unable to see.

Fig. 4 is a section of the compound eye of *Tetramorium Kollari*, a very rare ant, which I have found numerously

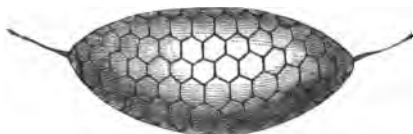


FIG. 4.—Portion of eye of ant (compound cornea), highly magnified.

represented in a hothouse at Stroud. It has been brought to me from the neighbouring parish of Eastington, also from a hothouse.

As a rule ants have a compound eye on each side of their head, and three simple eyes called *ocelli* or *stemmata*, on the vertex or summit of the head. The number of facets of the lateral compound eyes varies in the different species, and in the sexes of the same species; and in some species both the compound and simple eyes are wanting. The males have generally the largest number of facets to their compound eyes, the females come next in order, and the workers have fewest.

Thus, according to Forel,¹ the male of *Formica pratensis*, a species not found in Britain, has about 1200, the female 830, and the worker nearly 600. In *Tapinoma erraticum*, a species I have found at Bournemouth, Shirley Common, and East Lulworth, the male has about 400, the female 260, and the worker 100. In *Myrmica* or *Solenopsis fugax*—which had been discovered in England only at Southend and Deal, by Mr. F. Smith, until Easter, 1882, when a colony of this very rare ant was met with under a stone near Sandown, Isle of Wight, by Canon Fowler, of Lincoln—the male has more than 400, the female about 200, and the worker from 6 to 9. Since 1882, I have found more

¹ *Les Fourmis de la Suisse*, par Auguste Forel, M.D., Genève, 1874, pp. 117, 118.

than one extensive colony in the same locality, under Canon Fowler's guidance. In *Ponera contracta* and *Ponera punctatissima*, both found in England and very rare, the latter discovered by myself in a hothouse of Mrs. Frith, of Highlands, Minchinhampton, Gloucestershire, the female has from 100 to 150, the worker from 1 to 5. In the small worker the eye appears to me to be obsolete.

In some species two kinds of workers are found, the large and the small. In *Aphaenogaster barbara*, the harvesting ant, we find the large worker to possess about 230 facets in its compound eyes, and the small between 80 and 90. In *Camponotus ligniperdus* the large worker has nearly 500, and the smaller about 450; neither of these species is found in Britain.

According to Mr. Bates,¹ among the foraging ants, or *Ecitons*, of the Amazon Valley, are found species which have no eyes of the faceted structure, but have eyes composed of a single lens, such as *Eciton legionis*, *Eciton drepanophora*. Another species, *Eciton crassicornis*, has eyes sunk in deep sockets. This ant attacks the nests of other stinging species (*Myrmica*), and always avoids the light, concealing itself under leaves and prostrate timber, and, in the open, marches in secret beneath covered arcades which it forms as it goes along. The *Eciton vastator* has no eyes, but the collapsed sockets mark the position they should occupy; and in the *Eciton erratica* the sockets are wanting as well as the eyes. These both march under covered ways of their own construction, which they form rapidly as they advance through the thickets of their hunting-ground.

In the driver ants of Africa, no eyes can be discovered; they seem to have no settled dwelling-place, and are always on the march, searching houses for their prey, and crossing streams by forming floating or suspension bridges of their

¹ See *The Naturalist on the River Amazons*, by H. W. Bates, F.L.S., pp. 358, 359.

own bodies, and must be guided in their movements entirely by scent. I suspect this is the case in a great measure with all ants. Their vision seems very imperfect, and their sense of smell most acute. I have interrupted the course of an ant with a burden in its mandibles, removing the burden but a short distance, and the ant has had the greatest difficulty in finding its lost treasure, though no obstacle intervened to hide it from view.

The special functions of the compound and simple eyes it is somewhat difficult to determine. I am of opinion that the faceted eyes are of service only for near objects, and the *ocelli* for long distances and for the guidance of the males and females of the little people when on the wing in the pleasant sunbeams. This conclusion is strengthened by the fact that it is the winged sexes which are furnished with *ocelli*, while in the workers of the same species they are either very minute or obsolete. In the *Formica flava* (*Lasius flavus*) they are very minute. In the family *Myrmicidae* they are wanting in the workers of the different genera and species, but present in the males and females. In the solitary species (genus *Mutilla*), which consists of two sexes, males and females, the males have ample wings and are furnished with *ocelli*, and the females are without wings and have no *ocelli*.

It thus appears to my mind conclusive that we have discovered the true function of the *ocelli*. This conclusion is confirmed by an experiment of Réaumur upon a bee. Bees also are furnished with *ocelli*, and to test their function, Réaumur, according to Shuckard, 'covered them with a very adhesive varnish, which the bee could not remove, and then he let it escape. He found upon several repeated trials that the insect flew perpendicularly upward and was lost.'¹ It thus seems to be established that the bee in losing the vision of the *ocelli*, lost with it all power of control in flight, and all sense of distance and direction.

¹ See *British Bees*, by W. E. Shuckard, p. 27.

This seems to be a fitting opportunity for glancing at Sir John Lubbock's beautiful experiments and unwearied investigations as to the effect of light and colour on the vision of ants. I would suggest, however, that his observations might possibly have been affected by the conditions under which they were made, and by the assumption on which they are founded. These conditions appear to have been somewhat abnormal, and the assumption to demand a certain degree of qualification.

In order to arrive at a just conclusion, and to draw a correct inference, in a study of the habits of ants, it is absolutely necessary, I think, that their circumstances and surroundings should be, as far as possible, those of Nature. The artificial *formicarium* should be of sufficient dimensions to ensure to the little people perfect freedom of action, and enable them to meet the demands of their economy, and obey the promptings of their instincts with precision.

'After trying various plans,' writes the accomplished baronet, 'I found the most convenient method was to keep them in nests consisting of two plates of common window glass, about ten inches square, and at a distance apart of from one-tenth to one-fourth of an inch (in fact, just sufficiently deep to allow the ants freedom of motion), with slips of wood round the edges, the intermediate space being filled up with fine earth. If the interval between the glass plates was too great, the ants were partly hidden by the earth; but when the distance between the plates of glass was properly regulated with reference to the size of the ants, they were open to close observation, and had no opportunity of concealing themselves. Ants, however, very much dislike light in their nests, probably because it makes them think themselves insecure, and I always, therefore, kept the nest covered over, except when under actual observation.'

Such an arrangement as this, although convenient for observing many of their movements, would evidently affect

conclusions or inferences drawn from experiments as to the effects of light and colour upon their highly sensitive organization. For the ingeniously-constructed *formicaria*, instead of constituting nests or domiciles agreeing with the normal type, containing many storeys, and in each storey many chambers and many connecting corridors, are in point of fact only delicate sections of one storey of the Formic Castle. That the ants under such conditions would have no opportunity of concealing themselves I can well believe ; but why should their liberty in this respect be so restricted ? In order that their movements and their performances may be registered, as the faithful expressions of the exercise of their unfailing instincts, they should be perfectly free to act in any direction and in any manner that the suggestions of their nature may dictate.

For this reason I prefer providing my little friends with sufficient material and with ample space in my artificial *formicaria*, so that they may be able to construct their chambers and passages in accordance with natural dimensions. A bell-glass inverted and free to revolve in a firm stand, I find most suitable for the purpose of observation, the size of the vessel varying according to the exigencies of the species. The habits of the species are my guide in this matter ; e.g. *Myrmecina Latriellii* requires a much smaller vessel than *Formica flava* (*Lasius flavus*). Enough of the contents of a nest should be removed and transferred to the vessel to occupy about half of its available space. A cover either of baize or brown paper should be placed over the sides of the glass so as to conceal the contained earth, and to allow the light to filter only through the surface, so that the ants may be thus induced to work against the transparent sides of the *formicarium*. The darkness occasioned by the screen leads them to believe that they are working underground, at certain distances from the surface, and thus induces them to construct many tiers of chambers and connecting corridors

within the range of practical observation. This we may judge to our satisfaction when, after a few days, the screen is withdrawn for a short season, and the marvels of the constructive instinct of the little people revealed to our wondering gaze.

The assumption upon which the observations of Sir John Lubbock are founded, viz. that the ants very much dislike the light, must be accepted with a certain degree of qualification. That they prefer working underground is certainly true, and that they construct their chambers and passages out of sight is clearly established, and that they will not work against the sides of the bell-glass if exposed to the light, is undoubted fact. But it is not, I believe, because they dislike the light, but because, for sanitary, educational, and protective reasons, it is necessary that their many chambers should be arranged at certain depths below the surface, and therefore at varying distances from the light of day.

Such an arrangement is demanded, to be more explicit, in order to promote the health of the colony, to provide a safe retreat in case of heavy rains or other violent causes of disturbance, to forward the development of their young, which are very sensitive to changes and degrees of temperature, and to make preparation for their own hybernation, and in some instances also that of the autumn brood.

The different species of the little people pass the winter months in suitable chambers many inches below the surface, and in two instances the larvæ hatched out in the late autumn, as far as I have been able to ascertain, do the same, viz. those of *Formica flava* (*Lasius flavus*), a fact generally known, and also, as I have recently discovered, the larvæ of *Myrmica lævinodis*.

Now, to go a step further, so far from manifesting a dislike to light and avoiding it, ants are attracted by it, and cannot live without it, since the heat with which it is associated is

necessary for their preservation, their increase, their health and wealth. This I have discovered by an extensive series of experiments—I may say by hundreds of observations made as far back as the year 1861, during the four months of March, April, May, and June.

I have noticed that when the light of the candle is introduced into the nest through the glass sides of an artificial *formicarium*, the ants, instead of shunning it, gladly welcome it, crowd the chambers and passages illuminated, and bring forward their pupæ and larvæ to benefit by its pleasant warmth, to which they are keenly and intensely sensitive.

Take a few illustrations from my record of observations. On March 22, 1861, I examined a *formicarium* which I had established at my lodgings in Fleet Street in the immediate vicinity of old Temple Bar. The *formicarium* contained a colony of *Formica flava* (*Lasius flavus*). The ants had formed many tiers of chambers with connecting passages against the glass. I removed the screen, and with the light of a candle I illuminated the chamber at 11 P.M. In one upper chamber, marked (A), I found six cocoons; one cocoon was being moved downwards by a worker; the light, however, checked the downward movement of the nurse, which gradually brought it back through the intricate windings of the passages until it reached the nursery, where it deposited its precious charge, thus making seven in the illuminated chamber. In ten minutes two more cocoons had been added.

On March 28, 10.20 P.M., on removing the screen I found that there were no larvæ or pupæ in any chamber. I brought a candle to bear directly on chamber (A), and the ants began to show activity and collect in this upper chamber. At 10.45 one cocoon was carried into (A) by a willing nurse. At 11.50 this cocoon was deposited in (A) in care of two nurses.

April 1—at 7.15 A.M. The sky being overcast, I

noticed one cocoon in chamber (7), and one in chamber (8).
At 10.35 A.M. The rain is falling :

1 pupa	¹	in chamber	(5)
2 pupæ	in	„	(7)
1 pupa	in	„	(8)
3 pupæ	in	„	(o)
3 pupæ	in	„	(A)
2 pupæ	in	„	(B)

On this same day I took the *formicarium* about noon in a cab from Fleet Street to Paddington. I examined it at 12.30 ; I found the passage marked (X) nearly obliterated by the journey, and no pupæ were visible in any of the chambers. I then placed a light near the glass, exactly opposite chamber (B). At 12.45 two pupæ were brought into (B).

At 12.50 there were 5 pupæ in (B)

At 1.0 „ „ 11 „ „

At 1.30 „ „ 24 „ „

and five pupæ in chamber (g). Red ants, *Myrmica scabrinodis*, clustered in chamber (K). At 1.30 another pupa brought up to (B). Light removed. At 2.15 I found eleven pupæ in (B). I observed another pupa brought up to (B), so making twelve pupæ. No pupæ in chamber (g).

At 2.15 only one or two red ants in (K).

At 2.15 a larva in chamber (Z), in possession of a nurse, who handed it over to another, who disappeared with it.

At 4.55 I noticed that all the pupæ had been removed from chambers (B) and (g), and that the passage (X) had been repaired. I observed how the labourers dug with their feet, and then removed the earth with their mandibles.

I again applied the light. At 5.17 there were forty-two

¹ All the pupæ referred to in these experiments were inclosed in cocoons, as they belonged to *Formica flava* (*Lasius flavus*).

pupæ in (B) and four pupæ in (A). The candle was now removed.

At 6.20 I took the *formicarium* in a cab to a lecture I had to deliver, and at 7.30 I uncovered the bell-glass—there were now no pupæ visible and but very few ants. I applied the light towards the close of my lecture at 9.15, and at 9.30 numbers of ants put in an appearance, and there were many pupæ in the upper chambers. The nurses were busily occupied in carrying their youthful charges into the upper chambers.

A working-man told me, after the lecture, that his father often hung up things to a beam in a hothouse to tempt the ants, e.g. a melon. The ants were some time before they discovered the prize, but the first to find it always went back to inform the others, when they came in large numbers to enjoy the fruit. The hardy son of toil added, 'So it appears the ants are not selfish.'

I then returned to Fleet Street. It was now past midnight—12.15. I examined the *formicarium*; only one pupa was visible in a passage very low down. The passage (X) I found in a great measure obliterated again. At 12.17 there were no pupæ visible.

At 8.30 the next morning, April 2, there was rain. I uncovered the glass.

At 9.50 I noticed that two pupæ were carried up and disappeared in (A).

The red ants gathered under a stump (T) and the black ants, *Formica fusca*, upon it. The yellow ants had nearly restored their work of yesterday in (X), which had been obliterated by the homeward journey.

At 12.55 there were twenty-two pupæ in chamber (B) cherished by the nurses. The sun was now shining on the *formicarium*. At 4.0 no pupæ were visible, the *formicarium* being in the shade.

To prove that the ants are attracted by the light because of the heat with which it is associated, I may mention tha'

when the candle was placed close to the glass in order to illuminate the chambers of the *formicarium*, the glass had become warm, and thus a temporary source of radiant heat. Upon the withdrawal of the light the glad and willing movements of the ants are not checked, but are

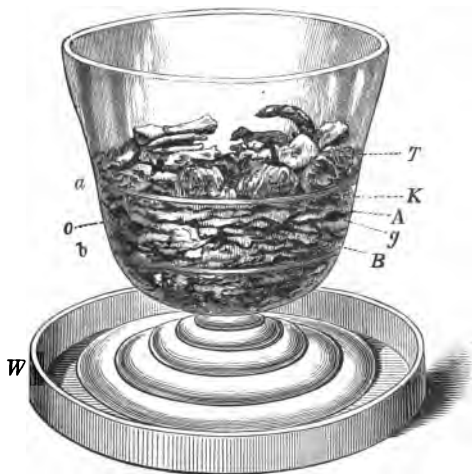


FIG. 5.—The author's *formicarium* (front view).

A, B, g, K, o, chambers; *T*, stump; *a* and *b*, narrow strip of paper as a guide to observation; *W*, encircling trench with water in which the vase and stand are placed.

still directed to the chamber or chambers recently illuminated, but now in comparative darkness.

I have noticed also that the chambers at that side of the *formicarium* next a fire are always sure to be crowded by the ants, though the screen intervenes. The screen, opaque to the luminous rays, is, as it were, transparent to the radiant heat. When the sun shines upon a *formicarium*, the ants are certain to be attracted to the surface, and manifest signs of pleasure and satisfaction; and when the sunbeams fall upon the screen which covers the sides of the glass vessel in which the colony is established, the ants

gather in the chambers and passages beneath the illuminated screen, bringing up with them not only the larvæ and pupæ, but the eggs also, to benefit by the genial warmth.

The observations above recorded show that ants are attracted to the sunlight, and bring their young beneath its

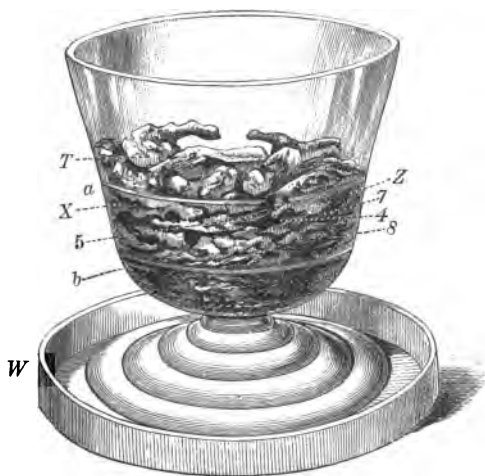


FIG. 6.—The author's *formicarium* (back view).

Z, 4, 5, 7, 8, chambers; *X*, passage; *T*, stump; *a* and *b*, narrow strip of paper as a guide to observation; *W*, encircling trench with water in which the vase and stand are placed.

influence for the sake of its warmth, in the same way in which they are attracted by the light of a candle placed close to the sides of the *formicarium*; the glass through its means becoming a source of radiant heat.

CHAPTER IV.

Continuation of the subject of the effect of light and colour on ants

—The prismatic colours possess different powers of illumination and varying degrees of heating power—The invisible rays at each end of the spectrum—The different coloured rays, as well as the invisible rays, possess more or less of chemical action—The significance of Mr. Busk's suggestion that certain colours are avoided by the ants because the chemical rays are distasteful to them—Professor Tyndall's demonstration, after Melloni, of the diathermancy of bisulphide of carbon—Sir John Lubbock's experiments with bisulphide of carbon and sulphate of quinine—His inference therefrom, and how far it should be modified.

LET us now see what inferences may be drawn from the beautiful experiments of Sir John Lubbock. The white sunbeam, when made to pass through a prism, is found to be composed of seven different colours, viz. violet, indigo, blue, green, yellow, orange, red. These differently-coloured rays possess also different powers of illumination, those rays nearest the centre being more luminous than those nearest the two sides of the spectrum. The lightest green or deepest yellow, occupying a central position in the seven-coloured band of light, would manifest most intense illuminating power. The different colours also possess varying degrees of heating power.

This fact was discovered by the illustrious Herschel¹ when viewing the sun through his telescope, which he had darkened by glasses of many colours. He at one time

¹ See *The Popular Encyclopedia*, article on 'Light,' p. 465.

experienced a powerful heat with a feeble light, at another, but little heat from a strong light. The result of his careful observation led him to conclude that the greatest heat was associated with the red rays or just beyond them, and the least with the violet or just beyond them.

Again, it is clearly established that, in addition to the coloured rays which are sensible to our sight, there are invisible rays on each end of the prismatic spectrum; the ultra red manifesting the greatest amount of heat, and the ultra violet the least. But though the latter have little heating power, they possess the more abundant measure of chemical action. Some think that all the coloured rays possess this attribute more or less; the violet in the highest degree and the red in the least. Others have found that though it is certainly true that the greatest chemical action is exercised just beyond the violet ray of the prismatic spectrum, and that the spot next in energy is occupied by the violet ray itself, and that the property gradually diminishes as we advance to the green, yet beyond this colour it seems wholly wanting. Judging from the above considerations, we gather that 'sunbeams, in traversing a coloured glass, produce similar effects to those caused by the differently coloured portions of the spectrum.'

With the guidance of this certain conclusion, let us now turn to the most characteristic experiments of Sir John Lubbock. In a deeply interesting and instructive paper, read by him at the Royal Institution of Great Britain on May 9, 1879, kindly presented to me by the author, he says,¹ 'I procured four strips of glass, similar, but coloured respectively green, yellow, red, and blue, or rather violet. The yellow was somewhat paler in shade, and that glass consequently more transparent than the green, which, again, was rather more transparent than the red or violet. I then laid the strips of glass on one of my nests of *Formica*

¹ See *Proceedings of the Royal Institution of Great Britain*, vol. ix. part ii. pp. 188-190.

fusca, containing about 170 ants. Those ants, as I know by previous observations, seek darkness, and would certainly collect under any opaque substance. I then, after counting the ants under each strip, moved the colours gradually at intervals of about half an hour, so that each should by turns cover the same portion of the nest. The results were as follows, the numbers indicating the approximate numbers of ants under each glass (there were sometimes a few not under any of the strips of glass) :—

1	. . .	Green.	Yellow.	Red.	Violet.
		50	40	80	0
2	. . .	Violet.	Green.	Yellow.	Red.
		0	20	40	100
3	. . .	Red.	Violet.	Green.	Yellow.
		60	0	50	50
4	. . .	Yellow.	Red.	Violet.	Green.
		50	70	1	40
5	. . .	Green.	Yellow.	Red.	Violet.
		30	30	100	1
6	. . .	Violet.	Green.	Yellow.	Red.
		0	14	5	140
7	. . .	Red.	Violet.	Green.	Yellow.
		50	0	40	70
8	. . .	Yellow.	Red.	Violet.	Green.
		40	50	1	70
9	. . .	Green.	Yellow.	Red.	Violet.
		60	35	65	0
10	. . .	Violet.	Green.	Yellow.	Red.
		1	50	40	79
11	. . .	Red.	Violet.	Green.	Yellow.
		50	2	50	60
12	. . .	Yellow.	Red.	Violet.	Green.
		35	55	0	70

Average red over 70 ; green, 48 ; yellow, 45 ; violet, $\frac{1}{2}$.

‘Adding these numbers together, there were, in the twelve observations : under the red, 890 ; under the green, 544 ; under the yellow, 495 ; and under the violet only 5. The case of the violet glass is most marked. To our eyes the violet was as opaque as the red, more so than the green, and much more so than the yellow ; yet, as the numbers show, the ants had scarcely any tendency to congregate under it. There were nearly as many under the same area

of the uncovered portion of the nest as under that shaded by the violet glass.

‘I also experimented in the same way with a nest of *Formica fusca*, in which there were some chrysalises. These chrysalises were generally collected into a single heap. I used glasses coloured dark yellow, dark green, light yellow, light green, red, violet, and dark purple. The colours were always in the same order, but the places were shifted after each observation. To my eye the purple was almost black; the violet and dark green very dark and almost opaque; the pupæ could be dimly seen through the red, rather more clearly through the dark yellow, while the light yellow and light green were almost transparent. The pupæ were, in fifteen observations, six times placed under the dark green, three under the dark yellow, four under dark red, once each under light yellow and light green, but not once under the violet or purple. In another experiment the pupæ were placed seven times under the red, six under the dark yellow, never under any of the other colours. The same experiment, tried with another species—*Lasius niger*—gave very similar results, the pupæ being placed, in forty experiments, nineteen times under the dark yellow, sixteen under the red, five under the green.’

‘It might be alleged that the avoidance of the violet glass by the ants was due to the chemical rays which were transmitted. From the habits of these insects, such an explanation was very improbable. If, however, the preference for the other coloured glasses to the violet was due to the transmission, and not to the absorption of rays; that is to say, if the ants went under the green and red rather than the violet because the green and red transmitted rays which were agreeable to the ants, and which the violet glass, on the contrary, stopped, then, if the violet was placed over the other colours, they would become as distasteful to the ants as the violet itself. On the contrary, however, whether the violet glass was placed over the others or not,

the ants equally readily took shelter under them. Obviously, therefore, the ants avoid the violet glass because they dislike the rays it transmits.

‘Mr. Busk suggested that as the red glass stops the chemical rays more effectually than the yellow or green, while the violet is most transparent to them, and as the ants appear to prefer the red glass to the yellow or green, and these, again, to the violet, possibly the explanation might be that the chemical rays were peculiarly distasteful to them. To test this, therefore, I made some experiments with fluorescent liquids, which Mr. Hanbury was kind enough to procure for me. I poured them into shallow glass cells about half an inch deep, which I put, as before, over the ants. If now they were affected mainly by the chemical rays, it must appear to them to be dark under these solutions. This, however, was not the case. The solutions seemed to make no difference to them. I also tried quinine and uranium glass with the same effect. I conclude, therefore, that the ants are affected by the true light rays. It is obvious that these facts suggest a number of interesting inferences. I must, however, repeat the observations and make others; but we may at least, I think, conclude from the preceding that (1) ants have the power of distinguishing colour; (2) that they are sensitive to violet light; and it would also seem (3) that their sensations of colour must be very different from those produced upon us.’

That ants are very sensitive to violet light is evident; that they have the power of distinguishing colour is quite possible, though the natural inference from the above experiments is, I think, that they are delicately appreciative of the different degrees of *heat* associated with the various colours, and avoid the violet because of the small measure of heat it transmits, as well as on account of the chemical action which it excites.

The significance of the fact pointed out by Mr. Busk, that the reason why the ants avoid the violet and prefer the

red to either the yellow or the green, may possibly be due to the influence of the chemical rays, is worthy of our careful consideration. Sir John Lubbock's experiments with fluorescent fluids are not, to my mind, conclusive as to their not being affected by the chemical rays, since we have seen by abundant observation that ants do not invariably avoid the light when they have an opportunity of sheltering themselves in darkness, but are guided in their mysterious movement by varying circumstances. And, so far from expecting them not to be affected by the chemical rays, I should readily anticipate their sensitiveness to chemical action on account of the formic acid which they secrete and discharge with such facility.

We may, however, add with the learned baronet, 'Though it is, then, very sufficiently evident that ants are differently affected by different colours, it by no means follows that they should see them as we do. It is, indeed, most remarkable how little we yet know with reference to their real nature, or how Nature herself appears to them. What actual impressions do colours give them? What are the limits of their vision? How far and how distinctly can they see?'

Sir John Lubbock, in his recent volume,¹ illustrates this attractive subject most charmingly. He watches the intelligent movements of the ants with their precious charges, in the prismatic spectrum thrown upon their nest by the electric light, and through coloured glasses and solutions illuminated by the diffused light of summer, the full blaze of the cloudless sun, the violet rays of the magnesium light, and the yellow glow of sodium. He makes it clearly manifest that as the ants are sensitive to violet, they are still more so to the ultra-violet, and that as they welcome the red rays of the spectrum, they are still more attracted by the ultra-red.

¹ *Ants, Bees, and Wasps*, by Sir John Lubbock, Bart., M.P., F.R.S., Lond. 1882.

We are thus led to the conclusion, not that they see differently to ourselves, and can appreciate colours which are invisible to man, but that they are keenly sensitive to delicate changes of temperature, as well as to the potent sway of chemical action, and are attracted to the ultra-red rays because these are associated with an excessive measure of heat and a feeble display of chemical action, and readily avoid the ultra-violet, which are peculiarly defective in warmth and most prolific in rays of chemical activity.

To set this matter at rest, we should endeavour to discover a chemical compound which would be at once opaque to the ultra-violet rays and transparent to the rays of heat, and then watch the movements of the ants when brought beneath its influence.

Now, bisulphide of carbon is opaque to the ultra-violet rays. And Professor Tyndall, in his work on *Heat, a Mode of Motion*,¹ has clearly demonstrated that it possesses the property of diathermancy in a remarkable degree, transmitting, that is, freely, the rays of heat. Following the table of Melloni, he gives the caloric transmissions of nineteen different liquids; the source of heat being an Argand lamp furnished with a glass chimney, the liquids being inclosed in a cell with glass sides, the thickness of the liquid layer being 9·21 millimetres, or 0·36 of an inch. Bisulphide of carbon stands, with bichloride of sulphur, at the head of the list; its transmission being 63 per centage of total radiation, while the lowest is that of the white of egg and distilled water, each being only 11.

Bisulphide of carbon will furnish us with the test we require in order to find a satisfactory solution to the problem under review. Now, Sir J. Lubbock tells us² that over one of his nests of *Formica fusca* he placed two pieces of dark-violet glass, 4 inches by 2 inches; and over one

¹ *Heat, a Mode of Motion*, by John Tyndall, D.C.L., LL.D., F.R.S., Lond. 1875, pp. 267, 268.

² *Ants, Bees, and Wasps*, pp. 209, 210, 213, 214.

of them he placed a cell containing a layer of bisulphide of carbon an inch thick, slightly coloured with iodine. The ants all collected under the glass over which was the bisulphide of carbon. He then tried the same experiment with pure bisulphide, and with the same result. He then tried it without the violet glass, although the bisulphide is perfectly transparent—covering part of the nest with the violet glass and part with a layer of bisulphide of carbon; the ants in every case went under the bisulphide. He then reduced the thickness of the layer of bisulphide to $\frac{4}{10}$ of an inch, but still they preferred the bisulphide.

He tried also the differently coloured glasses, all of which he had previously found were unmistakably preferred to the violet. It remained to be seen what effect placing the bisulphide of carbon on the violet would have. He tried successively green, pale yellow, dark yellow, and deep-red glass, placing each side by side with the violet covered with bisulphide of carbon; from which it seemed evident that while if violet glass alone was placed side by side with red, yellow, or green, the ants greatly preferred any of the latter; on the other hand, if a layer of bisulphide of carbon, which, to our eyes, is perfectly transparent, was placed over the violet glass, they went as readily, or even more readily, under it, than under other colours.¹

He then tried experiments with a solution of sulphate of quinine, which agrees with the bisulphide of carbon in cutting off the ultra-violet rays, and with the same result, from which he infers that the effect of placing either of these chemical compounds over the violet glass is to make it seem to the ants as good a shelter as any of the other glasses, and appears to his mind strong evidence that the ultra-violet rays are visible to the ants. And since every ray of homogeneous light which we can see at all appears to us a distinct colour, it becomes probable, he thinks, that these ultra-violet rays must make themselves apparent to the

¹ P. 215.

ants as a distinct and separate colour, of which we can form no idea, but as unlike the rest as red is from yellow, or green from violet.¹

Admitting that the inference drawn by Sir John Lubbock is perfectly legitimate and within the region of possibility, viz. that ants see colours differently to us, since even among ourselves there are those who are afflicted with colour blindness, who see colours perfectly diverse from their fellows with normally constituted vision, I would at the same time point out how his beautiful experiments justify also an alternate deduction, viz. that ants are peculiarly sensitive to varying degrees and changes of temperature as well as to the subtle influence of chemical action; so that while they welcome the rays of heat, they shun the rays of chemical activity.

For example, the ants gather under the coloured glasses which transmit most copiously the heat-rays, and most feebly the chemical rays, and leave deserted the sombre space beneath the violet screen, which transmits but few heat-rays and abundant chemical rays. Let but the conditions be changed by the superposition of a chemical compound, such as bisulphide of carbon, which has a subtle power of cutting off the ultra-violet rays, whilst it transmits the rays of heat, the scene is at once changed; the distasteful element has been eliminated. The ants gather to the spot which before they shunned, and seem to rejoice in the genial atmosphere which has, as it were, been artificially created for their benefit.

There is one fact which may at first sight give colour to the suggestion that ants dislike the light. When their habitations are opened, especially when constructed under a stone, and the upper chambers are exposed to view, and flooded with light, the ants, with surprising celerity, carry away the larvæ and pupæ, and rest not until every chamber is emptied.

¹ Pp. 216, 120.

To explain this familiar incident there is no need of the supposition that the ants dislike the light. In all these cases there is necessarily the destruction of a portion of their tenement ; and the little people by wisely withdrawing themselves and the young brood into the hidden recesses of their castle, ensure the safety and perpetuity of the formic establishment. Some species are more fearless than others, and resent attack or intrusion, as the *Formica sanguinea*, *F. rufa*, *F. congerens*, and *F. exsecta*, which turn upon their assailant. Others are more timid, such as *Formica fusca*, which takes to flight with the utmost expedition, except where it has been educated by the *sanguinea*, when it, in a measure, shares the latter's valour. The reason, then, why some ants escape with the young brood more rapidly than others, when light is flashed in upon the chambers of their home, must be attributed, not to a more intense dislike to light, but to a more timorous disposition, or, it may be, to a greater development of that discretion which is the better part of valour.

Once more, the fact that ants prefer to work out of sight should not be attributed to their aversion to light. The South American *Eciton*, which marches under a covered way which it constructs while engaged in a predatory expedition, is *totally blind*, and cannot therefore be materially affected by the light. The peculiar habit must belong to it rather for protective or strategic purposes.

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CHAPTER V.

The mouth with its allied appendages and their uses—The thorax and nodes of the petiole of the abdomen—Formic acid—A traveller's experience—A missionary's experience—The sting of an ant—The number of species of British ants—The house ant of Madeira added to the list—Naturalised ants—Saunders's enumeration—The common house ant—Details as to its habits—Another Madeira ant found in London—Its tastes and distribution.

LET us now continue the examination of the worker of *Myrmica scabrinodis*. Imagine the little creature to have its mouth wide open, and what a strange apparatus! There is a small fleshy tongue, and under-lip, called the *labium*, furnished with a pair of jointed sensitive feelers, or *palpi*, called also *antennulæ*, by which, it may be, it is enabled to taste its food before it passes down its throat, and are known generally as *labial palpi*. There is another pair of feelers attached to the membranous lower jaws, or *maxillæ*, longer than the former, by which, possibly, it can, as with fingers, test the nature of its food before it is swallowed, or assist in satisfying its own hunger and that of its infant progeny. These are designated *maxillary palpi*. What are those strange-looking implements on each side of its mouth, very like the horns of the stag-beetle in miniature? These implements are most serviceable to the little people. Fancy yourselves, my readers, if you can, without teeth, jaws, and arms; would you not feel very uncomfortable and helpless? So would the little people were they deprived of their mandibles. Though placed outside the mouth, they

serve them as jaws, furnished as they are in most cases with sharp and strong teeth. They answer also the purpose of arms, enabling their possessors to carry their food into their storehouses and nurseries, and their young from one chamber to another ; their enfeebled companions, when, in an emergency, it is necessary to change their position with all expedition ; and their dead, when it becomes their duty to remove them from their home to the cemetery. They

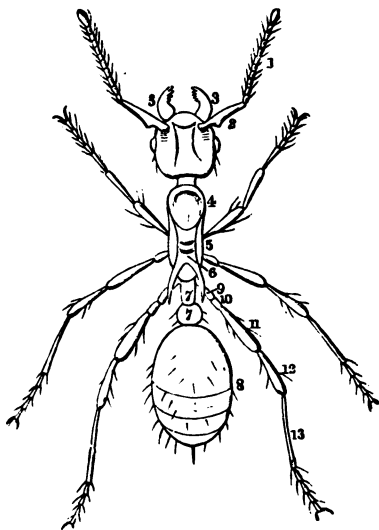


FIG. 7.—*M. scabrinodis*, with open mandibles; 1, flagellum of antennæ; 2, scape of antennæ, with acute angular lobe; 3, mandibles; 4, prothorax; 5, mesothorax; 6, metathorax, with spines—4, 5, and 6 forming the thorax; 7, nodes of the petiole; 8, abdomen; 9, coxa; 10, trochanter—9 and 10 forming the haunch; 11, femur (thigh); 12, tibia (shank); 13, tarsus (five-jointed foot with two toe-claws).

also use these wonderful implements as saws, by which they prepare the material, gathered, too, through their aid, wherewith to build their habitations. With them they channel out the earth or wood to construct the chambers and corridors of their dwelling.

The ant is divided into three parts—the head, the thorax,

and the abdomen. The head and thorax in this species are rough and striated. The thorax is subdivided into *prothorax*, *mesothorax*, and *metathorax*, this last carrying two long and acute spines. In *M. ruginodis* the spines are also long. In *M. laevinodis* they are short, and the sculpture of the thorax and head is more delicate than in the two former allied species. In some species the spines are wanting—e.g. our house ant, which has received many names; that which is most descriptive of its habits is, I think, *Diplocephum domesticum*. Attached to the three divisions of the thorax are three pairs of legs, each with haunch, thigh, shank, and five-jointed foot, which is armed with two toe-claws, which create a tickling sensation when the little creatures course over the human skin, and also a spur upon the shank or tibia, which spur in the foreleg is more largely developed and very conspicuous, and fashioned into a comb, with which it cleanses itself and completes its toilet, often standing erect, in a very grotesque attitude, to effect its laudable purpose. The abdomen is ovate in form, smooth and shiny, and composed of several rings. We notice, further, a very thin waist between the thorax and abdomen, called the *petiole*, elegant in form, furnished with two ornamental globular enlargements called *nodes*, the character of which forms a useful guide in the differentiation of species, the *M. scabrinodis* having the nodes rugose striated, the *M. ruginodis*, rugose, and the *M. laevinodis* comparatively smooth and shining.

Besides the necessary organs for preserving all the functions of the body in healthy exercise, we find the little creature provided with a bag of irritant spirituous liquor, which at pleasure it can eject, to the great annoyance of intruders on its privacy. This spirit, elaborated in the secret distillery of the little people, is called their formic acid. Its subtle presence may readily be detected by its peculiar though agreeable perfume. If the head be held over a nest of *Formica rufa* which has been disturbed, it

will be immediately appreciated, though it will be found exceedingly difficult to maintain the same position long with any comfort, so powerful is the emanation. The heaped-up nests of this prolific ant are not uncommon in woods and their neighbourhood. They may frequently be met with not very far from Stonehouse. I have found them also at Lynmouth, Porlock, Weybridge, Abbey Wood, Shirley, Symond's Yat, Tunbridge Wells, and the neighbourhood of Wellington College.

The nests of the two allied but scarcer species, which you may find on the heaths and in the pine woods of Bournemouth, will, when disturbed, yield the same strong though fragrant essence, viz. the *Formica congerens* and *Formica exsecta*. The former raises nests as extensive as the *rufa*. The latter, which I have found also at Ringwood, on the borders of the New Forest, is content with a much smaller domicile, which may at once distinguish the nest of this species from that of its neighbour. When, at Bournemouth, in 1876, I was examining a large nest of *Formica congerens*, I put one of the colony into my mouth, and found it to have a very acid taste, and was not unpleasantly impressed with the peculiarity of the flavour.

I have been informed that this formic acid has been utilised for the purpose of alleviating human pain in the preparation of chloroform, as the termination of this compound word would indicate; and though it is not so used now, I am assured by an intelligent medical man that such a mode of preparation is quite possible. How closely chloroform is allied to formic acid, we may clearly see by their chemical formulæ, which stand thus: for chloroform C_2HCl_3 , and for formic acid C_2HO_3 . Both have, therefore, the same radical, C_2H . It is significant that the celebrated Dr. Livingstone, in describing the attack of the black soldier ants of Africa upon the white ant, thus writes¹ of

¹ *Missionary Travels and Researches in South Africa*, by David Livingstone, LL.D., D.C.L., p. 537.

one of their marauding expeditions: 'When on their way to attack the abode of the white ants, the latter may be observed rushing about in a state of great perturbation. The black leaders distinguished from the rest by their greater size, especially in the region of the sting, then seize the white ants one by one, and inflict a sting, which seems to inject a portion of fluid similar in effect to chloroform, as it renders them insensible, but not dead, and only able to move one or two front legs. As the leaders toss them on one side, the rank and file carry them off.' Formic acid has also been used to assist the photographer to render lasting the beautiful and faithful delineations of the sunbeams.

This acid is sometimes most annoying to the human family; as was the experience of a modern traveller while on his journey 'through Norway with a knapsack.' Being overtaken by the shades of night, and wearied with his day's exertions, he strove to find repose within the precincts of a hay-barn. He tried to sleep, and thus refresh himself for the morrow's labour. In vain his effort! 'Sleep, gentle sleep; Nature's soft nurse,' affrighted, refused to weigh his eyelids down and steep his senses in forgetfulness. The little people, among other tribes of animated creatures, made his body the object of their attention, which their enterprising disposition led them to explore, by crawling under his clothes and all about his skin. He adds: 'If I had ever doubted the theory of their irritant acid perspiration, this night's experience must have converted me.' It tormented him, it seems, more cruelly than the Lilliputian arrows did the hands and face of Lemuel Gulliver; and did we understand the silent language of the little people who marched and countermarched upon the body of the northern traveller, which to them would seem as an island, a solid vantage-ground in the midst of a labyrinth of dry vegetation, we should, I doubt not, learn that their fearful wonder, when they saw and felt the unknown island heave

convulsively beneath their active little feet, was quite as great as that of the inhabitants of Lilliput, when they saw and felt the man-mountain struggle to undo their midnight work which kept him prisoner.

The acid perspiration, instead of being annoying, is sometimes most beneficial to man, for in some cases of sickness its irritant properties act as a restorative. I have been told by a friend of a well-authenticated instance. A missionary in the tropics was interrupted in his dauntless labours for his Master by a dangerous illness, which prostrated him, and showed its virulence by afflicting him with countless boils. He was lying helpless and alone in his hammock, when, behold, to his unspeakable horror, myriads of ants of ferocious aspect approached him, as he thought and feared, with deadly intent. They came nearer and nearer, surrounded him, and swarmed all over his body ; but, instead of keeping him down, as the inhabitants of Lilliput did Lemuel Gulliver, they enabled him to rise ; for, after anointing the prostrate sufferer with a profuse supply of their irritant acid, which proved to be a remedy suited to his peculiar malady, they left him, speedily to recover and resume his happy work, with gratitude to his God who had used this little people as his effectual preservers.

But to return. The species of ant we are examining is armed with a sting of the same construction as that of a bee, with which it opens an orifice in its victim's flesh, and into the gaping wound injects a venom, decocted in its internal laboratory, which gives a sharp pain similar to that caused by a stinging-nettle, as I had occasion to notice when opening a nest of the allied species, *M. lævinodis*, at Bournemouth.

'In other ants,' says Gould,¹ 'I cannot discover any sting, and therefore, unless you allow them time, they are not so venomous. They are obliged, first of all, to bite or

¹ See *An Account of English Ants*. By the Rev. W. Gould, A.M., p. 9.

make a small incision with their saws, and then eject some of their corroding liquor into the wound, which has the like effect as the above. The red ants live more open and exposed to view, travel at greater distance from their cells, are more bold than any of the others, therefore a weapon of this kind is serviceable to them.'

These observations are just, when the habits of the red ants are contrasted with those of the yellow, but the force of Gould's remarks is sensibly diminished when the long distances traversed by the common wood ant in its foraging expeditions is considered, for this ant is stingless, and also when the military advances of the stingless *F. sanguinea* into hostile territory is taken cognizance of. But the diligent observer, who only describes the manners and customs of five kinds of British ants, was evidently not aware of the existence of this interesting species on British soil. Gould speaks as if there was but one species of red ant, and that the only ant possessing a sting in this country. In the official list of British ants, compiled by the late Mr. F. Smith, and published, in 1871, by the Entomological Society, there are eighteen species recorded which possess stings, including two of the family of *Poneridæ*, and sixteen of the family *Myrmicidæ*.¹

This is not reckoning *Myrmica* or *Pheidole lævigata*, the house-ant of Madeira. This species, I think, should be added to the list, since whereas, when the British Museum Catalogue of British Ants was issued in 1858, the species had only been discovered in a hot-house at Exeter, a solitary example on a wall at Battersea, and three specimens on a garden wall at Hampstead by Mr. Smith. In the year 1861 I was happy enough to find it domesticated in large numbers in a baker's shop in the Borough, and one of Mr. Smith's sons has met with it since in an eating-house in the City. I found the ants in the baker's shop running

¹ *Catalogue of British Hymenoptera-Aculeata*. Compiled by Frederick Smith. Published by the Ent. Soc. Lond., pp. 2, 3, 4.

over and devouring buns and cakes. The young person serving in the shop at first denied their existence, and refused me leave to search her goods, but having seen a few of the little people upon the pavement in front of the house, I was persistent in pressing my inquiry, and at last softening her heart by purchasing some buns, she relented, and opening a drawer and lifting up some sponge-cakes, she said, 'There they are, and I will give you as many as you please.' I am afraid I looked more delighted than she, to her, distressing circumstances warranted. In 1877, just sixteen years afterwards, I visited this same shop, and found the unwelcome intruders still in great force, and as active as ever in their depredations; so that we may fairly consider this Madeira species to be now thoroughly established and naturalised in this country. It is reddish-brown in colour, and less than one-sixth of an inch in length. I would suggest that we might just as well strike out of the list of British Diurnal Lepidoptera, *Argynnis Lathonia*, the Queen of Spain Fritillary, which lovely butterfly I received from Dover in 1882,—because it is generally believed that it must have been originally blown over from France—as exclude from the list of British Heterogyna species which have become thoroughly established, though we may cherish the conviction that originally they must have been imported in plants or merchandise from other countries. There are cases where of course no reasonable doubt of a foreign origin can exist, when we should not feel justified in placing a species in our British Catalogue—e.g. two species of ants, belonging to the genera *Pheidole* and *Tapinoma*, were forwarded to me from Scotland, which were discovered by my correspondent as occupying together the scaly caudex of an Australian fern—the recent importation of which from Australia deciding at once the Australian nationality of the ants. Again, I discovered some years back several representatives of a new species of ant in my own Vicarage. I have no doubt in my mind that these ants were natives

of Africa, since they made their appearance shortly after I welcomed a consignment of ants' nests from Sierra Leone, though I found no living ants when I unpacked the case. These, of course, I did not enter on the British list. Mr. Smith considered them very like an African species, and I find specimens of the same, which I had given him, in his foreign collection, labelled 'Stonehouse Vicarage.' In Mr. E. Saunders' *Synopsis*,¹ published by the Entomological Society in 1880, there are recorded and described as British sixteen species of ants possessing stings; and while *Diplorhoptrum domesticum* (*Monomorium Pharaonis*), though mentioned as not indigenous, is included in this enumeration because so widely distributed, *Tetramorium Kollari*, *T. simillimum*, as well as *Pheidole levigata*, are excluded, and only referred to in a concluding note as importations. Add these to the list, and we are able now to chronicle nineteen stinging ants as having been discovered in Britain.

There is another species of stinging ant of a reddish-yellow colour, and less than a line in length, in truth a very little people—*Myrmica domestica*²—which has established itself in London, in St. Leonard's-on-Sea, and at Kemptown, Brighton; and lately it was sent me from a shop in Stroud, and the other day I discovered it in a house at Folkestone. At Kemptown, as also in the metropolis, it has proved so annoying as to render houses uninhabitable, and the valiant little race have driven the lords of the creation from their castles. I know one in London who was obliged to leave his house in consequence of the intrusive and protracted visit of the little people. It gets into food, being especially fond of sugar and sweet almonds, and it will even attack meat; anything greasy meets its fancy. In the winter-time it naturally prefers the kitchen, and in the

¹ Mr. Saunders' *Synopsis of British Heterogyna and Fossorial Hymenoptera*, Trans. Ent. Soc., December, 1880, pp. 214-223.

² *Diplorhoptrum domesticum*, Smith; *Monomorium Pharaonis*-Linnaeus, according to Saunders.

warmer weather it becomes an unwelcome visitant in the parlour. Wherever I go it seems to force itself on my notice, and I have obtained the unenviable reputation of introducing it where it is least desired.

I fear that my association with this little amber-witch would have gone hard with me, had I lived in the good old days, when traffickers in the dark art were liable to prosecution. Did I go into a baker's shop in the Kennington Road, I was met almost on the threshold by a royal procession. The queen, who may readily be recognised, since she is about five times as large, and between two and three times as long as the other members of the community, was marching solemnly up a whitewashed wall, attended by a large retinue of her loyal and devoted subjects. Did I sit down with the worthies of St. Dunstan's-in-the-West at a public dinner-table in an hotel in Fleet Street, one of this inquisitive and intrusive little people walked leisurely towards my soup-plate to pay me its respects. Did I look in upon my late landlord near Temple Bar, to see how he fared, this same little people, I learnt, had established an extensive colony in my late abode, and were asserting their presence in a most persistent manner. I disarmed my friend by at once throwing myself on his clemency, and entreating him not to prosecute me for the permanent annoyance I had unwittingly occasioned. Did I pay a visit at the house of some friends at the West End, and was refreshment hospitably offered me, upon the bun I took to eat I discovered one of this same tribe of tiny emmets. And when I stayed with my relatives a few years back at Stanhope Place, Hyde Park, I found that since my last appearance a strong body of this same prolific and molesting race had forced themselves into the kitchen, defying every effort to dislodge them; and some time since, when I spent the evening at the house of a college friend at St. Leonard's-on-Sea, on the dinner-table one of these same little people forced itself on my attention, and assured

me that my kind host was not a stranger to their presence and enterprising spirit.

When passing through London about the same time, I sent word of an intended call at Stanhope Place, requesting that a dainty repast should be got ready for the little people ; yea, a right royal feast, in order that the queen might be allured from her secret chamber to give me an audience. I called at the appointed time, and I learnt that the banquet had been prepared ; a table had been spread, and a variety of food laid out to tempt the royal appetite — sponge-cakes and dripping ! A few choice spirits only were feasting upon the cake, but on the dripping, in the dripping-pan, and around it, the sight was something marvellous ; thousands upon thousands of the loyal race were there, and not one, nor two, nor three, but nineteen queens, if not more, were present, and each attended by a faithful and devoted band of myrmidons. A sight such as this is a joy for ever ! I made an instant raid and captured all the queens I could, with many of their subjects too, and the trophies of my victory may be seen in my cabinet.

The following information concerning the tastes and habits of this Lilliputian race may be interesting, especially to those living in the metropolis, where so many houses are enlivened by their presence. I find that at Stanhope Place their favourite food is fish, especially whiting and haddock. If the dish of fish be placed only for a few minutes by the fire, it is completely covered with the ants. Sponge-cakes I have already referred to as attractive to them. The baker in the Kennington Road found it so to his cost ; and I kept, when living in Fleet Street, a large number of the little creatures in a sponge-cake, for the sake of observation, where they were 'as merry as you please.' I surrounded the tasteful castle with a trench of water. Many of them floated on the surface of the water, and others, I fear, made a bridge of boats of the bodies of their floating companions,

judging from the appalling experience of my landlord before narrated. The Rev. J. G. Richard, late Government Chaplain at Seychelles, states that he has seen the ants in this island cross the water in which the feet of the sideboard were placed, over the bodies of their floating companions, and so reach the food which it was the object of the encircling trench to guard from their encroachments. The dormouse at Stanhope Place was fed upon sponge-cake, and in consequence it became necessary to suspend the cage from the ceiling, for whenever it was placed in the kitchen the ants found their way to it and devoured the cake.

Fat of all kinds attracts them, also dead beetles. That they exercise thus the important duty of scavengers establishes for them a claim upon our favourable consideration. Almonds they are especially fond of. To illustrate this, a dish of almonds was *shelled* but not *peeled* for dessert. When it was brought to table the skins were found to be perfectly hollow, having been cleaned out by the depredators. Having had my attention called to the roads the ants at 2, Stanhope Place, had made over the passage-wall leading from the kitchen—faint lines, where their active little feet had travelled, being clearly seen up the wall to the corner of the ceiling beneath the cupboard in an upper anteroom—I made special inquiry as to the cause of the journey of the ants in the direction indicated, and I learnt that it was the almonds that chiefly attracted them. The store is always discovered by them within a day or two. The ants are laden with provisions when they return from their foraging expedition, evidently, unselfish creatures, to satisfy the wants of the members of the community at home. On this wall a queen has often been observed, attended by a strong body-guard of her loyal subjects.

There is yet another species of ant which has established itself in London. It is a native of Madeira. Its name is *Tapinoma gracilescens*, and does not occur in any published

list of British ants. I find it mentioned in the official General Catalogue of Ants in the British Museum, and the Botanical Gardens, Kew, is given as a habitat. The presence of this ant in the heart of the great city is a most interesting fact. It is many years ago since I first observed it in my brother's house. I noticed it in large numbers in the Rectory kitchen in 1876, and at Christmas, 1878, I received the queen and one of her subjects by post from one of my nephews, this being the first time I had set my delighted eyes upon her majesty. It is chiefly in the summer-time that they visit the dining-room, in the sugar. They are always seen downstairs, except in extremely cold weather. Their being noticed in the dining-room at Christmas-tide, and that an exceptionally cold season, was a most unusual circumstance. The queen immediately attracted attention by her great size. She was in the sugar-basin, and surrounded by a number of her devoted attendants. The latter are very small, of a black colour, with very long thin legs and antennæ. They run very rapidly, and are very difficult to capture, except when satisfying their hunger. I have often caught them by spreading sugar in their pathways and customary haunts. Though they are particularly fond of sugar, they will eat anything sweet. They feast also on shrimps' heads, when placed near the entrance of their burrows, and they are often seen carrying off dead flies and beetles. I have frequently noticed them bearing along dead flies as well as sugar for the good folks at home. They are also to be seen in the Crystal Palace, and they have been met with at St. Leonard's-on-Sea; so that I think it is a species which, though possibly imported, like the *Pheidole lævigata*, the other native of Madeira, may now be registered as British.

CHAPTER VI.

The workers and their offices—They vary in function, size, and structure—In some colonies more than two distinct forms—Bates's record—The workers of three orders—The worker-minors—Mounds and galleries—Cutting leaves—Robbing the farinha baskets—The function of the worker-majors—Worker-majors with unique frontal eye—The queen of *Myrmica scabrinodis* described—The princesses—Their mid-air dances—'The haunted tree's on fire!'—A political demonstration in the ant-world—Their constitution a limited monarchy—The princesses further described—The princes—Their short career.

IN a former chapter I endeavoured to describe the worker of the common red ant; I say *worker*, since you should know that, as in the constitution of the beehive, so also in the ant's colony, there are three classes of individuals, distinct in their character and differing in their employments—the workers, the females, and the males; the workers, again, vary in size, form, and function.

The *workers*, being neuters or undeveloped females, are those which form the main body of the community, and which usually present themselves to our view on the ants' highways, on the surface of the nest, or in the interior when an entrance has been effected. Their office it is to nurse and educate the young, to build the house, to defend the colony when attacked by enemies, and to forage for provisions.

I have generally found large and smaller workers in an ant colony; and sometimes intermediate forms connecting the two extremes. Their offices or functions seem to vary.

In disturbing a nest of our indigenous slave-maker, *Formica sanguinea*, I have always noticed that the large workers immediately come out to ascertain the cause of the disturbance and resent the unexpected attack, assuming an attitude of defiance, while the smaller workers remain indoors, possibly to quiet the babies or reassure the perturbed mind of their sovereign lady the queen. The special function of the smaller workers is to attend to all domestic duties. I have observed that the slaves that belong to the species *Formica fusca*, and to the labouring class, and who always keep within when the attack is made, as a rule are small workers. Sometimes the workers vary in structure as well as size. The large worker of the Madeira ant has a largely-developed head. (See Fig. 16, p. 95.)

In some ant colonies more than two distinct forms of workers are found. I may instance the Saüba, or Umbrella ant of Brazil. Mr. H. W. Bates has watched these marvellous ants in their native haunts in the Amazons valley, and has given us a graphic record in his work entitled, *The Naturalist on the River Amazons*. He thus describes the indefatigable workers with their diverse functions: 'This ant,' *Æcodoma cephalotes*, 'is seen everywhere about the suburbs of Pará marching to and fro in broad columns, and from its habit of despoiling the most valuable cultivated trees of their foliage, it is a great scourge to the Brazilians. In some districts it is so abundant that agriculture is almost impossible, and everywhere complaints are heard of the terrible pests. The workers of the species are of three orders, and vary in size from two to seven lines.'

The true working-class of a colony is formed by the small-sized order of workers—the worker-minors, as they are called. The functions of the two other kinds are not yet properly understood. In one the head is highly polished; in the other it is opaque and hairy. The worker-minors vary greatly in size, some being double the bulk of

others. The entire body is of very solid consistence and of a pale reddish-brown colour. The thorax or middle segment is armed with three pairs of sharp spines; the head also has a pair of similar spines proceeding from the cheeks behind.

'In our first walks we were puzzled to account for large mounds of earth, of a different colour from the surrounding soil, which were thrown up in the plantations and woods. Some of them were very extensive, being forty yards in circumference, but not more than two feet in height. We soon ascertained that they were the work of the Saübas, being the outworks or domes, which overlie and protect the entrances to their vast subterraneous galleries. On close examination I found the earth of which they are composed to consist of very minute granules, agglomerated without cement, and forming many rows of little ridges and turrets. The difference in colour from the superficial soil of the vicinity is owing to their being formed of the under-soil, brought up from a considerable depth. It is very rarely that the ants are seen at work on these mounds; the entrances seem to be generally closed; only now and then, when some particular work is going on, are the galleries opened. The entrances are small and numerous; in the larger hillocks it would require a great amount of excavation to get at the main galleries; but I succeeded in removing portions of the dome in smaller hillocks, and then I found that the minor entrances converged at the depth of about two feet, to one broad and elaborately worked gallery or mine, which was four or five inches in diameter. This habit in the Saüba ant of clipping and carrying away immense quantities of leaves has long been recorded in books of natural history. When employed on this work their processions look like a multitude of animated leaves on the march. In some places I found an accumulation of such leaves, all circular pieces, about the size of a sixpence, lying on the pathway, unattended by ants and at

some distance from any colony.' 'Such heaps are always found to be removed when the place is revisited the next day. In course of time I had plenty of opportunities of seeing them at work. They mount the tree in multitudes, the individuals being all worker-minors. Each one places itself on the surface of a leaf and cuts with its sharp, scissor-like jaws a nearly half-circular incision on the upper side; it then takes the edge between its jaws, and by a sharp jerk detaches the piece. Sometimes they let the leaf drop to the ground, where a little heap accumulates until carried off by another relay of workers; but generally each marches off with the piece it has operated upon; and as all take the same road to their colony, the path they follow becomes in a short time smooth and bare, looking like the impression of a cart-wheel through the herbage. It is a most interesting sight to see the vast host of busy, diminutive labourers occupied on this work. Unfortunately they choose cultivated trees for their purpose. This ant is quite peculiar to tropical America, as is the entire genus to which it belongs; it sometimes despoils the young trees of species growing wild in its native forests, but it seems to prefer, when within reach, plants imported from other countries, such as the coffee and orange trees.'¹ 'Besides injuring and destroying young trees by despoiling them of their foliage, the Saüba ant is troublesome to the inhabitants from its habit of plundering the stores of provisions in houses at night.' He mentions how, when residing at an Indian village on the Tapajos, he had ample proof of the fact of their entering habitations and carrying off grain by grain the farinha or mandicoa meal, the bread of the poorer classes of Brazil. 'One night my servant woke me three or four hours before sunrise by calling out the rats were robbing the farinha baskets (the article at that time was scarce and dear). I got up, listened, and found that

¹ *The Naturalist on the River Amazons*, by H. W. Bates, F.L.S., p. 12.

the noise was very unlike that made by rats. So I took a light and went into the store-room, which was close to my sleeping-place. I there found a broad column of Saüba ants, consisting of thousands of individuals as busy as possible passing to and fro between the door and my precious baskets. Most of those passing outwards were laden each with a grain of farinha, which was in some cases larger and many times heavier than the bodies of the carriers. Farinha consists of grains of similar size and appearance to the tapioca of our shops ; both are products of the same root, tapioca being the pure starch, and farinha the starch mixed with the woody fibre, the latter ingredient giving it a yellowish colour. It was amusing to see some of the dwarfs, the smallest members of the family, staggering along, completely hidden under their load.' 'It is one of the great peculiarities of the Saüba to possess *three* classes of workers. My investigations regarding them were far from complete. I will relate, however, what I have observed on the subject. When engaged in leaf-cutting, plundering farinha, and other operations, two classes of workers are always seen. They are not, it is true, very sharply defined in structure, for individuals of intermediate grades occur. All the work, however, is done by the individuals which have small heads, whilst those which have enormously large heads, the worker-majors, are observed to be simply walking about. I could never satisfy myself as to the function of these worker-majors. They are not the soldiers or defenders of the working portion of the community, like the armed class in the termites, or white ants ; for they never fight. The species has no sting, and does not display active resistance when interfered with. Some imagined they exercised a sort of superintendence over the others ; but this function is entirely unnecessary in a community where all work with a precision and regularity resembling the subordinate parts of a piece of machinery. I came to the conclusion, at last, that the

have no very precisely-defined function. They cannot, however, be entirely useless to the community, for the sustenance of an idle class of such bulky individuals would be too heavy a charge for the species to sustain. I think they serve, in some sort, as passive instruments of protection to the real workers. Their enormously large, hard, and indestructible heads may be of use in protecting them against the attacks of insectivorous animals. They would be, on this view, a kind of *pièces de résistance*, serving as a foil against onslaughts made on the main body of workers. The third order of workers is the most curious of all. If the top of a small fresh hillock, one in which the hatching process is going on, be taken off, a broad cylindrical shaft is disclosed, at a depth of about two feet from the surface. If this be probed with a stick, which may be done to the extent of three or four feet without touching the bottom, a small number of colossal fellows will slowly begin to make their way up the smooth sides of the mine. Their heads are of the same size as those of the former class of worker-majors, but the front is clothed with hairs instead of being polished, and they have in the middle of the forehead a twin ocellus, or simple eye, of quite a different structure from the ordinary compound eyes, on the sides of the head. This frontal eye is totally wanting in the other workers, and is not known in any other kind of ant. The apparition of these strange creatures from the cavernous depths of the mine reminded me of the Cyclops of Homeric fable. They were not very pugnacious, as I feared they would be, and I had no difficulty in securing a few with my fingers. I never saw them under any other circumstances than those here related, and what their special functions may be I cannot divine.'

We pass now to the females and males of a species found in England—the *Myrmica scabrinodis*. The apterous females, or queens—of which every colony has one at least, but, as a rule, more—differ in colour, appearance,

and form from the workers. Among these ants, viz. the red, often found lying in juxtaposition with the yellow, the queen is decidedly larger than any of her subjects. The top part of her head is nearly black, but adorned with silky golden tresses of most brilliant colour when the sun irradiates them. She, in common with her subjects, is armed with a sting, which, strange to say, is denied to monarchs as well as to the workers of many other species, most probably because, being of an adventurous disposition, she often takes a constitutional, and requires, therefore, a weapon of defence on any sudden emergency. She is enabled now and then to take an airing, since she is not so tied at home as others, numbering in her family only about a thousand, generally less, and at most under two thousand; whereas queens of some other tribes rejoice in families, at a moderate computation, of from four to five thousand. Some colonies of the stingless *Formica rufa* may be set down at ten thousand; and one community of the *Formica umbrata* (*Lasius umbratus*), closely allied to the common *F. flava* (*Lasius flavus*), which I discovered in 1878 in the heart of a large willow it had helped to destroy—a most unusual habitat for this species, which generally constructs its extensive habitation in the ground—must have numbered considerably above a myriad.

Before they leave their mother's roof the princesses are not merely adorned with a dress of scaly flounces, but they are provided with mantillas of the most exquisitely delicate workmanship, in the form of lace-like wings, smoky at their base, which seem to distinguish this from the two closely-allied species. These wings, as they circle in their summer mid-air dances, reflect with glittering brilliancy the many-coloured hues of sunlight; and in the setting sun they scintillate, as the little people swarm and fly upwards, like sparks from burning embers, which glitter in a midnight sky.

I have been informed by a late parishioner that there

stood in her native village an old tree which was infested with ants, and which the villagers used to say was haunted. They took, I presume, the little people to be elves or fairies of the haunted spot, as they darted in and out, and floated hither and thither on their glassy wings. One evening the wondering villagers crowded to their cottage doors, summoned by the exclamation, 'The haunted tree's on fire!' The sun went down, the fire went out, the fairies still survived and looked as beautiful as ever!

Sometimes, when the ants in the act of swarming are seen from below instead of from above, the appearance of curling smoke-wreath, instead of scintillating fire-flash, is presented. 'On the 28th of August last,' says a correspondent of a London paper, writing in 1866, 'smoke was seen to issue from the small spire above the belfry of the handsome church of St. Maurice, in Coburg. The news soon spread that the church-tower was on fire; the fire alarm was given, according to the German fashion, from the church-tower itself, the brigade of volunteer firemen donned their helmets, and rushed in all haste from their ordinary vocations to the post of danger, an express messenger was sent to the burgomaster, who was gone to a neighbouring village, and the whole population turned out to see the curl of smoke gradually ascending and disappearing in the clear blue sky. Nor was their anxiety for the old church without cause. Twice before in its history—once in 1807 and again in 1812—had the lightning set this very tower on fire. But whence now could the fire have come? The spot whence the smoke issued was far from any place in the tower ever used or visited; the day was bright and clear, and there had not been and was not any sign of a storm; the heat of the sun, it is true, was excessive, but no one could remember an instance when fire had been kindled by the lord of day. Whilst the spectators eagerly discussed these questions, hundreds of eyes were watching the ascent of the firemen from point

to point until they reached the belfry under the spire. A scaffold was then busily constructed, upon which a ladder was raised, and the cause and seat of the fire closely investigated. Sundry motions of the fireman on the ladder on high excited no little mystery below, for he seemed to be engaged in conflict with wasps or other warlike insects. The news soon spread to the earth that the cause of all this commotion was the millions of ants which had settled in countless numbers on the steeple—indeed, all over the upper part of the tower—and, as they rose to perform their gyrations in the air, had created the appearance of smoke, which could not be detected as a counterfeit from below. The mysterious motions of the man on the ladder were now explained—they were his attempts to beat off his insectile companions from himself, upon whom they were quite as disposed to settle as upon the steeple itself. I am not,' adds the correspondent, 'sufficiently acquainted with insect life to be able to speak scientifically as to the genus of the ant that succeeded in so distinguishing itself, but, having seen several that were brought down from the spire, I am able to say that they were an ant of a reddish colour, slightly larger than our common black ant, and of course furnished with wings.'

The genus would doubtless be that of the ant we are examining—*Myrmica*; and it may be also the same species, viz. *scabrinodis*, and if not that, of one or other of its allies, the *ruginodis* or *lævinodis*. The numbers may be accounted for by the suggestion which I would throw out—that it was a social conference or political demonstration in the ant-world, and that all the ant cities of one or more of the three tribes mentioned in the neighbourhood of Coburg had furnished numerous delegates or contingents. The cause and issue of the demonstration must to us ever remain a mystery. I may here mention that the little people are all politically enfranchised. Milton calls their constitution a democracy, though I should call it a limited

monarchy—a monarchy limited by the will and intelligence of a loyal, a contented, and a united people.

I witnessed, in the year 1876, a similar phenomenon to that which astonished the Coburg folks. On Doverow Hill, over against Stonehouse, I observed a swarm of ants rising and falling over a small beech-tree. The sun was shining brilliantly upon them, and on those also fluttering upon the leaves of the little tree, on which they sparkled like winged diamonds. The effect of those in the air—gyrating and meeting each other in their course, as seen against the deep blue sky—reminded me of the little dodder, with its tiny clustered blossoms and its network of ramifying scarlet threads, over the gorse or heather at Bournemouth. I noticed the swarm about thirty paces off, and it began to assume the appearance of curling smoke; at forty paces you could quite imagine the tree to be on fire. At fifty paces the smoke had nearly vanished into thin air. I captured some, and found them to be the male of the *Myrmica lævinodis*, which may be distinguished from the female not only from its colour—being tawny brown, with pale reddish mandibles, antennæ, and articulation of the legs—but because, among other characteristics, it wants the sharp spines upon the meta-thorax.

The females of the red tribes possess translucent jewels in the crown of their heads, three in number, of diamond lustre, set in the form of a triangle in their dark red skin, but so small that a lens can alone tell us of their shape and colour. They are not diamond-cut, as are their two many-sided eyes, which are fixed behind each of the antennæ, but are of a spherical form, and are given to them, it has been supposed, to see before them when upon the wing, helping them to keep aloof from birds of prey, and court the smiles of youthful princes who may seek to win their love. The princes of the species *Myrmica scabrinodis* differ but little in general appearance from the

princesses. In colour they are blackish-brown, instead of reddish-brown. The mandibles, terminal joints of antennæ, as well as the apex of the femora and tarsi, are pale reddish ; and the number of joints in the flagellum are twelve instead of eleven ; as with the females and workers, we find them differing from their royal consorts and daughters in being stingless. In size they are very nearly similar to the princesses, possessing, too, like them, the means of traversing the open firmament of heaven ; and being also aeronauts, they too are furnished, in addition to their lattice windows near their antennæ, with the *ocelli*, the three-jewelled skylights (I have seen them radiant with the colours of the garnet, amethyst, and topaz), through which they keep in view and joyously pursue along the sunbeams their chosen brides.

Their married life is, as a rule, short, ceasing as they do to live ere their youthful progeny have come to days of discretion—nay, sometimes before, or soon after the honeymoon has set. Their career is frequently cut short by drowning, or they become the prey of insectivorous birds and spiders. When their life is not prematurely brought to a close, they live many weeks, and even several months ; in this case, however, they have not left the shelter of their homes, being guarded and preserved by the workers, and, as a rule, are fed by these unwearied and unselfish attendants.

In the year 1877 I found the males of *F. umbrata* (*L. umbratus*) in the nest in the front border of the Vicarage as late as November 20. These must have been between three and four months old. In the year 1879 I discovered males in a nest of *F. aliena* (*L. alienus*) at Bournemouth in the month of November, which I should judge therefore to be upwards of three months old. I have also met with males in the nest of *F. flava* (*L. flavus*) in the same month, and hence of the same age.

As a rule, the males of ants do not live beyond the

winter months. In confinement, however, their life may be prolonged somewhat beyond this limit. Sir John Lubbock has kept two males of *Myrmica ruginodis* through the winter and into the spring, both being captured on the 14th of August, and one living till April and the other to the middle of May.

It has generally been considered that the duration of the life of a female is limited to a single year, but Sir J. Lubbock, in his work dated 1882, mentions¹ that he has in his possession two queens which have lived with him since 1874, and must therefore be at least seven years old, and some workers he has had in his nests since 1875. Since the publication of this work, the baronet has read another paper before the Linnean Society, in which he states that these ants are still alive (1882), so that the queens are now eight years and the workers seven years of age. I have had workers in my *formicaria* which have attained the age of between three and four years at least, and in my front border a colony of *F. umbrata* (*L. umbratus*) has been in existence for at least ten years, and until this year I have not noticed a single winged female, though I have observed with wonder thousands and tens of thousands of males and workers. May we not infer either that the workers are of the age of the period of my observation, or, which is more probable, that an apterous female, which has kept out of sight all this time, has borne a charmed life for this lengthened period, producing year by year the eggs of males only? In this duty she may have been assisted by the workers, which lay only male eggs, when under exceptional circumstances they are productive. If the inference is correct—and it is not easy to see how it can be called in question—we have here an instance of an ant's life extending beyond the limit of ten years.

This tribe of reddish emmets differs from the representatives of the yellow tribe who are found living under

¹ *Ants, Bees, and Wasps*, pp. 9, 10.

the same roof, though keeping perfectly distinct establishments; that is to say, *Myrmica scabrinodis* differs from

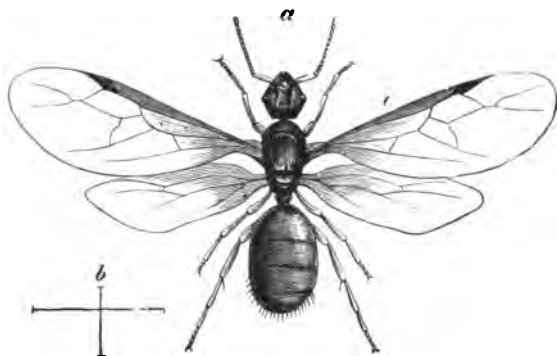


FIG. 8.—*Formica flava* (*Lasius flavus*). Female. *a*, magnified; *b*, natural size; *c*, costal area, or *marginal* cell.

Formica flava. First, the nurse and labourer is, as a rule, nearly twice as large as the average-sized yellow worker, the individual workers of this last-named ant differing considerably in length. Secondly, the red is armed with

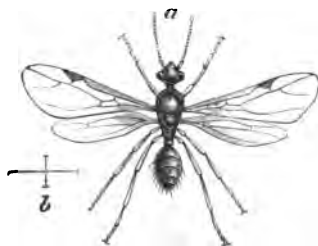


FIG. 9.—*Formica flava* (*Lasius flavus*). Male. *a*, magnified; *b*, natural size.

a weapon of defence and offence, while the yellow is stingless. To compensate, however, for this loss—thirdly—the yellow worker possesses what the red has not, the *ocelli* in the crown of its head, though in the smaller examples they are not discernible; these *ocelli* assisting it

to see where the other cannot, and so avoid occasions of offence and threatening danger. Fourthly, the antennæ of the yellow possess cylindrical joints instead of cup-shaped articulations, and they are devoid of the terminal club. Fifthly, the yellow emmet, instead of being ornamented like its red neighbour with two globular nodes, has merely a single node, which is flattened into a scale. And—lastly—the queen in size is about four times larger than

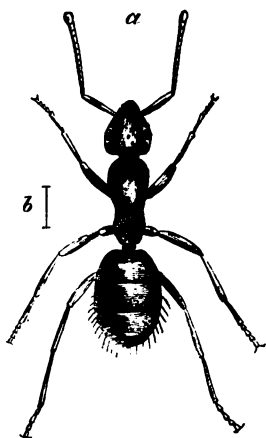


FIG. 10.—*Formica flava* (*Lasius flavus*). Large worker. *a*, magnified; *b*, natural size.

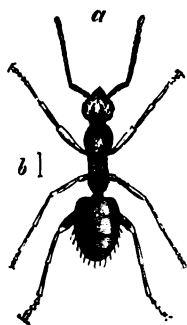


FIG. 11.—*Formica flava* (*Lasius flavus*). Small worker. *a*, magnified; *b*, natural size.

any of her subjects ; her robes of state are more magnificent than the dress of her royal sister, being yellow, inclining to a fine chestnut brown, and carrying a gloss of rich silk-velvet. Her wings are slightly tinted, but decidedly brownish at their base, the costal area or marginal cell in the upper wing being much darker and richer in colour ; the tints in the lower wing being less marked.

The wings of the male are much paler, almost colourless, with the exception of the costal area, which is tinted as with pale Indian ink. The body is nearly black, with

yellowish articulations of legs and tarsi. It is intermediate in size between the small and larger worker, and is much smaller than the female; the legs and antennæ are longer in proportion. With reference to these latter it should be noticed that, as a rule, as in the case of *Myrmica scabrinodis*, the number of joints in the flagellum of the male ant is twelve, while in that of the female and worker it is eleven, so that, including the *scape*, the antennæ have thirteen joints in the male, and twelve in the female and worker.

The red and yellow specimens are representatives of two tribes of the little people which are now the subject of our observation. They are representatives of two great nationalities into which the ant-world—at least the British ant-world—is almost entirely divided. The *Yellow*, representing the stingless emmet, with one scale or node, and three *ocelli*; the *Red*, those having their females and workers armed with a sting, possessing a double node, the workers wanting the *ocelli*. It is curious to notice also that the juveniles, or footless grubs of the stingless single-noded emmets, wrap themselves up in white or pale yellow silken coverlids, while resting in their crowded nurseries, just before they come out into the busy world to seek their fortune, while the stinging double-noded juveniles dispense with what they think perhaps a needless luxury.

Those without stings, with single nodes or scales, and three *ocelli*, and whose *larvæ* spin for themselves cocoons, are called *Formicidæ*; while those possessing stings, two nodes, and whose workers want *ocelli*, and whose chrysalids are naked, are called *Myrmicidæ*. Of the *Formicidæ*, there are, including the Madeira ant, *Tapinoma gracilescens*, which I found at St. Mary Aldermay Rectory, fourteen species, and of the *Myrmicidæ*, including the Madeira ant, *Pheidole lævigata*, which I discovered in the baker's shop in the Borough, seventeen species.

CHAPTER VII.

The *Poneridæ*—The two British species of *Ponera*—Mr. Smith's son's discovery at Bournemouth—A variety of *Lasius umbratus* (*Formica umbrata*) described—The *Mutillidæ*, or solitary ants—*Mutilla Europæa* found in the nests of humble bees—The strange noise it utters—The rare *Methoca ichneumonides*—The question, Should *Mutillidæ* be classed with the *Heterogyna*?—Number of species of social ants—Mr. F. Smith's record and estimate—Exceptions to the general rule of the distinct characteristics of the families *Formicidæ* and *Myrmicidæ*—The honey ants of Mexico and Colorado—Also from Australia, Singapore, and Borneo—Anomalous form of the female of *Anergates atratulus*—Strange constitution of the colony of this ant—Ants with large heads—The harvesting ants of the South of France.

THERE is a third nationality or family of the little people, the *Poneridæ*, forming a connecting link between the *Formicidæ* and the *Myrmicidæ*; for while they have only one node—which is raised to a level with the first ring of the abdomen, which latter is always more or less constricted—they have their females and workers furnished with stings, and the larvæ spin for themselves cocoons. These are represented by two rare species, the *Ponera contracta* and *Ponera punctatissima*.

A year or two since it was thought that Mr. Charsley, of Oxford, had discovered a new species belonging to this genus, a species which he named '*tarda*;' but after comparing it most carefully with the two familiar forms, I came to the conclusion that the supposed new species was identical with *punctatissima*; and I satisfied the late Mr.

Smith that such was undoubtedly the case. So that the number of species in the three families of the division *Heterogyna*, of the order *Hymenoptera*, including the two Madeira ants, is thirty-three.

I should, however, mention that Mr. F. Smith recorded in the *Entomologists' Annual* for 1866 a species, several representatives of which his son captured at Bournemouth, and which he denominated *Formica gagates*. In his

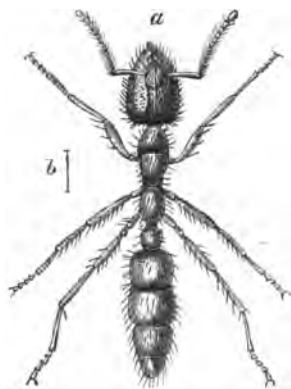


FIG. 12.—*Famera punctatissima*. *a*, magnified; *b*, natural size.

Catalogue, published by the Entomological Society in 1871, he omits it from the British list. I communicated with him on the subject, and he assured me that he did not consider it as a distinct species, but only a variety of *F. fusca*. He doubtless compared it with the continental forms in coming to this reversed decision. I have done so, through the kindness of Mr. Saunders, who lent me a specimen of the Bournemouth ant, presented to him by Mr. Smith, for examination. This I compared with undoubted specimens of *gagates* from abroad which I have found in Mr. Smith's collection, now in my possession, and the difference between them is most marked. The

Bournemouth ant is closely allied to *F. fusca*, but with a glabrous or shining abdomen, with a few scattered and bristly hairs, and piceous or pitchy in colour. The continental *gagates* is decidedly larger than *fusca*, very glabrous, and jet-like in colour, and with quite a fringe of strong yellowish-white hairs when examined sideways with a Codington lens. I find that Mr. Saunders, in his recently published *Synopsis*, has reintroduced it as *gagates*; but I think that my late friend exercised a sound judgment in considering it distinct from *gagates*.¹

What, then, should the ant be called, if it be not considered as a variety of *fusca*? I would designate it provisionally as a new species, *Formica glabra*. If such shall prove to be the case, we have as many as thirty-four species of social ants inhabiting Britain. There is yet one other form which demands a passing notice. Mr. G. C. Bignold, of Stonehouse, Plymouth, has recorded the discovery by himself of an ant new to Britain, which he calls *Lasius mixtus*. He first thought it was *Lasius umbratus*, but upon a re-examination he seems to have identified it with the continental *mixtus*. He kindly furnished me with specimens—they are marvellously like *Lasius umbratus* or *Formica umbrata*; the workers and males especially so. The pubescence, however, is not so conspicuous upon the tibiæ in the workers and females as in *umbratus*, and the colour of the females is of a dark sepia brown rather than of a reddish brown or mahogany tint, as in the typical specimens of *umbratus*. However, I have specimens of *L. umbratus* intermediate in its degree of pubescence and in its colouring between the two extremes.

¹ Since the publication of the first edition of this work I have visited Bournemouth several times, and have instituted a careful search for the species, but it was not until the year 1892, as stated in the preface, that my perseverance was rewarded by its re-discovery. I was fortunate to find upon the heath many workers, the queen, and at last the nest itself. In 1893 I repeated my visit to Bournemouth, and I was again successful in finding a goodly number of the workers of this interesting and brilliant species.

One with a reddish tinge, another of the pale yellowish-brown kind, and a third of the dark sepia brown, precisely similar in its colouring to Mr. Bignold's specimens, from a very strong and long-established colony of *umbratus* in my garden. This colony for very many years has produced no females, males having been developed in their thousands, nay, tens of thousands, but not a single female having come within view. In 1882, however, the species swarmed in the Vicarage, and must have come up through the foundations in some mysterious way. The males and females were accompanied by the workers, who seem to exercise over them a singular and controlling power. All the females were of the dark brown type with a fine, silky sheen, and the pubescence I find more marked and clearly defined in some specimens than in others. In Mr. Smith's collection I possess continental representatives of the workers of *mixtus* which are very similar to those of the *umbratus*; there are, however, no females of the former to compare with the latter. Forel considers *mixtus* and *umbratus* to be races of the same species, and Mr. Saunders does not consider Mr. Bignold's specimens to be a species distinct from *umbratus*—hence I conclude that my own long-established colony is *Formica umbrata* of Smith's *Catalogue*, or *Lasius umbratus* of Saunders' *Synopsis*, but of the dark sepia brown variety. I should add that the three families above referred to embrace all the British social species; that is, those species of ants living in society, having males, females, and workers.

There is yet a fourth family, the *Mutillidæ*, called the Solitary Ants. Of these there are four species recorded in Mr. Smith's *Catalogue*. Two of these—*Mutilla Europæa* and *Mutilla Ephippium*—I have found at Bournemouth; the *Ephippium* also I have met with near Christchurch, in Sandown Bay, where it was more abundant; and also on the sand-hills of Deal. The third, *Myrmosa melanocephala*, I have found at Charlton in Kent, and also at Bournemouth.

Of the fourth, the rare *Methoca ichneumonides*, I have in my collection one specimen, presented to me by Mr. F. Smith, and two or three found by myself for the first time in August, 1881, at Bournemouth, when I discovered, remarkable to relate, the representatives of the four solitary species on a sandy spot in the open heath, running in the brilliant sunshine!

These solitary ants consist of two sexes, male and female. The males are winged, and the females apterous. There is no third order designated workers, as in the social

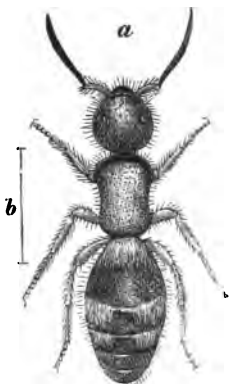


FIG. 13.—*Mutilla Europaea*. Female. *a*, magnified; *b*, natural size.

species and with the bees. The *Mutilla Europaea* has been found in the nests of humble bees. Drewson of Copenhagen gives the following account¹—‘From a nest of *Bombus Scrimsheranus* he obtained only two worker bees, but as many as seventy-six of *Mutilla Europaea*—forty-four males and thirty-two females. The larvæ of the *Mutilla* were found in the cells, closed in as usual by the full-fed grub of the bee; this appears to prove that the

¹ See *Catalogue of British Fossorial Hymenoptera*, by Frederick Smith, V.P.E.S., 1858, p. 39. The account of M. Drewson, here given, is taken from *Journal of Ent. Soc. of Stettin*, 1847, p. 210.

genus *Mutilla* is parasitic, and that it is carnivorous in the larva state, for the cells contained the full-grown grub of the parasite only.' Christius also mentions the fact of the larvæ of *Mutilla* being found in a similar situation. 'Their attacks, however, cannot be confined to humble bees. These insects are not found either in Australia or in tropical Africa, yet *Mutilla* is plentiful in both; in Brazil the *Mutillidæ* abound, but *Bombus* appears to be only sparingly distributed.'

In this country, up to 1858, the species of *Mutilla* were scarce, and it appears strange that no one should have

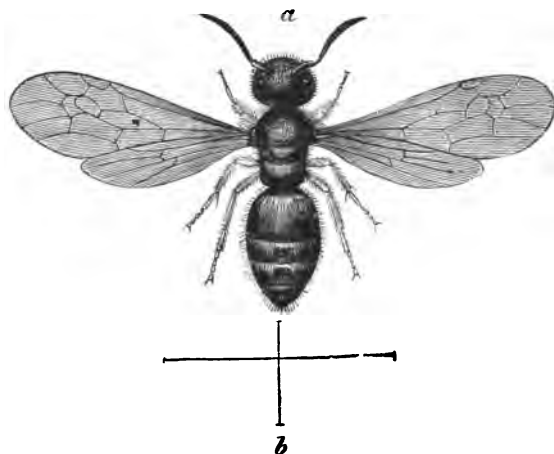


FIG. 14.—*Mutilla Europæa*. Male. *a*, magnified; *b*, natural size.

met with them in the nests of humble bees which were frequently examined. Since that date they have been met with in the nests of *Bombus*. Under the head of *Bombus muscorum* the late Mr. Smith mentions¹ how 'the parasite, *Mutilla Europæa*, was found in the nest of this *Bombus* last summer, by Miss Madeline Pasley, at Shedfield Grange, near Wickham, Hants; several nests were examined, and

¹ *Catalogue of British Bees*, by Frederick Smith, 1876, p. 200.

the *Mutilla* was found in each. This is the first time I have heard of this parasite being found in the nest of *Bombus muscorum*.'

In 1876, at Bournemouth, when I laid hold of a fine female of *Mutilla Europæa*, which was hurrying in the sunshine over a turf-bank, it uttered a cry like the strange noise made by the *Sphinx atropos*, the Death's-head hawk-moth, as if it were chiding me in reproachful accents for venturing to deprive it of its liberty. This interesting creature is considerably larger than the ordinary ant, being sometimes quite eight lines in length: it has a black head, reddish-brown thorax, and a black abdomen, banded with beautiful fringes of bright yellow, glossy hair. The strange noise I find to be peculiar to this species.

When I saw the record of Miss Pasley's capture, I wrote to her with reference to this peculiarity. In her reply she states: 'I shall be very glad to tell you what little I observed about the *Mutilla Europæa*. If I had known at the time that it was worth anything, I would have taken more trouble about it. I am indebted to Mr. S. Marryat, of Shedfield Grange, for the discovery, because he first showed me some nests of *Bombus muscorum* in his orchard, about the middle of August. He was under the impression that the *Mutilla* was an apterous bee belonging to the nest; because there appeared to be one in each nest. I only examined three nests; in each of them was one *Mutilla*, a female, which ran out as soon as the nest was disturbed. I only found those three in the nests, and I caught one afterwards in a garden. I did not find any males. I noticed that it made a very peculiar noise, something between a squeak and a buzz. I could not understand a wingless insect buzzing, so I watched it. It contracted and expanded its body, and felt about with its antennæ, making the noise all the time and walking about in a jerky manner round the box it was in.'

In the *Mutilla* the stemmata or simple eyes are three in

number, placed in the form of a triangle in the vertex or forehead of the male. In the female they are wanting.

The very rare *Methoca ichneumonides* is the British representative of the genus *Thynnus*. This genus is parasitic upon *Lepidoptera*. Mr. Bakewell obtained specimens from the cocoons of moths which had been dug up from the ground. This instructive discovery seems to indicate at once their parasitical and fossorial character. Mr. Smith ever recognised their fossorial character; in fact, he, as a rule, while tabulating his captures in the *Entomologists' Annual*, groups the *Mutillidæ* with the *Fossores*, or the Sand-wasps; but at the same time he classes them with the *Heterogyna*, in order to show that, together with the social ants, these solitary species are distinctly heterogynous; that is, possess females of an anomalous form diverse from the males, which latter are always winged, whereas the females are apterous. In fact, as Shuckard rightly points out in his monograph of the *Dorylida*,¹ that if we are called upon to select for the distinctive designation of *Heterogyna*, either the social or the solitary species, the latter should secure the preference, since it is only these that have constant anomalous or apterous females, whereas, with the social species, the immature females or workers only are constant in their apterous character, the true females being winged when they first see the light, and only become apterous when about to occupy a throne and found or perpetuate a colony. It should not be overlooked, also, that many of the social species are fossorial in their character, and that as with some of these the *ocelli* are obsolete, so it is with the females of the solitary species.

Even in structural characters the two are sometimes allied, as may be noticed when comparing a well-arranged

¹ *Monograph of the Dorylida*, by W. E. Shuckard, Libr. Roy. Soc., from the *Annals of Natural History*, May, June, and July, 1840, p. 2, footnote *.

and extensive collection of these two attractive groups. For instance, we cannot but be struck with the similarity between the genus *Apterogyna* of the solitary group, and the genus *Myrmecia* of the social group, not only in their form and sculpture, but in the neururation of the upper wings, which contain but one recurrent nervure, which distinction the *Apterogyna* share, I believe, with the whole tribe of the social ants.

With reference to the number of species of social ants, foreign as well as British, there is much uncertainty. Mr. Smith, in 1858, mentions¹ that he had thus far recorded 690 species, and he has expressed his conviction that with the actual number we are probably but slightly acquainted. He adds: 'The metropolis of the group undoubtedly lies in the tropics, and when we reflect upon the observation of Mr. Bates, who has collected for some years in Brazil, "I think the number in the valley of the Amazon alone cannot be less than 400 species," how limited must our present knowledge of the group be! The imagination is unable even to guess at the probable amount of species.'

I myself forwarded three species to the British Museum sent me from West Africa, which were not found in the national collection, and for which there was no recognised designation.

The following is Mr. Smith's estimate of the number of species of ants:²—'In Great Britain, 32 species have been discovered. In the year 1802 the French naturalist, Latreille, described 102 species, that number being all then discovered of the ants of the world. In 1858, in my own work on the ants, 1000 species are enumerated' (*i.e.* the 690 social species above referred to, and 313 of the

¹ *Catalogue of British Fossorial Hymenoptera, Formicidae, etc.*, by Frederick Smith, V.P.E.S., p. 2.

² From a manuscript of an unpublished lecture on *Formicida*, 1868, by Frederick Smith, now in my possession.

genus *Mutilla*). 'About 300 have been subsequently described, and these, including also the number of undescribed species with which I am acquainted, will swell the list to about 1400 distinct species. Well, this is the number of *known species*, but what the actual number of existing species may really be it were impossible to guess at with any degree of certainty, but when we remember that the greater part of the habitable globe is unsearched, we may be pretty sure that if we double that number we shall not be over-estimating it. I have no doubt of the existence of at least 3000 species;' and deducting a fair proportion of the solitary species, which are doubtless included in this estimate, we may reasonably suppose the number of social species to be not less than 2250.

I said that the stingless species belonging to the family *Formicidæ* spin cocoons. I should mention that there are exceptions to this general rule. I have found the pupæ of *Formica fusca* and *Formica flava* naked under stones; and, in 1876, I noticed what has not been recorded before, the pupæ of *Formica rufa* without the usual silken envelope, in one of its thatched domiciles at Weybridge.

Other exceptions to my general description of the distinct nationalities of the little people occur. For instance, some of the *Myrmicidæ* are found to spin cocoons. This is the case with the genus *Myrmecia*, which appears restricted to Australia and Tasmania. In 1854, Mr. Smith mentioned¹ that he possessed a pupa, and silken cocoon from which it was extracted, of a species closely allied to *M. gulosa*, from New Holland. This pupa and cocoon are now in my possession, with five of the workers. The name of this Australian ant is *Myrmecia piliventris*. Looking through a microscope, at the British Museum, at a species which manifests this weaving instinct, an Australian colonist, I

¹ See *Essay on the Genera and Species of British Formicidæ*, by Frederick Smith, Esq., from the *Trans. Ent. Soc.* (read December 4, 1854), p. 115, footnote.

noticed it possessed three prominent *ocelli* of a topaz colour in a rough and prominent vertex, evidencing thus another exception to the general rule. Some *Myrmicidæ* have been discovered without their weapons of defence and offence. Again, in some *Formicidæ* the *ocelli* are not discernible, as in the common yellow; they are wanting in the smaller workers, and in the larger workers they are far apart. In another species, again, the little diamond eyes are close together, resembling the trefoil window of a church. As a rule, all ants possess the pair of side eyes formed of many lenses. I have microscopically examined four species of the Brazilian Processionary Ants (the *Ecitons*, referred to before when speaking of the eyes of ants), in two of which the eye was visible, but very small; in another, I could discover none at all; and in the fourth, clad in rich brown velvet tunic and glossy orange skirt, the eyes were visible, but without the lattice-work formation which is usual with the ants of this genus.

Some ants are most eccentric in their general appearance. I have noticed one carrying on its head what looked exactly like a tea-tray of old-fashioned shape. I have this curious species now in my possession; it is called the *Cryptocerus discocephalus*. Another, a native of Brazil, has grooves chiselled in its head and thorax, that it may stow away its antennæ and legs when anxious to feign death, and so escape the observation of an enemy. This species, as also the former, belongs to a sub-family denominated *Cryptoceridæ*. I have in my cabinet some Australian ants of this construction, having a yellow abdomen, and the gentleman who sent them to me graphically described how, when the ground near their nest was struck with the palm of the hand, they simultaneously appeared as dead. Another family, or genus, curve their abdomen over their thorax when upon the march, each resembling a pedestrian with a knapsack on his back. I have quite a colony of an unnamed species of this genus (*crematogaster*) sent me from Sierra Leone, both

small and large workers, and also their wonderful habitations, called by the natives, on account of their form and colour, negro-heads. A short time back I received one of these singular nests from Poonah.

Among other peculiar species of ants, I have noticed one in the British Museum, which is very remarkable. It is called the Honey Ant, the scientific name being *Myrmecocystus Mexicanus*. Its native land is Mexico. It has, however, recently been found by Dr. H. C. McCook, in the 'Garden of the Gods,' Colorado. It has its abdomen immoderately distended by honey injected through its

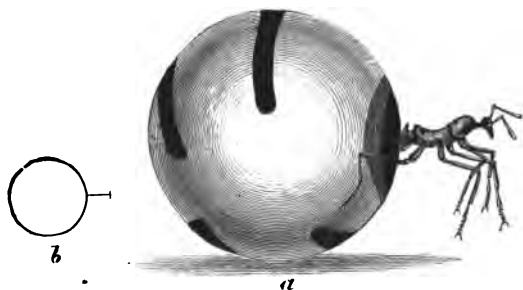


FIG. 15.—a, *Myrmecocystus Mexicanus*; b, approximate natural size.

mouth by those workers who collect it. It looks as if its head and shoulders were disengaged from the rest of its body, and that, thus shorn of its fair proportions, it was struggling under difficulties round the world to seek its fortune. It has been noticed that, when filled with honey, the globular abdomen of these honey-bearers resembles small Delaware grapes. According to Mr. Smith,¹ the honey undergoes in the bodies of this ant a sort of distillation, and when thus distilled it is given to the young brood. These ants are sold, he is informed, in the Mexican markets, by measure, a quantity put into a suitable vessel,

¹ *Catalogue of Hymenopterous Insects, Part VI.—Formicidæ*, by Frederick Smith, V.P.E.S., p. 200.

and the honey is then pressed out, and forms a basis of an exhilarating drink, something like mead. Dr. McCook calls¹ the honey ants after Llave, *M. melliger*, denominating Wesmael's ant 1 var. *Mexicanus*, and that discovered by himself in Colorado, 2 var. *hortus-deorum*.

A new kind of honey ant has been received from Adelaide, Australia, by Dr. McCook and Sir John Lubbock, the latter naming it *Camponotus inflatus*. It belongs to a different genus from *Myrmecocystus*. It is black, and about two-thirds of an inch in length.

I have recently received from Adelaide what will prove to be, I suspect, another honey ant. It has a large black head, a very pale brown thorax, a single scale, and an abdomen with the chitinous plates widely sundered upon a white elastic membrane. It belongs to the family *Formicidæ*.

I have in my collection another perfectly distinct species of honey ant, which has, instead of an enlarged abdomen, an enlarged thorax, which contains a honeyed secretion which is utilised for the benefit of the community to which it belongs. Its name is *Crematogaster inflatus*. It is black and shining; the posterior portion of the thorax forming a semi-transparent, bladder-like swelling. The *habitat* of this ant, which is of a genus diverse from either of the preceding, is given by Mr. Smith² as Singapore and Borneo (Sarawak). It belongs to that strange kind of ant which turns up its abdomen when it walks, and builds its nest in trees.

There is another abnormal ant³ whose abdominal segmental plates are widely sundered by very distended connecting membranes. It is a female form of *Anergates*

¹ See *The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains*, by Henry C. McCook, D.D., p. 75.

² *Catalogue of Hymenopterous Insects, Part VI.—Formicidæ*, by Frederick Smith, p. 137.

³ See *Les Fourmis de la Suisse*, par Auguste Forel, M.D., pp. 341, 342; and also p. 67.

atratus—a species which has no workers, and where the male is apterous. The workers upon which it is dependent, for it cannot even feed itself, are those of *Tetramorium caespitum*, a species which is not uncommon in England, and generally inhabits the sea-coast. This latter species I have found at Folkestone, near Dunwich, in Suffolk, at Southend, Bournemouth, Deal, Lynmouth, Branscombe, S. Devon, and in the middle of Hampstead Heath.

Some ants are quite one inch long, such as the female of *Formica gigas*, of Borneo, and the male of the genus *Dorylus*,

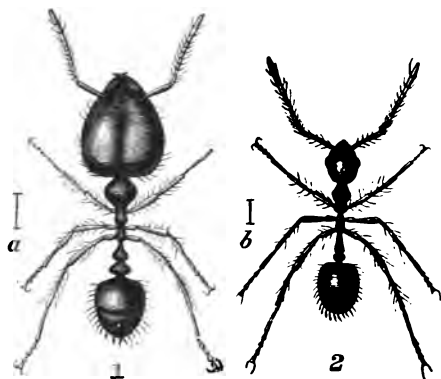


FIG. 16.—*Myrmica (Pheidole) lavigata*; house ant of Madeira.
1. Large-headed worker. *a*, natural size. 2. Small worker. *b*, natural size.

from South Africa and India. I have a fine series of a species of this interesting genus from the Cape. I have another species, the greater part of an inch in length, from Sierra Leone, called *Ponera pestilentia*, from the terrible odour which clings to it, and which is so powerful and subtle that in a very short time it permeates the atmosphere of a large room. Others there are with heads of enormous dimensions, as the 'driver' of Africa, the umbrella ant of Brazil, and the large worker of the house ant of Madeira. In the year 1877 I secured several of these large-headed

fellows, who, I think, must be the police or soldiers of the tribe, in the baker's shop in the Borough.

Another large-headed species is the provident ant of India, so called on account of the methodical manner in which it lays up its food for future need, in the same manner as the harvesting ants of the South of France, and which clothes the statement of Scripture with such a true and beautiful significance. Saith the inspired naturalist,¹ 'Go to the ant, thou sluggard; consider her ways, and be wise: which having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest.' Of these ants there are four kinds: the *Atta barbara*, under two forms or varieties—one wholly black, the other red-headed; *Atta structor*, similar to *barbara*, but of a claret-brown colour; and a minute yellow ant, the large workers of which have gigantic heads, named *Pheidole*, or *Atta megacephala*. In one nest of *barbara*, Moggridge found granaries containing seeds taken from more than twelve species of plants; and from the subterranean granaries of *Atta structor* and *Atta barbara*, he tells² us in his 'Supplement' to his original narrative, that he was able to collect the seeds or small dry fruits of fifty-four distinct species of wild plants. He found that the seeds, though moist, showed no trace of germination, and the ants, he concluded, from careful observation, exercised a power over them which checks the natural tendency to germinate; and he noticed that if, by any chance, the seed should assert its inherent power, it was immediately checked by the wise little people destroying the radicle.

Sir John Lubbock, who kindly gave me specimens of *barbara* from a colony he had from Italy for the purpose of observation, has assured me that they will not store grain unless there are a large number in the colony. It is noteworthy that Mr. Smith has recorded *Atta barbara* as having

¹ Prov. vi. 6-8.

² *Harvesting Ants and Trap-door Spiders, with Supplement*, by J. Traherne Moggridge, F.L.S., p. 168.

been discovered in Palestine, and that in the Mishna, or text of the Talmud, there are directions as to the rights of the gleaners in the case of corn found in the granaries of ants, wherein it is stated that if discovered after the reapers have passed, the upper part of the heap of grain shall go to the poor, and the lower to the proprietor of the field, though the Rabbi Meir expresses the opinion that the whole should go to the poor.

This interesting Jewish legislative enactment is fully discussed by Moggridge; and we may, with him, draw therefrom the just conclusion that the harvesting ants of Syria had earned a place in the ancient records by amassing stores of grain of sufficient size, and so disposed, as to make them worth collecting.

CHAPTER VIII.

The harvesting instinct of ants—Called in question by Gould, Latreille, Hüber, and others—The ancient belief true—The repudiation of the harvesting instinct accounted for—British ants possess the instinct—The reference in the Mishna—Lieut.-Col. Sykes's notice of the *Atta providens* of India—The agricultural ant of Texas—Dr. McCook's account of *Pogonomyrmex barbatus*—The architecture of their houses—The large *formicaria* in the neighbourhood of Austin, Texas, described—The *Ecodoma cephalotes* of South America—Belt discovers them to be mushroom growers—Honey ants—Other harvesting ants in America—Are they found in the Holy Land?

It may be both interesting and instructive to my readers to consider more in detail the harvesting instinct of the little people. The following¹ are the significant declarations of Solomon :—

‘The ants are a people not strong, yet they prepare their meat in the summer.’ ‘Go to the ant, thou sluggard ; consider her ways, and be wise : which having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest.’ Notwithstanding these explicit statements of Revelation, the harvesting instinct in the little people has been called in question, explained away, or even denied by theological students and eminent naturalists. The Rev. Wm. Gould, the historian of British ants in the last century, was the first, it is supposed, to call

¹ Prov. xxx. 25 ; vi. 6-8.

in question the harvesting habits of ants. He met¹ the testimony of classical and inspired literature with the supposition that probably different species exist with different habits according to their different climatic environment, or it might have been a received opinion, as was the sun's motion.

Latreille, one of the greatest of entomologists of the present century, who made the little people his peculiar study, gives his verdict against the harvesting instinct.² This was more wonderful in his case, since he was personally acquainted with the famous harvesting ant, *Atta barbara*; and its ally, *Atta structor*, he himself brought to light. Yet he was ignorant of the harvesting habit of these interesting species.

M. P. Hüber, also, called by Kirby 'the great historiographer of ants,' who has given us a most graphic account of the Amazon slave-makers, thus records³ his dissent from the now happily established opinion: 'I am naturally led to speak in this place of the manner in which ants subsist in winter, since we have relinquished the opinion that they amass wheat and other grain, and that they gnaw the corn to hinder it from germinating.'

Kirby, though acknowledging that ants may harvest grain in tropical countries, yet gives⁴ in his adhesion to the surmise that the ancients, observing the ants carrying 'their pupæ, which in shape, size, and colour not a little resemble a grain of corn, and the ends of which they sometimes pull open to let out the inclosed insect, mistook the one for the other, and this action for depriving the grain of the corculum.'

¹ See *An Account of English Ants*, by the Rev. Wm. Gould, A.M., 1747, pp. 93, 94.

² See *Histoire Naturelle des Fourmis*, Paris, 1812, p. 23.

³ See *The Natural History of Ants*, by M. P. Hüber, translated from the French by J. R. Johnson, M.D., F.R.S., etc., 1820, p. 237.

⁴ See *An Introduction to Entomology*, by Wm. Kirby, M.A., F. Rand, L.S., and Wm. Spence, Esq., F.L.S., 1818, vol. ii. p. 46.

The Rev. Wm. Houghton, in his article, entitled 'Ants,' in Smith's *Dictionary of the Bible*, says,¹ 'the fact is that ants seem to delight in running away with almost anything they find—small portions of sticks, leaves, little stones—as any one can testify who has cared to watch the habits of this insect. This will explain the erroneous opinion which the ancients held with respect to that part of the economy of the ant now under consideration; nor is it, we think, necessary to conclude that the error originated in observers mistaking the cocoons for grains of corn, to which they bear much resemblance.'

The scholar rightly affirms that it is not credible that Aristotle, Virgil, Horace, and other ancient writers could have been such poor observers as to mistake ant-cocoons for wheat-kernels, close as the resemblance may be between the two objects; and he then offers this explanation as accounting for the general belief of the ancients: 'Ants do carry off grains of corn, just as they carry off other things, not, however, as was stated, for food, but for their nests.'

The ancient belief is nevertheless true; and as the foresight of the ant has every support in the sacred writings, so has it also in the records of natural history. In attributing to the ant the harvesting instinct, the results of scientific observation are recorded. The men of all ages and countries who believed it, according to the learned Bochart, were in the right. They chronicled the facts that had come under their own observation, or were well established upon the trustworthy evidence of others. And it is worthy of note that, as a rule, in those countries where these ancient sages lived and wrote, the harvesting ants abound in the present day.

The repudiation of the harvesting instinct by so many intelligent observers has arisen from a too hasty generalisation and an observation extending over a too limited area.

¹ See American edition of Smith's *Dictionary of the Bible*, article Ant.'

It is true that as yet in our own country, and in other countries of the same or colder temperature, ants with the harvesting habit have not been discovered,¹ and that the little people slumber through the winter season, and so have no need of sustenance; yet there are times when the weather is more genial than at others, and on sunny days they revive and call out for food, and, wondrous to relate, an ample provision is at hand. In winter they can, as a rule, find a supply of milk from their gentle cows, which hibernate with them. In opening ants' nests in winter I have always found the aphides—and in one nest of the little *flava* I found a chamber which looked like a granary crowded with what seemed like little shining black seeds—and upon examination I found them to be the egg or pupal form of the ant cows. The providence of the British species of ants is thus fully established. Truly the apposite saying of Dugald Stewart is abundantly satisfied in the history of the little people: 'The discoveries which in one age were confined to the studious and enlightened few, become in the next the established creed of the learned, and, in the third, form part of the elementary principles of education.'

A remarkable confirmation of the harvesting habit of ants is found in the Mishna,² which is a collection of Jewish traditions and comments thereon of the learned Rabbins.

¹ Since the publication of the first edition of this work I have, as stated in the preface, discovered the harvesting instinct manifested in a colony of the *Tetramorium cespitum* at Branscombe, South Devon. I observed the workers carrying seeds of grass (*Lolium perenne*, I believe) into their nest; I noticed, also, the seeds intermixed with the debris, which might indicate that these seeds were the contents of the destroyed granary. I should add that Moggridge, in his work on *Harvesting Ants and Trap-door Spiders* (p. 63), mentions that this species has been noticed carrying seeds. The result of my observation is, I believe, the first record of the harvesting instinct having been noticed in England.

² *Tractatus de Angulo*, p. 53, '*Formicarium Cavernulae*,' etc. See *Agricultural Ant of Texas*, Dr. McCook, pp. 46, 47; also *Harvesting Ants and Trap-door Spiders, with Supplement*, by J. Traherr Moggridge, F.L.S., pp. 166, 167.

This treatise contains laws relating to the corner of the field left to the poor to glean, and a law is registered relating to the property rights to stores of seeds found in the granaries of the ants in the field. Its runs thus : ' The little caves of ants, when in the midst of a standing crop, are adjudged to the owner of the field ; of those behind the reapers, the upper part is the property of the poor, the lower of the proprietor. Rabbi Meir decides that all belong to the poor, since whatever is in doubt in gleaning goes to the gleaner.' The law of the Mishna dates back to the close of the second or beginning of the third century.

The earliest record we have in the present century of a harvesting ant was made in India by Lieut.-Col. Sykes, at Poonah, in 1829. The account was read before the Entomological Society in 1834, and published in vol. i. of the *Transactions*, 1836.¹ He observed in several places near the parade-ground more than twenty little heaps of grass-seed. These were raised by a species of ant, named by him *Atta providens* ; thousands of which were employed in bringing up the seeds to the surface from a store below. ' The grain,' he says, ' had probably got wet at the setting in of the monsoon, and the ants had taken advantage of the first sunny day to bring it up to dry. The store must have been laid up from the time of the ripening of the grass-seeds in January and February. As I was aware that this fact militated against the observations of entomologists in Europe, I was careful not to deceive myself by confounding the seeds of a *Panicum* with the pupæ of the insect. Each ant was charged with a single seed, but as it was too weighty for many of them, and as the strongest had some difficulty in scaling the perpendicular sides of the cylindrical hole leading to the nest below, many were the falls of the weaker ants with their burdens from near

¹ ' Descriptions of New Indian Ants,' by Lieut.-Col. Sykes, *Trans. Ent. Soc. Lond.*, i. p. 103.

the summit to the bottom. I observed they never relaxed their hold, and with a perseverance affording a useful lesson to humanity, steadily recommenced the ascent after each successive tumble, nor halted in their labour until they had crowned the summit and lodged their burden on the common heap. On October 13 of the same year, after the closing thunderstorms of the monsoon, I found this species in various places similarly employed as they had been in June preceding; one heap contained a double handful of seed.'

I have lately been in correspondence with Major Coussmaker, of Poonah, and he has sent me some ants, one of which seems very similar to the *providens*, having the same large head and the same mahogany colour, and, in my opinion, it is a harvester. The major states that he has observed ants harvesting seeds in his neighbourhood.

The account of the agricultural ant of Texas was given in 1860 by Mr. Buckley, and seems to have been the first notice of the harvesting ants in North America. A brief note,¹ by the same author, appeared, in January of 1861, in the *Proceedings* of the Academy of Natural Science, Philadelphia. In the same year Mr. Darwin gave an abstract of a letter, from Dr. Lincecum of America, in the *Proceedings* of the Linnæan Society of London, which made the harvesting habits of this ant (*Myrmica* or *Atta barbata*) widely known. It not only stores seeds of a particular kind of grass-like rice, and called ant-rice, but is stated to maintain a clean crop of this plant on the disk cleared for the purpose in the immediate vicinity of its nest, suffering no weed to grow among it, garnering the crop in the proper season, and further, wondrous to relate, sowing the seed in view of the future harvest.

Recently Dr. McCook, in a most attractive work, replete

¹ See *Agricultural Ant of Texas*, Dr. McCook, p. 56. The following reference is given in a footnote, "'Note on Ants in Texas," *Proceed. Acad. Nat. Sci. Phila.*, 1861, p. 10.'

with startling incidents of ant life, has recorded a detailed account of this ant, which he calls the *Pogonomoyrmex barbatus*. His narrative embraces the habits, the architecture, and the structure of this marvellous harvester. His observations confirm, in a remarkable manner, those of Dr. Lincecum, with one exception, which further observation may yet verify. Dr. Lincecum was fully satisfied that his agricultural ant sowed the seed after preparing the soil to receive it. This he has not yet established, and hence his experience in this respect only amounts to the Scotch verdict, 'Not proven.' The architecture of the formic houses varies. There is what Dr. McCook calls the flat disk, the mound disk, the gravel disk, the cone disk, the mound nest, and the cone nest. The mound disk is located in a black soil. The mound is two and a half feet in diameter, with a depression in the centre in which are two connected gates or entrances. Tall grass grows on the margin near the mouths of some of the roads; of these there were seven plainly marked, like the ridings, we may suppose, in Cirencester Park. The width of the belt, or flat bare space between the mound and the margin, is about that of the mound. The number of disks of this form at Camp Kneass, on the highlands of the Colorado River, was very small. He mentions also a flat disk which had a diameter of ten feet six inches.¹ Some of the disks are larger and some smaller. The surface is quite smooth and free from grass, and at one point in the upper margin of the disk there was a clearing.

Dr. McCook says:² 'I frequently found in the neighbourhood of Austin, large *formicaria* with cleared disks of ten and twelve feet established in the midst of a thicket of wild sage, daisy, and other vigorous weeds, with stalks at times as thick as one's thumb, and standing two or three feet in height. This rank growth, quickened by the fat soil and semi-tropical sun of Texas, is as completely under the

¹ *Agricultural Ant of Texas*, p. 62.

² *Ibid.*, p. 24.

control of the agricultural ants, as are the cleared fields in the midst of American forests under the axe of the pioneer. Not a plant is suffered to intrude upon the formicary bounds, and although often seen, it always was an interesting sight, after pushing through the weeds, to come upon one of these nests, and observe the tall, tough vegetation standing in a well-nigh perfect circle around the circumference of the clearing. The weeds had crowded up as close 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 fear of the little insects, whose energy was continually saying to them, "Hitherto shalt thou go, and no further."

There are two species of seeds in the granaries, one being the ant-rice (*Aristida stricta*), which resembles a grain of oats, and tastes like rice. This grain, according to Lincecum, is sown in time for the autumn rains to bring it up. 'About the 1st of November, at the fall, a green row of the ant-rice, about four inches wide, is seen springing up on the pavement in a circle of fourteen or fifteen feet in circumference. In the vicinity of this circular row, the ants do not permit a single spire of any other grass or weed to remain a day,' until the rice ripens, which occurs in June of next year.¹ 'After the maturing and harvesting of the seed, the dry stubble is cut away and removed from the pavement, which is thus left unencumbered until the ensuing autumn, when the same species of grass, and in the same circle, appears again, and receives the same agricultural care as did the previous crop.' 'There can be no doubt,' says Lincecum, 'of the fact, that this peculiar species of grass is intentionally planted, and in farmer-like manner carefully divested of all other grasses and weeds during the time of growth.' Dr. McCook says,² that 'An examination of the grass-covered nests showed that the *Aristida*' (ant-rice) 'has exclusive

¹ *Agricultural Ant of Texas*, pp. 33, 34.

² *Ibid.*, p. 34.

possession of the surface clearing. This statement rests upon a large number of careful observations, and is made without any qualification whatsoever.' Before McCook confirmed in a great measure Dr. Lincecum's researches, an English naturalist, the late Mr. Moggridge, already referred to, brought to light several species of harvesting ants in the South of Europe. He was an invalid, and spent his leisure hours in the study of natural history, giving great attention to the habits of two ants, the *Aphenogaster* (*Atta*) *structor* and *Aph. barbara*. He found that both these

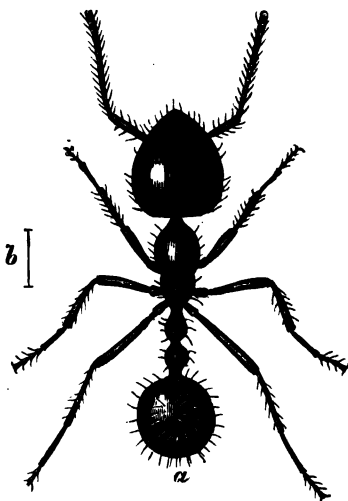


FIG. 17.—a, *Aphenogaster barbara*; b, natural size.

species are true harvesters. He watched them collecting and carrying the seeds of various plants to their homes, and having opened many nests at various periods of the year, he uncovered the numerous granaries which he found filled with the garnered grain. He observed, as I have noticed before, that the ants exercised over the grain a wondrous influence, preventing it from growing. If any of the grains

began to sprout, the ants watched them and cut off the radicle of the sprouted grains. They brought up the grain after rain to the surface of the nest to dry. They not only garnered the grain and malted it, but he clearly proved that they thus harvested it and prepared it for food.

There is, as I have before noticed, an interesting ant in South America, called *Ecodoma cephalotes*, which has been seen by Mr. Bates, the naturalist, plundering baskets containing Mandioca meal (an impure form of tapioca) in Brazil, and this in so wholesale a manner as to threaten the loss of the entire supply. This umbrella ant, a true harvester, is the ant which defoliates trees, and carries circular bits of leaf which it has cut off the orange trees, in long procession to its nest. Mr. Bates thought it used these to thatch its domicile, but Mr. Belt, the naturalist, has since discovered that in Nicaragua it stores the leaves until they decay, and that on the decaying mass a fungus grows which forms food for the ant. 'They are,' Mr. Belt adds, 'in reality mushroom growers and eaters.'¹

The honey ant of Mexico and Colorado, referred to before, is also a harvester. It does not harvest grain, but honey. Some of the workers are used as honey-pots. The workers gather the honey from certain galls,² which exude a sweet secretion during the darkness of the night, and on their return they discharge the secretion which they have gathered into the mouths of those who, as a rule, stay at home. These workers form receptacles for the honeyed store like the waxen cells of the honeycomb. The abdomen swells out into a membranous and diaphanous sphere, which becomes quite globular and shines brilliantly. The stored honey is used in time of need, the members of the community receiving it from the mouths of the rotunds. These

¹ See *The Naturalist in Nicaragua*, by Thomas Belt, F.G.S., 1874, p. 79.

² *The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains*, by Henry C. McCook, D.D., pp. 25, 26.

globular ants cling¹ to the ceiling of a chamber which forms the store-house. When they fall on their backs they cannot as a rule recover their position. When the ants meet with an accident and the honey exudes, the workers lap it up eagerly, but when they die, they snip off the globular abdomen and carry, or rather roll it, to the cemetery, with the other parts of the body. They show their respect for the dead by not devouring the honeyed store.

There are two other harvesting ants in America. One peculiar to Florida,² *Pogonomyrmex crudelis*, and the other³ the occident ant of the great American plains, *Pogonomyrmex occidentalis*. In India there are three more harvesters mentioned by Moggridge.⁴

The question that remains is this. Has any harvester been found in the Holy Land and its neighbourhood, some ancestors of which may have come under the direct observation of Solomon? Dr. Thomson, in *The Land and the Book*, describes⁵ most graphically a species of ant which he had noticed garnering grain. One link is yet wanting to complete our chain of evidence; has it been supplied? Have any recognised species of harvesters been recently discovered in the Holy Land? This important link has been supplied. In the same volume of the *Proceedings of the Linnean Society* which recorded Darwin's abstract of Dr. Lincecum's observations on the agricultural ant of Texas, and closely following upon it, is a paper by Frederick Smith, giving an account of certain new species of ants from the Holy Land, with a synonymic list of others previously

¹ *The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains*, p. 22.

² *Agricultural Ant of Texas*, p. 39.

³ *The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains*, pp. 142, 143.

⁴ *Harvesting Ants*, etc., p. 59, footnote. The names of these Indian harvesters being, *Ecodoma (Atta) diffusa*, *Atta rufa*, and *Pseudomyrma rufa nigra*.

⁵ *The Land and the Book*, by W. M. Thomson, D.D., Lond. 1880, pp. 336, 337.

described.¹ The ants which form the subject of the paper were collected in Syria and Palestine by Dr. J. D. Hooker and Mr. Daniel Hanbury, during a visit of a few weeks to those countries in September and October, 1860. The species, though only ten in number, contain both the *Atta barbara* and *Atta structor*, which Moggridge established as true harvesters about ten years later. In Mr. Smith's collection, now in my possession, among a large number of specimens of *Atta barbara* are several from Jerusalem, which may possibly be descendants of the very ants which the Inspired Naturalist observed, and the manifestation of whose harvesting instinct he has so faithfully chronicled. These harvesters from the Holy City belong to the two forms noticed by Moggridge, and before him by Nylander and Mayr, and are evidently varieties of the same species; the representatives of one being perfectly black, and those of the other having the head and legs bright red, and the thorax a dull red, those of this latter variety from Jerusalem being very beautifully and brilliantly coloured. Many specimens of the allied harvester, *Atta structor*, a smaller ant, is also in my collection, several being from Mount Sinai. One specimen was found in the garden of the Convent of St. Catherine on Mount Sinai, where Tischendorf discovered one of the most ancient manuscripts of the New Testament and Septuagint. Thus, wonderful to relate, on this mount of God wherein in ancient times the law was promulgated, we find in these latter days the word and the works of the Eternal with one accord attesting the Divinity of their great Original. Yes! we have clearly demonstrated, I believe, from the contemplation of God's works as displayed in the wondrous harvesting instinct of the little people that God's word is truth. The little harvesters lift their tiny testimony to that truth, though their voice is not heard, from the old world and the new, from North and South America, from the sunny shores of the Mediterranean,

¹ *Journal of the Proceedings of the Linnean Society for 1861*, part vi.

from the burning plains of India, and from Sinai and Jerusalem, those two sacred spots where the Law and the Gospel respectively were promulgated for the instruction and the enlightenment and salvation of the world ; and as the little harvesters thus are one with the whole creation in raising an unconscious chorus of praise to Him who sitteth upon the throne, may we gladly and intelligently add our songs of thanksgiving to the Author of our being and our bliss !

CHAPTER IX.

The manners and customs of the ants—The members of the royal family—The career of the males—The self-sacrifice of the females—The power of a single female to originate a colony—The labours of the workers—Election of the queen—The loyalty of the ants—Their frolicsome exercises.

LET us now unfold more in detail the ways and doings, the manners and customs, of the British ants. We left the members of the royal family, it will be remembered, dancing joyously in the glorious fields of light. Sometimes the swarms of a whole district have been noticed to unite their countless myriads, and seen at a distance produce an effect resembling the flashing of the Aurora Borealis; sometimes the effect is that of rainbow hues in the spray of laughing waterfalls; sometimes that of fire; sometimes that of smoke-wreath. The males are short-lived, some dying a natural death, a few only living through the winter, and others, together with many of the females, being devoured by birds and fishes when they fall upon the water, and by spiders when they get entangled in their webs.

This was the fate of hundreds of the males of the *Formica umbrata* (*Lasius umbratus*) in the year 1876, a species generally distinguished from the common yellow by its pubescent legs and antennæ, the larger head of the female, and the smoky wings of the males. The extensive colony established against my Vicarage produces every year many thousands of males. These are carefully guarded

and marshalled by the workers, and, it appears, are not allowed to leave the common home without their permission ; but when once it is secured they swarm over the ground and upwards into the sunbeams. In 1876 they were interrupted in their upward flight by the many webs spread over the jessamine and cotoneaster upon the house. The nets were crowded with the little people, and the spiders kept high festival.

Let us now watch the marvellous career of those winged females who escape the keen glance of active enemies, or survive the fatal effects of unpropitious weather. They commence the business of their unselfish lives by doing all the work that is usually done by the common labourers ; and, in order to live for others more effectually, they strip themselves of their wings, and so cut off all inducement to sport gaily in the sun-bathed air, to the neglect of their numerous offspring. Such an extraordinary instance of self-sacrifice I witnessed when at Bournemouth. A female of *Formica nigra* (*Lasius niger*), the common garden ant, I found deprived of three of her wings. I persevered in watching her every movement, and was agreeably astonished to see her deliberately snap off the remaining wing. I thus confirmed the testimony of M. P. Hüber, as given in his own words. 'I took,' says he, 'some earth and strewed it lightly over the table, and then covered it with a bell-glass. I induced a female to go under the glass by presenting to her a fragment of straw, on which she mounted, and upon this I conveyed her to her new habitation. Scarcely did she perceive the earth which covered the bottom of her abode, than she extended her wings with some effort, bringing them before her head, crossing them in every direction, throwing them from side to side, and producing so many singular contortions, that her four wings fell off at the same moment in my presence. After this change she reposed, bruised her corselet with her feet, then traversed the ground, evidently appearing to seek a place of shelter.

She partook of the honey I gave her, and at last found a hiding-place under some loose earth which formed a little natural grotto. On several females of different species I repeated,' he said, 'the like experiment, and always obtained the same result.'¹

It has been doubted by some whether a single female has the power of originating or founding a colony. Forel and Ebrard, judging from their failure in inducing a single female to do so, concluded that she never could bring her young to maturity. Hüber made experiments on several females, placing them in a vessel full of earth, 'with which they constructed,' he says, 'lodges where they resided, some singly, others in common. They laid their eggs, and took great care of them; and notwithstanding the inconvenience of not being able to vary the temperature of their habitation, they reared some, which became larvæ of a tolerable size, but which soon perished from the effect of my own negligence.'

In connection with this debatable point in the history of the ant's economy I mention a very interesting circumstance that occurred to me at Lulworth, in 1881, which I think clearly proves that the female *has* the power of assuming the functions of a worker, and unaided initiating a colony. I discovered under a stone a very small community indeed. The scene disclosed surprised and delighted me. There was a single apterous female of *Formica aliena* (*Lasius alienus*) in association with three or four pupæ inclosed in cocoons, which, judging from their very small size, must have been those of the small worker. How did this isolated queen act? She did not try to escape and hide herself when the light of day flashed in upon her, and while seeking a safe asylum for herself leave the cradled young to their fate. She acted the part of a true mother and tender nurse by gently seizing one of

¹ Hüber's *History of Ants*, translated by J. R. Johnson, M.D., F.R.S., etc., pp. 114, 115, 117, 121.

the delicate pupæ in her mandibles, and slowly and gracefully raised it from the ground, looking hither and thither for some advantageous retreat.

Sir John Lubbock has shown that females are capable of doing in captivity what I have thus verified is done by them in a state of nature, though he has gone further in his observation, and witnessed not only the development of the larvæ from the eggs beneath the nursing influence of the isolated female, as was the case in the experience of Hüber, and that also of the pupæ, as in the instance I have detailed at Lulworth, but he has witnessed also the pupæ arrive at maturity under the fostering care of an isolated queen. His testimony is so valuable that I have pleasure in quoting it in detail. He thus gives the record of his experience :—

‘The following observation shows that, at any rate in some cases, isolated queen ants are capable of giving origin to a new community. On August 14, 1876, I isolated two pairs of *Myrmica ruginodis*, which I found lying in my garden. I placed them with damp earth, food, and water, and they continued perfectly healthy through the winter. In April one of the males died, and the second in the middle of May. The first eggs were laid between April 12 and 13. They began to hatch the first week in June, and the first larva turned into a chrysalis on the 27th; a second on the 30th; a third on July 1, when there were also seven larvæ and two eggs. On the 8th there was another egg. On July 8 a fourth larva had turned into a pupa. On July 11 I found there were six eggs, and on the 14th about ten. On the 15th one of the pupæ began to turn brown, and the eggs were about fifteen in number. On the 16th a second pupa began to turn brown. On the 21st a fifth larva had turned into a pupa, and there were about twenty eggs. On July 22 the first worker emerged, and a sixth larva had changed. On the 25th I observed the young worker carrying the larvæ about when I looked

into the nest ; a second worker was coming out ; on July 28 a third worker emerged, and a fourth on August 5. The eggs appeared to be less numerous, and some had probably been devoured. This experiment shows that the queens of *Myrmica ruginodis* have the instinct of bringing up larvæ and the power of founding communities. The workers remained about six weeks in the egg, a month in the state of larvæ, and twenty-five to twenty-seven days as pupæ.¹

Though it is therefore evident that females in case of necessity are enabled unassisted to construct their habitations, and to educate their family, yet, as a general rule, while they introduce their young into the colony, the workers build, and nurse, and give them, as we shall see, a liberal education.

And now it must be noticed that all the females do not quit the old home to seek their fortune amid newer scenes, since it is necessary that some should linger to keep up the population. All being naturally anxious to try their glittering wings before their early widowhood, and oftentimes lifelong imprisonment, means are adopted by the workers to detain them against their will, and crown them queens by force, and yet with the diadem of a fond attachment. And how ? They strip them of their wings, and thus keep them royal prisoners. Hüber, while watching an emmet's residence, observed the greater number of females quit the nest, never to return. 'One,' however, he says,² 'was about to take flight, when the labourers retained her by her feet, kept her down by main force, tore off her wings, and conducted her back to her' native home, 'where they obstinately guarded her.' Others he noticed mutilated and imprisoned in like manner.

The workers, knowing full well that the very existence of their colony depends upon the presence among them

¹ See *Ants, Bees, and Wasps*, pp. 32, 33.

² Hüber's *Ants*, p. 129.

of a sufficient number of queens, guard them when mutilated with the greatest assiduity, nourish them with the most wakeful care, conduct them to those quarters of their domicile of most genial temperature, do not allow them to refresh themselves with summer gales, and—abandon them, no, not for an hour. When the queen gives birth to a numerous progeny, in the form of tiny eggs, the desire of quitting her abode being gone, she no longer is placed under restraint, yet still has a constant guard, who

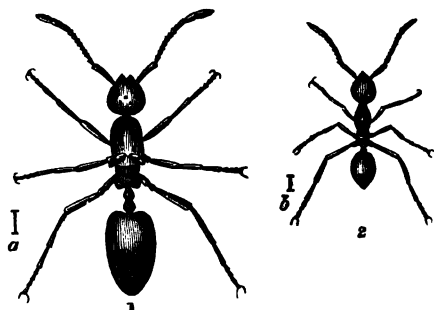


FIG. 18.—*Myrmica domestica* (*Diplorhoptum domesticum*).
1. Queen (apterous female). *a*, natural size. 2. One of her subjects. *b*, natural size.

watch her every movement, anticipate her every want, and provide with admirable foresight and over-anxious care her daily—nay, hourly—necessities. A sentinel¹ is placed near the body of the queen, to carry off the little eggs as soon as laid. As soon as one leaves her presence with its precious burden another takes its place to watch her. A retinue attends her of from three to fifteen in number, sometimes even more, whose duties in offering her refreshments and accompanying her through the difficult passages are not only faithfully discharged, but whose affection is unceasingly manifested as they caress her with their antennæ. In the baker's shop in the Kennington Road, I observed the queen taking a morning walk in her home park, which

¹ Hüber's *History of Ants*, translated by Johnson, p. 132.

consisted in the whitewashed wall, and she was attended by a body-guard of about a dozen of her loyal subjects. In the dripping-pan at Stanhope Place, which I found swarming with the same species, I was able to detect the presence of the queen by the crowd of tiny workers who completely surrounded her ; and so assiduous were they in their attention, and so devoted in their loyalty, that they covered her with their bodies, and thus shrouded her from the vulgar gaze, while at the same time always indicating her existence by their clustering numbers.

In 1878 I received a colony of the minute rare ant *Myrmica unifasciata*. It consisted of a queen, the royal children, and many of her faithful subjects. They reached me alive, so that for many days I carefully watched their movements. I was able to witness the loyalty of the little people for their beloved sovereign. It was very marked. They attended her in her perambulations, they formed round her when she rested ; some showed their regard for her by gently walking over her, others by patiently watching by her and cherishing her with their antennæ, and in every way endeavouring to testify to their affectionate attachment and generous submission. It has been noticed¹ that 'in whatever apartment a queen condescends to be present, she commands obedience and respect, and that a universal gladness spreads itself through the whole cell, which is expressed by particular acts of joy and exultation.'

'They have a peculiar way of skipping, leaping, and standing up on their hind legs and prancing with the others. These frolics they make use of both to congratulate each other when they meet, and to show their regard for the queen.' I have observed them also in the case of the *Formica umbrata* (*Lasius umbratus*) thus gambolling together when guarding the youthful princes at the entrance of their palaces, while welcoming their presence, and, at the same

¹ See *An Account of English Ants*, by the Rev. Wm. Gould, A.M., p. 24.

time, methodically repressing their enthusiasm and natural longing for independence. These frolicsome exercises I have witnessed in the case of the *Formica aliena* (*Lasius alienus*), when the sun has shed its gladsome rays suddenly upon them through the glass sides of one of my artificial *formicaria*, or formic crystal palaces. I have been also delighted to witness them in the case of the *Formica flava* (*Lasius flavus*), when, having placed a *formicarium* which inclosed this common yellow species near the fire, and the welcome heat caused the little people to swarm in the passages and testify their gladness at the suddenly increased temperature, they seemed hardly to be able to contain themselves for joy. They embraced each other, and skipped and danced like playful lambs or kittens.

CHAPTER X.

The affection of the ants for their young—Their earlier life-history—The eggs—The larvæ—Instance of the care of the workers for the larvæ—How they keep them at a suitable temperature—The workers enjoy the sunshine—How the larvæ are fed and cleansed—The little weavers—The multiplied labours of the workers—How the foster-mothers guard the inclosed pupæ, and extricate the young ants from the cocoons—The workers conduct their education—The solicitude of the workers for the males—No pupæ in winter time—The pupæ of ants with stings not inclosed in cocoons.

ANTS, in addition to the loyalty and the love they have for their queen, show affection for the youthful charges delivered over to their nursing care by their gracious sovereign. The queen is ever encircled by devoted adherents and attendants, and among these are some who take charge of the tiny eggs as soon as they are deposited, and hasten with them to the nurseries. These eggs are very small, whitish, semi-transparent, and of an oval form; and as they reach maturity they increase in size and become slightly kidney-shaped, indicating the form of the coming larva. They are so minute that the nurses could not safely transmit them in their mandibles to their place of shelter; we find, therefore, that they are glutinous, and adhere together, and can thus in little clusters be carried in perfect security in the loving arms of their foster-mothers.

Certain chambers in the subterranean domiciles are set apart as nurseries, which are crowded with numerous little inmates in the form of ringed footless grubs, attenuated

and curved towards the head, of a dull white, often clouded with grey. Examined through a microscope, these grubs, which are without feet and composed of about twelve rings, are found to be hairy and have little mouths, at each side of which are yellowish-brown hooklets, like tiny jaws, yet so far apart as to be of little or no service to them. They may possibly be the embryo of the future mandibles; for

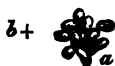


FIG. 19.

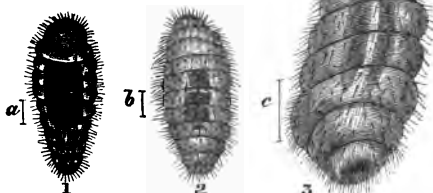


FIG. 20.

FIG. 19.—*a*, Cluster of eggs. *b*, natural size.
FIG. 20.—Larvæ of ant. 1, front view of larva; 2, back view of larva; 3, larva of female in hungry attitude. *a*, *b*, *c*, natural size.

these grubs form the second stage in the life-history of the ants, and come from the eggs before mentioned, which is the first stage of their early existence.

When disturbed or alarmed, the nurses seize their tender charge in their mandibles and hurry off with them as fast as their little legs can carry them. They strive to shelter them from danger when exposed, by grasping them in a tender embrace, which interesting incident, seen whenever an ant's nest is disturbed, is plain proof of their care and love for them.

It is a noteworthy circumstance in the history of the yellow species, *F. flava* (*L. flavus*), that the last autumn brood is arrested in its growth and hibernates, and that

those larvæ which are able to survive the winter months are more densely clothed with hair, besides being provided with nurseries as far removed as possible from the outer variable temperature, being transported thither by their careful guardians. I have discovered that the larvæ of the red *Myrmica lævinodis* also hybernate. I have seen many larvæ in the centre of a cluster of the workers of this species dug up many inches below the surface of the soil in the winter time. This interesting fact in its life-history has hitherto been unrecorded.

In one of my *formicaria* I have observed a marvellous instance of the care of the workers for the larvæ. There was a piece of earth lying on a helpless grub; one or two workers showed the greatest anxiety to emancipate their imprisoned charge; one gently pulled the larva with its mandibles, and the other removed the earth bit by bit, joined now and then by another, who gave friendly assistance at intervals. They rested not until the rescue was effected, and then one took one end and the other the opposite end of the larva, and only for a moment hesitated as to the course to adopt, when one unselfishly resigned to the other worker the privilege of conveying the object of their interest to a subterranean place of safety.

To keep them always at a suitable temperature during the warmer months, the careful nurses carry the grubs after the sun is risen, and has shed its radiance on their domicile, to the chambers near the surface of their nest, to nourish them by the sun's warmth; and every evening they carry them back to a lower story, to protect them from the dews and colds of night. I have oftentimes watched them act thus through the glass sides of my *formicaria*, while regulating their marvellous movements by artificial light and heat. I have also observed the workers bring up clusters of the tiny eggs into chambers subjected to the warmth of the morning sun, and remove them in the afternoon, when the pleasant sunbeams have ceased to

play upon the sides or surface of their habitation. Frequently I have watched such a marked instance of intelligence in the colony of *Formica sanguinea* in the glass vessel in my study window.

The workers themselves thoroughly enjoy the sunshine, for the chambers on which the sun is shining are crowded with workers, even when no eggs are visible. It is the same with other species, as when, in the instance before recorded, I suddenly introduced a gleam of sunlight into a chamber of another *formicarium* in my study, which served as the winter quarters of *F. aliena* (*L. alienus*), and the clustering workers began to move, and, seemingly, dance for joy, under the vivifying influence of the sunbeam.

The *F. aliena* (*L. alienus*) is closely allied to *F. nigra* (*L. niger*), the common garden ant, though not nearly so frequently met with. I have, however, found it not only at Bournemouth, a recognized habitat, but most extensive colonies in Suffolk, especially at Lowestoft, and in profusion under the stones scattered over the warren at Minehead. The colony I have in my possession I met with under a stone at Stinchcombe Hill, one of the highest points of the Cotswolds, which is another new locality for this species. I have also discovered it in strong force on the top of one of the walls of Conway Castle. The workers may be distinguished from the common *nigra* by the scape of the antennæ and the legs being more pubescent. The males and females have been hitherto difficult to separate, in consequence of the pubescence varying in its denseness; but I some time ago discovered a distinguishing characteristic for the female of *aliena*, and accepted as such by Mr. Smith. I found it to possess a tinted costal area (one of the cells into which the wing is divided), while the costal area of *nigra* is colourless, since which I have noticed that the male of *aliena* has also a tinted costal area, though of a different colour, being smoky and very pale; whereas that of the female is yellow.

When hungry, how are the helpless larvæ to obtain the needful sustenance? They stretch the anterior part of their bodies, open wide their tiny mouths, and seek from their nurses the food without which they could not live. The tender nurses administer the welcome aliment through their own mouths. The regimen, it has been presumed, is proportioned to their growth, and the females are fed with greater liberality. With the exception of the winter months the young require feeding several times a day; and when we remember that in well-stocked nests there are many thousand mouths craving food at stated intervals, we are able to form some idea of the work, and shall not wonder at the ceaseless activity of the self-denying labourers. Then, to keep the babies clean, the faithful nurses pass over them their mandibles and their tongues, rendering them by this means as white as milk.

When the infants have reached their full proportions they try their hands, or rather their mouths, at weaving, and fall asleep in silken coverlids of their own design and making. And now, is the care and labour of the nurses at an end? By no means; for, food excepted, these pupæ, or cocoons, as they are called, and which are the third stage in the little people's life, require as much attention as the larvæ or grubs. They need to be carried from the bottom of the nest, and thence again every morning and evening; and who are able to perform this arduous task but the loving nurses? who, strange to say, regulate their proceedings by the sun, removing their little charges, as is their wont, according to his rising and setting. I have oftentimes induced them to act in a similarly methodical manner in the night season by causing the light of a candle to fall upon the transparent side of a *formicarium* and withdrawing it after a stated interval.

Their labours are, of course, considerably increased when their home is thrown into confusion by the unhappy tread of a passing animal, or when the nurseries are flooded by

an unusually heavy shower, their duty being to gather together the helpless young and shelter them, or carry them down into safer and drier apartments; to repair the breach in their castle walls, to reconstruct its ruined chambers, and clear away the crumbling masonry from the numerous avenues and corridors, and rescue their companions who may have suffered from the untoward accident. By breaking down a part of the masonry, and flooding the upper nurseries in an artificial *formicarium*, I have witnessed the intelligence, the sympathy, and unwearied diligence of the workers in active exercise. The rapidity with which they remove their infant charges from the crowded nurseries to a place of safe retreat, and reconstruct their desolated home, is something marvellous to witness.

Then, again, how tenderly the indefatigable foster-mothers watch the silken envelopes inclosing the voluntary prisoners! They listen ceaselessly as they mount guard to catch the first feeble stir of returning consciousness. As soon as they detect the helpless effort of the prisoner to escape, knowing by unerring instinct that, unaided, it cannot, three or four, with admirable care and skill, stand upon the cocoon, and begin to open it where they know the head is situated. This, strange to say, is always at the end opposite to that which is marked by a little black bead-like protuberance. With their mandibles they cut the many silken threads of which the envelope is fabricated, until a hole is made large enough to enable the inmate of the prison to escape. Even then it cannot move without the assistance of the careful workers, since it is inclosed in a second covering, or pellicle, which has to be removed. With the utmost gentleness, they help to extricate it from its trammels, and with loving touch they smooth the wings of those who happily possess them, and, according to Hüber,¹ after liberating and afterwards feeding the new-born insects, they still, for several days, watch and follow

¹ Hüber's *History of Ants*, pp. 96 and 98.

them everywhere, teaching them to unravel the paths and winding labyrinths of the common habitation; and when the males and females again take flight, these affectionate stepmothers accompany them to the summit of the highest heaps, showing the most tender solicitude for them (some

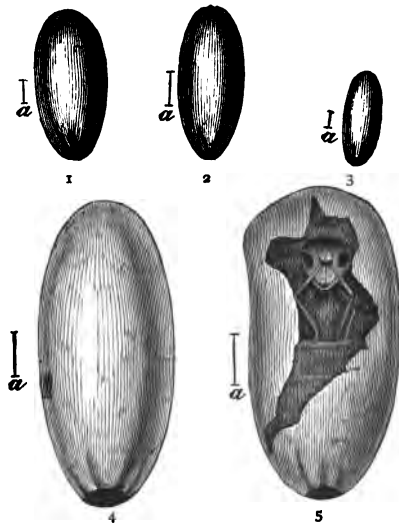


FIG. 21.—Cocoons of *Formica flava* (*Lasius flavus*). 1, male; 2, large worker; 3, small worker; 4, female; 5, cocoon of female, open, to show pupa *in situ*; *a*, natural size.

even endeavour to retain them), feeding them for the last time; and at length, when they rise and disappear, seeming to linger for some seconds over the footsteps of these favoured beings, of whom they have taken such exemplary care, and whom they will never behold again.

I have often been an interested spectator of the tender solicitude of yellow workers of the *umbrata* for the black males. In my artificial *formicarium* I have seen them give them food from their own mouths, and follow them as they mount the crystal walls. And the numerous entrances of the natural *formicarium* in my front flower-border I have

often seen crowded with males; each cluster being constantly guarded by a cordon of workers, the contrast between the yellow workers and the black males being singularly beautiful. When one or more of the princes have managed to break through the ranks, the sentinels have followed them and brought them back. And when by mutual consent the males have ventured to take a constitutional, the workers have always followed them and kept them in view, and in due time directed their steps homeward, and ceased not to guard them until they were again safe and sound within the domestic circle.

Anderson¹ tells us, in his *Recreations in Agriculture*, that the Russian shepherds ingeniously avail themselves of the attachment of ants to their young for obtaining with little trouble a collection of the pupæ, which they sell as dainty food for nightingales. They scatter an ant's nest upon a dry plot of ground, surrounded with a shallow trench of water, and place on one side of it a few fir branches. Under these the ants, having no other alternative, carefully arrange all their pupæ, and in an hour or two the shepherd finds a large heap clean and ready for market. The inclosed pupæ are those small white or pale yellow objects of oval form and varying size, according to the sex of the future ant, which any one may notice in an ant's nest when disturbed, for then the nurses seize them in their mandibles and run about with them over the crumbled ruins of their houses, seeking a safe retreat. They are by the uninitiated called 'ants' eggs,' and are collected in Germany as in Russia, with the kind assistance of the nurses, and sold as fattening food for birds. In the season they may be purchased in London shops as a delicacy for youthful pheasants and partridges. For this purpose ants' nests are considered as valuable property by gamekeepers. I have

¹ See Kirby and Spence's *Introduction to Entomology*, 1815, vol. i. p. 361, footnote, containing reference to Anderson's *Recreations in Agriculture*, etc., iv. 158.

been told by a gamekeeper in Stonehouse that he has often fed his master's game with the eggs, as he calls the inclosed pupæ of the yellow ant. The ants themselves are greedily devoured, but the red species are avoided; these latter would, he says, sting his birds to death. The yellow, and those other species which spin cocoons, have, you will remember, no stings.

In the winter season you may inquire in vain for pupæ in the bird-fanciers' shops in the neighbourhood of the Seven Dials, since at this time of the year they cannot be obtained from the nurseries of the ants. The growth of the



FIG. 22.—Pupa of *Myrmica lœvinodis*, with pellicle partially removed.
a, natural size.



FIG. 23.—Front view of pupa of *Myrmica ruginodis* (female) in pellicle.
b, natural size.

larvæ of the autumn brood is always arrested before the cold weather sets in, since the pupæ are too delicate to outlive a severe temperature. I have never found any pupæ in these yellow ants' nests I have carefully examined during winter, but I have noticed the nurseries crowded with small larvæ with their winter clothing. In the case also of *Myrmica lœvinodis*, I have found no naked pupæ, but only larvæ in the winter-time.

A beautiful illustration have we in this incident in the economy of the little people of the inspired assurance that God's tender mercies are over all His works.

Those ants which have stings and do not spin cocoons

are covered with a thin membranous envelope, which is common also to those pupæ which are robed in silk, from which they cannot extricate themselves without the kind assistance of the nurses. These naked pupæ are sometimes spotless white, sometimes yellow, sometimes light brown, and sometimes nearly black, according to the sex and age, assuming, doubtless, the colour of the perfect insect the nearer it reaches the period of liberation from its bonds. The pellicle fits the pupæ like a glove, so closely that every part of the future ant is distinctly indicated, viz. the antennæ, thorax, peduncle with its nodes, abdomen, legs, and undeveloped wings, predicting unhesitatingly the sexes. In the year 1879 I obtained pupæ of the rare *M. lobicornis*, and I could identify the species from its distinguished characteristic, the little horn on the scape of the antennæ, being seen by reason of its delicate and closely-fitting vesture.

CHAPTER XI.

The ants at their toilet—Funeral rites—A funeral procession in Australia—Startling phenomena in the author's *formicarium*—Formic cemeteries—Habits of *F. umbrata* (*L. umbratus*)—Burial customs—Ants' affection for the living greater than their respect for the dead.

THE little people are most cleanly in their habits. They not only are indefatigable in their efforts to free the younger members of their community from all impurities, but are most careful as to their own personal toilet, and may be frequently observed cleaning themselves most assiduously with leg, tongue, and mandible. The workers of the *M. unifasciata* I have had a good opportunity of watching. I have seen them leaning on one side while resting on two legs and rubbing the other four together, and again passing the right fore-leg over the left antenna after drawing it through its mouth, like a cat in the act of cleaning itself with its paw. These quaint little beings often amuse themselves by sitting upright, their two hind-legs resting on the ground, and their abdomen between them and at right-angles with the erect thorax and head, their fore-leg in the air, and their antennæ waving to and fro. Another I have seen standing on the tip of the abdomen, being supported by the toe-claws of the hind-legs.

Ants are very particular about their houses, and keep their many apartments, halls, and corridors neat and tidy. When any of their companions die they immediately remove

the dead bodies with their mandibles, and carry them into the open air. Gould mentions¹ that as soon as a member of the fraternity dies, 'it is carried out of the settlement, and thrown upon the ground without ceremony or rites of a funeral;' but he adds, 'Pliny² informs us that the ants of his country are wont to bury their dead, which is a curiosity not imitated by ours in England.' The observant Roman naturalist, who lived in the first century, and completed his great work on Natural History the year before he perished in the eruption of Vesuvius, which destroyed Herculaneum and Pompeii, was not far wrong, as may be fairly judged from what I am able to narrate about the marvellous habits of the closely allied species, *F. flava* (*L. flavus*) and *F. umbrata* (*L. umbratus*). I will be the more explicit, since they have not, as far as I can learn, been before noticed by any other observer. Before, however, I give the result of my own observation, I will mention an astonishing account of the intelligence of an Australian ant, without which our chronicle of the funeral rites of the little people would not be complete.

In the *Proceedings of the Linnean Society* for 1861 is a communication from a Mrs. Hatton, of Sydney (I quote now from a manuscript of the late Mr. F. Smith, which he most generously placed at my disposal), in which are details of a most remarkable character attributed to an ant, there called the soldier ant. The communication is in substance as follows:—

'One day a little boy of mine, about four years old, being tired of play, threw himself down on a grassy mound to rest. Shortly after I was startled by a sudden scream. My instant thought was that some serpent had stung him. I flew in horror to the child, but was at once reassured on seeing him covered with soldier ants, on whose nest he had laid himself

¹ *An Account of English Ants*, by the Rev. Wm. Gould, A.M., p. 17.

² Pliny, *Nat. Hist.* lib., ii. cap. 29.

down. Numbers of the ants were still clinging to him with their forceps, and continued to sting the boy. My maid at once assisted me in killing them. At length, about twenty were thrown dead on the ground. We then carried the boy indoors. In about half an hour afterwards I returned to the same spot, when I saw a large number of ants surrounding the dead ones. I determined to watch their proceedings closely, and followed four or five that started off from the rest towards a hillock a short distance off, in which was an ants' nest. This they entered, and in about five minutes they reappeared, followed by others. All fell into rank, walking regularly and slowly two by two, until they arrived at the spot where lay the dead bodies of the soldier ants. In a few minutes two of the ants advanced and took up the dead body of one of their comrades; then two others, and so on, until all were ready to march. First walked two ants bearing a body, then two without a burden; then two others with another dead ant, and so on, until the line was extended to about forty pairs, and the procession now moved slowly onwards, followed by an irregular body of about two hundred ants. Occasionally the two laden ants stopped, and, laying down the dead ant, it was taken up by the two walking unburdened behind them, and thus, by occasionally relieving each other, they arrived at a sandy spot near the sea. The body of ants now commenced digging with their jaws a number of holes in the ground, into each of which a dead ant was laid, where they now laboured on until they had filled up the ants' graves. This did not quite finish the remarkable circumstances attending this funeral of the ants. Some six or seven of the ants had attempted to run off without performing their share of the task of digging; these were caught and brought back, when they were at once attacked by the body of ants and killed upon the spot. A single grave was quickly dug, and they were all dropped into it.' 'Now,' says Mr. Smith, 'allowing something for the lady's imagination, there can be no doubt

of the fact of ants having buried ants. The lady is well known to connections of the members of the Linnæan Society, and we may feel assured that unless perfect confidence was felt in the party communicating this wonderful account, the paper would not have been read before the Linnæan Society.' I do not find it difficult to credit this extraordinary narrative after what I myself have witnessed.

On March 1, 1886, I established a *formicarium* by transferring a portion of a nest of *F. flava* (*L. flavus*) to a glass receptacle. On the 2nd, the ants had thrown up masonry work and constructed chambers and passages, varying from one inch to two inches between the turf and the glass. Several dead ants had been brought up from the interior of the nest and placed on the surface. One ant I observed walking with only half its body. What an instance we have here of the continuance of vitality after serious mutilation! On March 3, two ants were moving without their abdomen, one bearing a larva on its mandibles. What an evidence of the power as well as the vitality, the strong affection for their infant charge, and also the immunity from acute sensations enjoyed by these little creatures! The possibility of the phenomenon arises from the arrangement of the nervous system, which, instead of being concentrated, as in the higher order of animals, in the brain and spinal cord, is distributed with ants and other insects in the form of ganglia, or nervous knots, with connecting nervous filaments. Each ganglion forms a centre of life and motion, so that if the body of an insect is severed between the ganglia, the separate portions have for a season power to move and act as if possessed of independent life. I have watched for many hours a fly without a head cleaning its wings as if perfectly unconcerned at its abnormal condition.

To return. I noticed that the number of the dead upon the surface of the nest on March 3 had increased. On

March 4 I found more than two hundred dead bodies lying against the glass, and ants here and there were carrying the corpses of their companions as well as the bodies of their living charges, the masonry now reaching from the turf to the glass from one inch to two and a half inches in breadth, and against the glass from one and a half to two and a half inches in height.

On March 6 the number of dead further increased, and



FIG. 24.— C_1 , C_2 , C_3 , card-trays used as cemeteries by *F. flava* (*L. flavus*) in one of the author's *formicaria*; N_1 , N_2 , N_3 , N_4 , chambers containing pupæ.

the ants were more active in carrying them. I now placed three card-trays with honey for food. Instead of using them as hospitable and festive boards, from whence they might satisfy their hunger, they converted them into *cemeteries*. About a quarter of an hour afterwards in each of two of the trays there was one dead ant. About one hour after this in

one tray there was *one* dead ; in the second, *three* dead ; and in the third, *six*. While I was watching, an ant brought a corpse and placed it tenderly in the third tray, and so increased the number there to *seven*. It was 2 p.m. when I first placed the trays, and at

4 p.m. in I. there were 2 dead.

" " II. " " 4 "

" " III. " " 9 "

At 10.30 in I. " " between 40 and 50.

" " II. " " " 50 " 60.

" " III. " " " 60 " 70.

Several of the little sextons I observed with dead in their mandibles, and one in the act of burying a corpse.

March 7.—In each tray I noticed between seventy and eighty.

March 8.—At 1.45 in I. there were about 140.

" " II. " " 180.

" " III. " " 180.

At 2.30 I placed two more trays on the surface of the nest, and without honey, on opposite sides of the *formicarium*.

At 8.15 in one of these previously empty trays I found nine dead bodies. Two were deposited while I was watching, and so the number was increased to eleven. In the other tray there were ten, two being deposited while I was observing, and thus the number in the second tray reached twelve. The dead were not interred without considerable difficulty, in consequence of the sides of the trays being almost perpendicular. The work of the sextons continued until no dead bodies remained upon the surface of the nest, but all were interred in the extramural cemeteries. Afterwards I removed the trays, and turned the contents of the *formicarium* upside down, and then I placed six trays on the surface of the earth, two of which I filled with sugar for food. All six were used freely as cemeteries, being crowded with the corpses of the little

people and their young, the larvæ which had perished in the disruption of their home.

I have noticed in one of my *formicaria* a subterranean cemetery, where I have seen some ants burying their dead by placing earth above them. One ant was evidently much affected, and tried to exhume the bodies, but the united exertions of the yellow sextons were more than sufficient to neutralise the effort of the disconsolate mourner. The cemetery was now converted into a large vault, the chamber where the dead were placed, together with the passage which led to it, being completely covered in.

The allied species, *F. umbrata* (*L. umbratus*), does not, as a rule, use the trays as cemeteries; only one or two dead, and the wings of the males in the swarming season, every now and then I found therein; but the workers utilised them to stow away their waste building material, and I have seen them completely filled with earth. A partial exception I have noticed to this rule.

On August 30, 1879, I established a *formicarium* by filling a glass vessel more than half full of a portion of a marvellous nest of the *umbrata*. Instead of earth, the ant had used comminuted wood like sawdust, of a rich brown colour, to fashion its innumerable apartments and their intricate communications. I soon observed the desolate and disarranged portion of the nest reconstructed through the crystal wall of their new domicile, the brown dust being before long consolidated and modelled into well-formed nurseries and withdrawing-rooms. The nurseries were at the bottom of the nest, which, by September 5, could be seen, by raising aloft the glass vessel, to be about twelve in number, and occupying about one-sixth of the entire ground-floor, and crowded with thousands of larvæ. Masonry work was being rapidly raised on the surface more than an inch in height, which, on September 6, touched the muslin with which the glass was covered: but the little builders, nothing daunted, cut the threads of the muslin with their

mandibles, and made holes in several places, which gave them power of egress and ingress, of which they availed themselves, using the string which bound the muslin as a ladder, and reaching thus the stand which formed the base of their palace. At 8.50 there were as many as two hundred or more on the stand, about twenty on the muslin, through a hole in which one went in and another came out. At 11.30 p.m. there were nearly a hundred on the muslin, several hundred on the stand, and the strings were covered with them. When I lifted up the muslin on September 7, I found the surface of the nest covered with hillocks, or turrets, three inches or more in height.

The sugar placed on the surface for sustenance of the little people was hidden from view. Numbers of ants were in the encircling trench, which I had arranged to keep the little people from roaming, evidently cast there by active members of the community, for they were all dead; and several parts of ants and two larvæ I noticed also in the water. One ant I watched on the stand with a corpse in its mandibles go to the edge of the trench and return without its burden. I placed sugar on the surface near glass at 10.45; cleared the trench of floating ants, of which there were immense numbers, at 12.15. There were about thirty dead bodies on the sugar, and other dead bodies were sparsely scattered over the surface. In one spot there were about sixty or more deposited by the unwearied sextons, one of whom I noticed with a corpse in its mandibles. At 1.35 I observed two ants with dead, and I now placed a paper tray between two turrets, nearly in the centre of the surface. At 2.25 there were three dead in the tray, and one or two grains of comminuted wood. At 4.10 there were four dead in the tray, and several grains of wood and one larva. At 10.45 p.m. there was one moving mass of ants upon the surface, about half of the bottom of the tray was covered with pieces of wood, and in the tray only one

or two were dead. I noticed a sexton take a dead ant out of the tray, and place it in a cavity by the tray, and disappear under the tray. Then came a second sexton with a dead body in its mandibles, and moved into the tray and then out of the tray with its burden, which it also carried into the cavity. A third I noticed remove a dead body out of the tray, and a fourth carried a corpse down the cavity. A few dead were lying on the surface of the nest, where numbers were seen earlier in the day. Over the sugar by the glass there were numbers of dead. This seemed to be now recognised as the cemetery. Very little sugar was seen, comminuted wood and dead covered it. No dead were now scattered over the surface; several ants were seen carrying dead. There were very few floating in the trench. There was a difficulty now in reaching it, since the muslin with its strings, which formed the scaling-ladders of the little people, had been removed.

September 8.—2.53. I noticed between forty and fifty dead in the middle of the tray, a thin layer of wood covering the tray. In the cemetery near glass about same number of dead. One ant placed a dead body within its precinct.

September 10.—10.15. The tray was nearly covered with wood. Seventy or eighty dead were in the tray on wood. In the tray, about as many on the shady slope of neighbouring hillock, and about a dozen in depression near glass.

I kept another *formicarium* of *umbrata*, having taken a portion of the nest in my front border. When the males were in strong force I placed them in a confectioner's glass vase, with a screen of brown paper, to shade them from the light and induce them to work against the glass. A card-tray they soon filled with earth; and as the males died they were buried in depressions in the soil, in the upper chambers against the glass, on the shady side of the *formicarium*.

A most interesting incident came under my notice here.

The little sextons utilised the earth-laden card-tray for the burial of some of their dead by carrying the corpses into the cavity formed beneath the tray, the tray forming the slab of, to them, an extensive vault.

From all that I have witnessed and now narrated, surely we may safely affirm that, in their due regard for health and cleanliness, and especially in the disposal of their dead, and in their varied funeral rites, the little people show their wisdom. However, their affection for the living is greater than their respect for the dead. One mourner I observed some time back in another *formicarium* bearing off a corpse to burial; it let down its burden that it might rest a while, when, looking round, it espied a larva lying helplessly upon the ground. It immediately forsook the dead body of its comrade, to be interred later by itself or another worker, and clasped fondly the tender youngster in its mandibles, and carried it doubtless to the nursery; but I had not time to note the track the foster-mother took.

CHAPTER XII.

Ants live happily together—Instance of unselfish devotion and disinterested kindness witnessed by the author—Exhuming buried companions—Concerted action—Joy at meeting after separation—A recognition after four months' absence recorded by Hüber—The author's observation of a recognition after a separation of one year and nearly three months—Successful experiments with members of a colony of *F. sanguinea*—Sir J. Lubbock's observations—Ants recognised by members of the colony when removed as pupæ—Intoxicated and chloroformed ants recognised by their friends.

I HAVE noticed how happily the members of the same community seem to live together. Harmony reigns everywhere supreme. The little people ever help each other when in need or difficulty. When one is hungry, another feeds it. When one is sickly, another ministers unto it. The smaller workers of not so stout a build or robust a habit as others are borne along in the loving grasp of their more stalwart neighbours. I have seen members of a colony of *Formica rufa* marching in single file, each with a fellow-worker in its mandibles, the object of its sympathetic regard doubling itself up in order to give its benevolent companion as little inconvenience as possible in the transit. The sympathy of the little people sometimes assumes a most touching aspect. We are told¹ that the eminent entomologist, M. Latreille, once cut off the antennæ of an ant, and its companion, evidently pitying its sufferings,

¹ Hüber's *Ants*, p. 171.

anointed the wounded part with a drop of transparent fluid from its mouth. When a burden is too heavy for one to carry, another will surely come to its succour, and relieve its overtaxed powers by bearing a part of the weight; and if the commissariat department is to be strengthened, and unwilling victims to be sacrificed, for the maintenance of the colony, a foraging party unite to forward the common weal by dragging to the shambles the struggling captive. This I have often witnessed.

A remarkable instance of unselfish devotion and disinterested kindness gave me unmixed satisfaction at Shirley Common on May 9, 1878. I had, for the sake of observation, disturbed a colony of *Formica sanguinea*, the slave-making ant. When some of the little people got into difficulties, and were likely to be buried alive beneath the ruin of their desolated home, to extricate them from the fallen *débris*, was it necessary for me to act the part of a friendly giant and deliver them from their impending doom? By no means. Their own tender-hearted companions were equal to the emergency; in fact, were it not for the perturbation and evident anxiety of those who were at liberty, I should myself have been utterly ignorant of the extent of the catastrophe and the imminence of the peril which threatened with destruction several hapless members of the interesting community.

My attention was directed to a *sanguinea* which was working with great earnestness at a small hole in the sandy soil with which the nest was constructed, and which it was trying to enlarge, evidently with some determined object in view. I watched with much interest to see what that object was. The little labourer left its occupation but to return and pursue it with renewed vigour; again it left its work and again returned, and then went into an adjacent hole and reappeared after a careful investigation of the cavity. Without disturbing the indefatigable *sanguinea*, I carefully examined the hole, and noticed the leg of an

ant moving, which at once unveiled to me the mystery of my little friend's persistent movements. It was evidently endeavouring to extricate an imprisoned companion! Startled possibly at my presence, it moved away again, but its philanthropy overcoming its timidity, it soon came back and addressed itself to its benevolent task with redoubled energy. It loosened the earth above the quivering limb, and then went underneath and fairly extricated the anxious captive. The liberated ant, in the gladness of its heart,



FIG. 25.—Ants rescuing a buried companion; *a* drags the body out of the ground with its mandibles; *b* and *c* simultaneously remove pellet of earth from its head.

ran a little way from its prison, but being wearied in consequence of the painful character of its enforced detention, it rested itself. The liberator immediately ran towards it, and having ascertained doubtless that the object of its solicitude was uninjured, left it immediately, the latter continuing its rapid journey from the place of its captivity, while the former returned to the scene of its recent exploit to re-enact a similar act of kindness.

In the second instance its difficulties were increased, since, as well as the superincumbent soil, a small stone

rested on its unfortunate companion. Nothing daunted, it went actively to work, and did not cease until its unremitting efforts were crowned with complete success. It then dragged its friend out of the uncomfortable and perilous position, and removing it thus forcibly a few inches from its living grave, and ascertaining that it was in an exhausted condition, lifted it in its mandibles and carried it in triumph through the open door into the inner recesses of the common habitation.

I have every reason to believe that these are not uncommon illustrations of the sympathy and kindness of ants. In a *formicarium* of *sanguinea* which I established in my study, the same interesting scene has been enacted with heightened colour and more striking emphasis, since in this instance the unhappy victim of adverse circumstances seemed really hopelessly entangled by its surroundings. My frequent observation of their ways and doings has clearly proved that ants know, to their never-failing advantage, that union is strength, so that when one proves unequal to an allotted task, it seeks the co-operation of others, and the task is sure to be happily accomplished. And so it was in this case: concerted action wrought deliverance for the trembling captive in my *formicarium*.

When separated for a while from each other, the joy of the little people at meeting knows scarcely any bounds. Hüber has told us¹ of a separation having taken place between the members of a colony for four months. When the prisoners were released and brought back by a friendly hand of their emancipator to the home of their childhood, they were recognised at once and welcomed with every demonstration of joy. *Antennæ* met *antennæ* in playful gladness.

From personal observation I can testify to a recognition after a separation of one year and nearly three months! On June 18, 1881, I discovered a strong colony of *Formica*

¹ Hüber's *Ants*, pp. 171, 172.

sanguinea, the slave-making ant, at Crowthorne. The year before I had picked up a specimen on the Wellington College estate, which prepared me in a measure for my discovery. I removed and transferred to a tin box a large portion of the nest, with a number of the slave-makers and their auxiliaries, the workers of the *Formica fusca*, with many large pupæ. On reaching Stonehouse I placed the contents of the box in a glass vessel. The ants soon settled down in their new quarters, and flourished; for in the month of July many females were developed, this being the first time that I had seen the females alive.

On June 30, 1882, I visited the same nest at Crowthorne, and again disturbed the quiet of the *formicarium*, and transferred to a tin box another section of the same, with slave-makers, slaves, and large pupæ, and two or three females, which had, judging from their pale colour, but recently emerged from their pupal shroud. I took them that same day to Stonehouse, and placed them in another glass vessel.

In a few days many more winged ants appeared, a small proportion of them being males, which I had never before seen alive. They were readily distinguished from the females by their black head and thorax, these being blood-red in the female. It was a beautiful sight to witness all the members of this formic establishment in full activity in the brilliant sunshine of a summer's day.

On October 8, 1882, I visited the *formicaria*, and taking advantage of the experience of Sir J. Lubbock, who introduced the satisfactory expedient of marking with paint, individual ants for the purpose of watching their movements, and of recording with accuracy the results of his observations, I touched with yellow paint the upper part of the abdomen of an ant from last year's section of the Wellington nest established in the glass vessel No. 1, and placed it on the surface of the earth in vessel No. 3, which contained the second section of the nest removed this year.

It soon met an ant of this section, and a friendly recognition was at once manifested by the graceful and mutual movements of the antennæ, which vibrated joyfully together. Three such manifestations occurred at certain intervals between 1.50 and 2.10. Subsequently another recognition took place between an ant in No. 3 and one marked yellow from No. 1.

I now reversed the order of the experiment, to render it as complete as possible. I took a worker from vessel No. 3, and marked it with vermilion paint, and placed it on the surface of the earth in No. 1. Very shortly—a minute or two only had passed—a meeting occurred between this ant and a member of the last year's section of the Wellington nest, and the recognition was even more marked than in the former instance, and for full twenty minutes a quiet satisfaction and enjoyment was evidenced when the left antenna of the visitor from this year's section, in vessel No. 3, touched and rested and then gently glided over the left antenna of the ant from section of last year, arranged in vessel No. 1. This satisfactory recognition was perfected notwithstanding the fact that the bright vermilion mark of the visitor was carefully examined by the cautious host.

Sir J. Lubbock records¹ a friendly recognition and an amicable reception after an interval of one year and nine months—from August 4, 1875, to May 14, 1877—in the case of the members of a colony of *Formica fusca*, which had for that period been divided and kept entirely apart. He has demonstrated also by careful experiment that young ants are recognised when removed as pupæ. He proves² how thirty-two ants, belonging to *Formica fusca* and *Lasius niger*, removed from their nest as pupæ, attended by friends, and restored to their own nest, were amicably received. And what is even more extraordinary, of twenty-two ants belonging to *F. fusca*, removed as pupæ, attended by strangers, and returned to their own nest, twenty were

¹ *Ants, Bees, and Wasps*, p. 123.

² *Ibid.*, pp. 145, 146.

amicably received. 'As regards one I am doubtful,' says the indefatigable and careful observer, 'the last was crippled in coming out of the pupa-case; and to this perhaps her unfriendly reception may have been due. Of the same number of *Lasius niger*, developed in the same manner from pupæ tended by strangers belonging to the same species, and then returned into their own nest, nineteen were amicably received, three were attacked, and about two I feel doubtful.'

'These,' and kindred 'experiments,' he says, 'seem to indicate that ants of the same nest do not recognise one another by any password. On the other hand, they seem to show that if ants are removed from a nest in the pupa state, tended by strangers, and then restored, some at least of their relatives are puzzled, and for a time doubt their claim to consanguinity. I say some, because while strangers under the circumstances would have been immediately attacked, these ants were in every case amicably received by the majority of the colony, and it was sometimes several hours before they came across one who did not recognise them.'

These experiments were made with ants taken from the nest as pupæ, and though he did not think the fact that they had passed their larval existence in the nest could affect the problem, still he acknowledged it might be so.¹ 'I determined therefore to separate a nest before the young were born, or even the eggs laid, and then ascertain the result. Accordingly, I took one of my nests of *F. fusca*, which I began watching on September 18, 1878, and which contained two queens, and on February 8, 1879, divided it into halves, which I will call A and B, so that there were approximately the same number of ants with a queen in each division. At this season, of course, the nest contained neither young nor even eggs. During April both queens began to lay eggs. On July 20 I took a number of pupæ

¹ *Ants, Bees, and Wasps*, pp. 147, 148.

from each division, and placed each lot in a separate glass, with two ants from the same division. On August 30 I took four of the pupæ bred in B, and one from those in A (which were not quite so forward), and after marking them as usual with paint, put the B ants into nest A, and the A ant into nest B. They were received amicably, and soon cleaned. Two, indeed, were once attacked for a few moments, but soon released. On the other hand, I put two strangers into nest A, but they were at once driven out.' From these and many similar observations the learned baronet remarks, 'they seem to me conclusive as far as they go, and they are very surprising. In the previous experiments, though the results were similar, still the ants experimented with had been brought up in the nest, and were only removed after they had become pupæ. It might therefore be argued that the ants, having nursed them as larvæ, recognised them when they came to maturity; and though this would certainly be in the highest degree improbable, it could not be said to be impossible. In the present case, however, the old ants had absolutely never seen the young ones until the moment when, some days after arriving at maturity, they were introduced into the nest; and yet in twenty-one cases they were undoubtedly recognised as belonging to the community. It seems to me, therefore, to be established by these experiments that the recognition of ants is not personal or individual; that their harmony is not due to the fact that each ant is individually acquainted with every other member of the community. At the same time, the fact that they recognise their friends, even when intoxicated, and that they know the young born in their own nest even when they have been brought out of the chrysalis by strangers, seems to indicate that the recognition is not effected by means of any sign or password.' In order to test whether ants would recognise their friends when in a state of insensibility, Sir J. Lubbock¹

¹ *Ants, Bees, and Wasps*, pp. 108-111.

administered chloroform to both friends and strangers, placing them near where a certain number of the little people were feeding. After many experiments with *Lasius flavus*, it seemed clearly established that in this insensible condition friends were not carried into a place of safety, but as a rule, with the strangers, were picked up and dropped into the water. But since ants under these circumstances were to all intents and purposes dead, and hence possibly the reason why friends and strangers were treated alike, instead of chloroforming the ants he intoxicated them. 'The sober seemed somewhat puzzled at finding their intoxicated fellow-creatures in such a disgraceful condition, took them up, and carried them about for a time in a somewhat aimless manner.'¹

On 'November 20, 1879, he first experimented with six friends and six strangers, beginning at 11.

'At 11.30 a friend was carried to the nest.

11.30 a stranger was dropped into the water.

12.30 " " "

12.31 a friend " "

1.10 a stranger " "

1.18 " " "

1.27 " " "

1.30 a friend (partly recovered) was taken to the nest.

2.30 a friend was taken up and carried about till 2.55; she was then taken to the nest, but at the door the bearer met two other ants, which seized the intoxicated one, carried her off, and eventually dropped her into the water.

3.35 a friend was carried into the nest.

'Out of these twelve, five strangers and two friends were dropped into the water; none of the strangers, but three friends, were taken to the nest. None of the friends were brought out of the nest again.'²

¹ *Ants, Bees, and Wasps*, p. 112.

² *Ibid.*, pp. 112, 113.

And this is how these and other allied experiments are summarised :¹—

‘The general results were that the ants removed forty-one friends and fifty-two strangers. Of the friends, thirty-two were carried into the nest, and nine were cast into the water. Of the strangers, on the contrary, forty-three were thrown into the water; only nine were taken into the nest, and seven of these were shortly afterwards brought out again and thrown away; indeed, I fully believe that the other two were treated in the same manner, though we could not satisfy ourselves of the fact. But it was only by very close observation that the seven were detected, and the other two may well have escaped notice. It seems clear, therefore, that even in a condition of insensibility these ants were recognised by their friends.’

¹ *Ants, Bees, and Wasps*, p. 117.

CHAPTER XIII.

The ants have a language, and are able to communicate their ideas and wishes to each other—Illustrations from the author's *formicarium*—How they make known the cause of fear or anger—How the military expeditions are conducted—The antennæ serve also as organs of smell—The ants are little farmers and cattle breeders—Their many breeds of cattle—The blind clavigers yield milk to the ants, and are maintained by them—The number of ants' nest beetles found in Britain.

FROM the consideration, in the last chapter, of the power possessed by the little people of recognising friends under varying circumstances, we are led on to observe that the ants have a language by which they communicate their ideas and wishes one to the other. It is a silent language, yet mutually comprehensible.

How quickly does alarm spread throughout the colony! Upon any imminent danger, intelligence is immediately conveyed from chamber to chamber, from corridor to corridor, from the uppermost apartment to the lowest withdrawing-room of their extensive domicile, and in a very short time their treasures are removed out of harm's way. In my original *formicarium* I pressed the earth which covered a chamber full of pupæ, and on a later occasion I, by accident, shook the glass in which the ants had arranged their commodious habitation, and through the sides of which I could most conveniently watch their movements, and thus altered the form of another chamber used as a nursery, and crowded also with the young in their silke

swathing-bands. In less than a minute, in each case, the pupæ were removed by the indefatigable nurses, the ants running about the while in the utmost consternation. In some nests, those especially of the yellow tribes (*Formica flava*), it has been noticed that sentinels are stationed in its avenues. When desirous to communicate the cause of fear or anger, they strike their heads against the members of their community in close proximity to them; these in the same way convey intelligence to others, until the whole colony is in a ferment, and measures of defence have been effectively taken.

Some ants there are which engage in military expeditions, notably the *Ecitons*, or processionary ants, of Brazil, though, from personal experience, I find the military instinct is not confined to this species. These have been observed to send out spies, or rather, a small party, detailed for the service. If the intelligence gathered by the scouts is favourable, the march commences in regular order, communications are maintained between rear and van, and during a contest, should occasion demand it, couriers are despatched for reinforcements. The officers, who are distributed at regular intervals along the line of march, are distinguished by very large heads. They are never found carrying either the young or the spoils of war, which consist of all kinds of soft-bodied insects, such as locusts and cockroaches. There is one of these large-headed fellows before me as I write.

The relative proportions in the size of the heads of the large and small workers is about similar to those of the heads of the large and small workers of the Madeira ant which I discovered in the baker's shop in the Borough. I there ascertained that the large-headed workers are not employed in foraging expeditions for the purpose of furnishing the commissariat department, which is the province of the small workers. It may be that they belong to a military order, and that their duty is to defend the more peaceable

members of the community. Though in the colonies of the British species we do not find any of these large-headed individuals, yet, as a rule, the size of the workers varies considerably, and in some it is much more marked than in others. As an instance, I would call attention to *Formica sanguinea*. In the nest of this ant we find some very large workers, and I have noticed that, when the nest is disturbed, it is only these workers who make their appearance and stand in a threatening attitude at the entrances and in the environs of their dwelling, prepared to resent most determinedly all intrusion upon their privacy.

When quite a boy, I remember well how I used to rejoice in handling the fat maggots which I found in the folded leaves of rose-trees, and which developed, when undisturbed, into some dipterous insect, and I was accustomed to place these maggots near the entrance of an ants' nest, which was that of the common garden ant, *Formica nigra*. I then watched some of the colony examine the grub, and then hasten to convey the news of their prize to others, since numbers would sally forth, and with united effort would drag the unwilling prisoner into their castle to be devoured.

The antennæ are the chief organs of speech. By their means useful discoveries are reported, the hungry ask for food, the nursing mothers gently tap their helpless babies when wishing them to open wide their mouths for the luscious and dainty meal, and with them the military tribe are placed in marching order and rallied for a contest; and you should know, my readers, that these antennæ, besides being sensitive feelers and facile talking machines, serve also other purposes in the marvellous economy of this little people.

The antennæ have also been considered the organs of hearing, but this I think very doubtful, since ants seem insensible to any sound. When I have rapped the glass side of the vessel in which they are established, so as to

produce a sharp ringing series of vibrations, no effect upon them has been produced.

Sir John Lubbock tells¹ us that he has over and over again tested them with the loudest and shrillest noises he could make, using a penny pipe, a dog-whistle, a violin, as well as the most piercing and startling sounds he could produce with his own voice, but all without effect. A solitary species, *Mutilla Europæa*, I have noticed, produces a distinct sound when handled, as it does also of its independent will when left to its own devices, as Miss M. Pasley has observed. Since it is the apterous female which makes the noise, it is quite possible that it may be a call to the winged male to assure her lord of her presence, which he may recognise in some manner quite beyond our power to understand.

But if the antennæ do not serve as organs of hearing, they seem to serve as organs of smell. Sir J. Lubbock tells² us how he took a large female of *F. liguiperda* and tethered her on a board by a thread; when she was quite quiet he tried her with the tuning-fork, which, however, did not disturb her in the least. He then advanced the feather of a pen very quietly, so as almost to touch first one and then the other antennæ, which, however, did not move. He next dipped the pen in essence of musk and did the same, and then the antenna was slowly retracted and drawn back; he repeated the same with the other antenna. If he touched the antennæ, the ant started away, apparently smarting. He repeated the same experiment with essence of lavender, and with a second ant, and the result was the same.

This experiment is certainly very significant and suggestive. It shows us that the sense of smell is very delicate and acute, and that in some way or other it is associated with the highly sensitive and beautifully fashioned antennæ. I made inquiries on one occasion in Stanhope Place in

¹ *Ants, Bees, and Wasps*, p. 222.

² *Ibid.*, pp. 234, 235.

reference to the power of the cosmopolitan house ant, *D. domesticum*, to discover its favourite food, though hidden from view and far from its *formicarium*, and I learnt that when sweet almonds or sugar were placed in a cupboard on the ground floor, the ants in the kitchen below in a comparatively short space of time, not longer than a day or two, detected the store and rifled it, though the kitchen is underground and the little people would have to traverse diagonally the wall of a passage from the pavement to the ceiling in order to reach the hidden treasure.

The ants are little farmers, not only clearing the land round their dwellings, sowing the prepared soil with grain, reaping their corn when ripe, and gathering it into granaries for future use, as one species certainly does, and has in consequence justly merited the designation of the 'agricultural ant;' but the little people also possess beasts of nearly as many sizes and colours as are owned by country farmers and cattle breeders. In their farm stock they have their gentle Jerseys—more familiarly known as 'Alderneys'—yielding a rich supply of milk, and their larger Guernseys, similarly serviceable: their Shorthorns, with, as their name indicates, horns shorter than many other breeds, and of beautiful structure, and with face of mild and pretty aspect; their South Devons, large and well favoured. Neither of the last two yield milk so plentifully or so rich as the first. Then they have what answers to the Midland home breeds, of snowy whiteness, which are usually kept within the precincts of their homestead, the property generally of the yellow tribes, though I have found that other tribes or species possess them, but in less abundance. The ants' nests in the neighbourhood of Stonehouse abound with them; whether they yield milk or not is not yet known. It may be so, but after many years' observation I have seen nothing to justify this determination of their province in the economy of the little people. I would suggest that they act the part of scavengers; that their constant presence in

the colony is not only favourable to their own development and maintenance, but serves also to promote the health and comfort of the little people themselves.

These little cattle, or scavengers, have, strange to say, many legs, and look like woodlice. They have curiously formed horns, which move tremulously and rapidly as they traverse the passages of the *formicarium*. They are really crustaceans, and bear the euphonious name of *Platyarthrus Hoffmannseggii*. The Devonshire breed has pretty horns, six legs, and short winged cases, and belongs to the Coleopterous family *Brachelytra*, a family represented by many species among the *Myrmecophilous*, or ants'-nest beetles. They are characterised by short elytra which entirely cover the folded wings, and long, narrow bodies, which they turn up when in the act of running. They are known to live in offal, manure, or under plants in a state of decay, and subsist on animal substances. My impression, therefore, is that they are also serviceable to the ants as scavengers, though they may also be used by them as cattle, since the species we are specially referring to has been known to supply a secretion between the rings of its abdomen, which the little people appropriate to their use as pleasant milk.

This species is called *Atemeles emarginatus*, and Mr. Smith has informed me that he has found it in large numbers beneath the flat stones near Watersmeet, in the enchanting valley of the East Lyn, North Devon, in association with *Formica fusca* and the species of *Myrmica* which are common in the neighbourhood. Their Short-horns, of a reddish-brown colour, possess the singular name of *Claviger testaceus*. They have short horns curiously fashioned, and their hide is of a tough texture; their form is most quaint, and, strange to say, they are perfectly blind. The yellow ants are fond of these, and hold them in almost exclusive possession. Mr. Smith states that they are the representatives of a rare exotic beetle, found nowhere in

Britain but in the colonies of this tribe of ants, who set great store by them. He disturbed a colony of *F. flava*, and discerned several representatives of *Claviger testaceus* perambulating the nurseries of the little people. As soon as danger threatened they were seized immediately by the anxious nurses, though the helpless babies were lying sprawling on the floor. I examined a specimen through a lens, and found it had a cavity on its back, in which is distilled a honeyed liquor, which is lapped up with avidity by the foster-mothers and given to the hungry children of the colony.

According to Müller and Lespés, the little *Clavigers* who afford nourishment to the ants are in return fed and thus maintained by their grateful hosts.¹ Müller first pointed out that the *Clavigers* seem to be quite dependent upon the ants, for they never are seen to feed themselves.²

I once discovered *Claviger testaceus* in the neighbourhood of Clevedon, Somerset, under a stone on the pleasant slope of the Court Hill, overlooking the smiling valley of Walton. I captured two specimens in friendly association with a colony of *Formica flava*.

About forty different species of beetles are found in British ants' nests,³ thirty-three of which are in my possession. Three of these are generally met with only in the larva state, notably the brilliant beetle *Cetonia aurata*, the splendour of whose metallic lustre, when it rests in the sunshine on the opening petals of a crimson rose, forms a sight not readily to be forgotten. The larva of an allied species, the *Cetonia ænea*, also finds a congenial habitat in

¹ See *Les Fourmis de la Suisse*, par Auguste Forel, p. 425.

² See *Ants, Bees, and Wasps*, p. 76.

³ See *Cat. Brit. Foss. Hym.*, Fred. Smith, Appendix, pp. 223, 224; *Entomologist's Annual*, 1857, pp. 95, 96; *Observations on the Myrmecophilous or Ants' Nest Beetles of Britain*, by Edward W. Janson, Sec. Ent. Soc. I have, since the publication of the first edition of this work, been in correspondence with Canon Fowler, the author of a complete work on British Coleoptera, and I have ascertained that the number of ants' nest beetles is now approximately sixty-five.

the nests of ants. The third species which in the larva state inhabits the dwellings of our attractive little friends is the *Clythra 4-punctata*, so called from the four spots which ornament the pale brown wing-cases of the perfect insect. The beetle itself has also been found in ants' nests.

A letter I received from Mr. Frederick Smith, bearing date January 11, 1878, says: 'The larva of both *Cetonia* and *Clythra 4-punctata* are found in nests of *F. rufa*. I once found the latter in larva and perfect condition in great numbers in the nests of the wood-ant in Yorkshire. In this part of the country (*i.e.* the London district) *Clythra* is not often found. I could have taken hundreds in Yorkshire. *Cetonia* I know is only occasionally found in the nests, and I look upon it as quite accidental its being there at all. *Cetonia aenea* is common in Scotland, and at Loch Rannoch the collectors took it in plenty, and occasionally found it in the nest of *F. rufa*.'

Setting aside, however, these three species, the remarkable fact remains that there are at least between thirty and forty different kinds of beetles found exclusively in the nests of the ants. Their special function is not easy to determine. Some few, it may be, as already hinted at, are used as cattle, and, as before suggested, many may serve as scavengers; or the presence of a differing order of insects in ants' nests may imply, as Sir John Lubbock urges, that the little people are fond of domestic pets.

CHAPTER XIV.

The aphides or ant cows preserved and bred by the British ants—Their form and habits—How the little people milk their cows—Hüber's observations—Do the ants breed their cows?—The author's observations and discovery—Are the aphides both viviparous and oviparous?—The marvellous history of the milch-kine—The 'eggs' are pupæ or the nymphal form of the aphid—Bonnett's view, indorsed by Hüber, correct—Sir J. Lubbock's judgment—The cocci or gallinsecta—The cochineal insect—Some ants omnivorous.

WHATEVER doubt may exist as to the relation existing between the ants and the coleoptera and the crustaceans, as represented by *Platyarthrus Hoffmanseggii*, none can exist concerning their association with the aphides and cocci, popularly called plant-lice and scale insects, and both belonging to the order *Hemiptera*, an order which embraces also the crimson cochineal insect of commerce, the brilliant lantern-fly, and the musical and classical cicadæ.

The aphides, the gentle Alderneys of the ants, furnish the sweetest milk in great abundance, and are known emphatically as ant-cows. In almost every nest of the yellow ant, *F. flava* (*L. flavus*), I came across in my Blackheath excursion—and remember it was the winter season—I found some of these little cattle; and such has been my experience in all subsequent investigations in the neighbourhood of Stonehouse, among the conical domiciles of *F. flava* (*L. flavus*). And though the British species of ants do not store grain for future consumption, as the

agricultural ant of Texas, the provident ant of India, and the harvesting ants of the south of France, Italy, and Palestine, their wonderful habit of preserving and breeding their aphides is established as an unquestionable fact.

The ant-cows are of many colours, both apple and olive

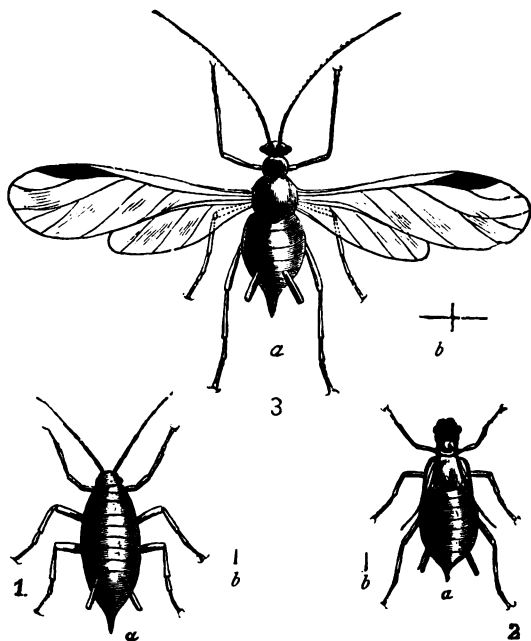


FIG. 26.—1, Wingless aphid; 2, aphid with rudimentary wings, antennæ bent back; 3, winged aphid; *a*, magnified; *b*, natural size.

green, grey, black, white, and delicate violet. Their bodies are either roundish or oval; they are found both winged and wingless. Their antennæ are sometimes long and tapering to a point, or shorter with cylindrical joints. They are provided with a rostrum, or tube, which is sometimes of great length; and when at rest it is folded against the under part of the abdomen. With this

instrument they suck the sap of plants, by which they are nourished. They possess six legs, but are very slow in their movements. The punctures caused by their rostra sometimes so alters the form of the leaves and leaf-stalks they frequent that excrescences or cavities are produced which serve to shelter them in large numbers. From this circumstance they are not inaptly termed 'blight.'

They now and then eject from their bodies the sweetest



FIG. 27.—Rose-branch with aphides.

limpid drops, which are eagerly devoured by the ants when at hand. When such is not the case, this viscid exudation falls upon the leaves of trees and shrubs they inhabit, and is known as honeydew. The little people oftentimes visit trees and plants on which the little cattle browse, to satisfy

their appetite and carry off the honeyed aliment to their hungry young. When I see ants on trees or rose-bushes, the lordly oak or the worthless thistle, I know the cause of their presence at once, and am almost sure to find the aphid on a careful search. Sometimes, however, the fruit itself forms a dainty and luscious meal, and sometimes the honey in the nectaries of flowers, and even the sweet and tender buds and petals of expanded blossoms. The viscous liquid of the aphid is the principal support of many kinds of ants, *F. flava* (*L. flavus*) especially, and the liquid they can obtain without waiting the pleasure of their cows.

Hüber observed a thistle-branch covered with brown ants and pucerons, as he calls the cows. He noticed an ant station itself near one of the smallest of their cattle; it appeared to caress it by touching the extremity of its body alternately with its two antennæ with an exceedingly rapid movement. He saw, with much surprise, the fluid proceed from the body of the puceron, and the ant take it in its mouth. Thus it is that the little people milk their cows. What the Swiss naturalist saw I have seen, and, strange to say, it was upon a thistle-branch that I first watched the ants milk their cows; and the ants were brown, and they milked the aphides by causing their antennæ to vibrate over their bodies, as it has been aptly said, like the play of the fingers in a shake upon the pianoforte.

In one of my *formicaria* I observed both on March 22 and 24, 1868, a lilac-coloured cow being milked by several of the yellow tribe, *F. flava* (*L. flavus*), and on each occasion the operation took place in the same spot and in the same chamber. A little later in the same year I again witnessed an ant milk one of its cows, and after the operation I saw it seize its little Alderney in its mandibles and carry it to a place of shelter. The yellow ants lap up the milk with their tongues; the red, it has been confidently affirmed, with their antennæ, the last joint being enlarged, it may be, for this very purpose. The yellow ants breed

their cattle and rear them through the different stages of their existence as carefully and tenderly as they do their own young. They construct their habitations oftentimes in situations especially suitable to their sustenance, their subterraneous corridors and chambers generally being found among the roots of grass, from the pleasant juices of which the milch kine extract their necessary nutriment by means of their invaluable sucking-pipes. But do the little people really breed their cows? Undoubtedly they do—I speak from personal observation.

At the close of winter, in March, 1877, I made forcible entrance into one of the elevated domes of the *F. flava* which adorn the Great Western Railway embankment near Stonehouse. In the upper part of the nest, not far from the surface, I uncovered a chamber which, at first sight, looked like a granary. It seemed stocked with a number of minute black and shining seeds, interspersed with a few of a pale brown colour. The contrast between the ebony-coloured grain and the yellow bodies of the ants who were sedulously guarding their treasure was very pleasing. Upon being disturbed, the ants seized little parcels of the bright shining grain in their mandibles in the same way as is their wont with their own eggs and pupæ, and hastened off with them to hide them, if possible, from the unceremonious intruder. I was able, however, to secure many parcels of this supposed grain, and many of the yellow storekeepers also. I found that they adhered together like the minute white eggs of ants, and to which they were not dissimilar in form.

After sending off a parcel of what I now hoped might prove to be the 'eggs' of aphides to the British Museum for Mr. F. Smith's examination, I placed some with their guardians, the yellow ants, in a receptacle which I had arranged for observation, and others I placed upon damp wool, to hatch them out, if possible, without the intervention of their adopted guardians; having learnt from Mr. Smith,

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that, apart from the ants, a damp atmosphere was necessary for their development. In a few days my patience was rewarded, and, to my great delight, both from the 'eggs' in custody of the ants, and from those left to themselves on the damp wool, came forth two kinds of aphides, one being white, with pale-violet decorations, and the other being olive green, the former having a semi-spherical form, with somewhat short antennæ and legs, the latter more ovate and elongate, with similarly short antennæ and legs. I should notice that it is absolutely necessary to keep the wool moist for a successful experiment. The eggs in charge

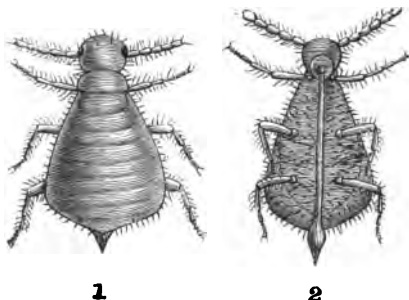


FIG. 28.—1, Aphis bred from nest of *F. flava* (*L. flavus*). 2, Aphis bred from nest of *F. flava* (*L. flavus*). Underneath showing sucking-tube.

of the ants are moistened by the little people themselves, who constantly watch them and cherish them with this end in view.

On March 26, 1877, I heard from the British Museum. Mr. Smith observes: 'Have hatched a number of the little aphids. The aphid that I bred from eggs some years ago¹ were dark insects with mottled wings and long legs. Those I have now reared are light-coloured and short-legged.' It is generally believed that aphides are both viviparous and oviparous, those produced in the autumn being oviparous,

¹ See an account of this successful experiment in Mr. F. Smith's 'Notes on Hymenoptera' in the *Entomologist's Annual* for 1871, p. 60.

this being the harvest season with ants as with the lords of the creation, when they collect the 'eggs' of the aphides and store them up for future development in their domiciles. A marvellous history have the milch-kine of the ants. When, in the late winter or early spring, these 'eggs,' as they are called, hatch, only females are produced, who soon become mothers, and so on, until the tenth, or as some¹ think the eleventh generation, when the autumn has again come round, and both males and females are produced, and 'eggs' are again deposited—a wondrous chain of being! and almost interminable, since it has been computed by Réaumur² that a single aphid may thus become the progenitor of 5,904,900,000 descendants during its life. This number would comprise the fifth generation according to Bonnett, who carefully observed that a single female produced generally 90 young ones, and so the computation thus runs, viz:— $90 \times 90 = 8100$ at the second generation; these again give a third generation or $8100 \times 90 = 729,000$, and these a fourth generation or $729,000 \times 90 = 65,610,000$, and these, multiplied by 90, a fifth or 5,904,900,000—and if we continue the calculation to the tenth or eleventh generation we should be utterly baffled in an attempt to conceive the true significance of the vast enumeration. I am strongly of the opinion, that these so-called 'eggs' are really pupæ, or the nymphal form of the ant-cow, so that the aphid is not really oviparous. Such was the conviction of Bonnett, and evidently indorsed by Hüber, and I believe the judgment of these eminent observers will be found to be correct.

Sir John Lubbock having examined sections of these 'eggs' microscopically, has come to the conclusion that they are really eggs, and not the pupal form of the aphid. If such is the case, it seems to be remarkable that Mr. Smith should have observed issuing from them aphides

¹ See *Insect World*, by Louis Figuier, Eng. Trans. 1869, p. 126.

² Rennie's *Insect Transformations*, 1830, p. 19.

perfectly equipped for flight. This certainly looks as if these mysterious bodies are a mere pupal envelope containing the young aphids.

It has been noticed that some ants take possession of a branch, upon the leaves of which their little cattle delight to browse, and prevent foreign colonists from interfering with what they hold to be their valuable estate. Some erect a wall of earth, and thus inclose their cattle, to remind the stranger that trespassers will suffer. The cows I found upon the thistle-branch were thus inclosed. About four or five other species keep cattle at their homesteads, but some erect a covered way of earth from their dwellings to the pleasant pastures on which the cattle graze, by means of which they can communicate with them without the knowledge of others, and along which they can transport them at pleasure to their commodious domain.

I must not pass over the most interesting history of the relation of the ants to the aphides described by Sir John Lubbock as the result of his pleasant experience. In 1879 'the eggs commenced to hatch the first week in March. Near one of my nests of *Lasius flavus*, in which I had placed some of the eggs in question, was a glass containing living specimens of several species of plant commonly found on or around ants' nests. To this some of the young aphides were brought by the ants. Shortly afterwards I observed on a plant of daisy, in the axils of the leaves, some small aphides very much resembling those from my nest, though we had not actually traced them continuously. They seemed thriving, and remained stationary on the daisy. Moreover, whether they had sprung from the black eggs or not, the ants evidently valued them, for they built up a wall of earth round and over them. So things remained throughout the summer; but on October 9 I found that the aphides had laid some eggs exactly resembling those found in the ants' nests, and on examining daisy-plants from the outside, I found on many of them similar aphides,

and more or less of the same eggs. I confess these observations surprised me very much. The statements of Hüber, though confirmed by Schmaida, have not indeed attracted so much notice as many of the interesting facts which they have recorded, because, if aphides are kept by ants in their nests, it seems only natural that their eggs should also occur. The above case, however, is much more remarkable. Here are aphides not living in ants' nests, but outside, on the leaf-stalks of plants. The eggs are laid early in October, on the food plant of the insect. They are of no direct use to the ants, yet they are not left where they are laid, exposed to the severity of the weather and to innumerable dangers, but brought into their nests by the ants, and tended by them with the utmost care through the long winter months until the following March, when the young ones are brought out and again placed on the young shoots of the daisy. This seems to me a most remarkable case of prudence. Our ants may not perhaps lay up food for the winter, but they do more, for they keep during six months the eggs which will enable them to procure food during the following summer, a case of prudence unexampled in the animal kingdom.'

The cocci, or gallinsecta, as Réaumur calls them, are the Guernseys of the little people. They, like aphides, yield a serviceable secretion, either letting it fall on the trees and plants on which they feed, or, when waited upon by the ants, offer it to them in return for their antennal caresses. The female is like a scale of a brown colour formed of many segments, convex above and flat below, and it fastens itself upon the stalks, branches, and leaves of trees, shrubs, and plants by means of its beak, with which it sucks up the vegetable juices. It is found on the elm, oak, lime, oleander, myrtle, etc., and its presence is familiar to us on many greenhouse plants in company with ants, which visit it for its sweet and pleasant milk, where it is called the scale insect. The male is winged and active. The valuable

cochineal insect which belongs to this family is called *Coccus cacti*. It is found in Mexico on the nopal, or prickly pear, and it is said that they are always accompanied by ants.

Some ants are omnivorous, e.g. *Myrmica lævinodis*, which is a common ant in Stonehouse; my vicarage garden abounds with it. I have seen it feasting in the yellow blossom of the buttercup, on the crimson petals of the rhododendron, and on the tender buds of the yucca. I have noticed it milking its cows, and holding high festival on the dead body of the green linnet. The *Formica rufa* I have noticed bearing off insects wherewith to replenish its larder, and visiting trees for the purpose of milking its kine. A bird or a rat thrown upon its heaped-up nest will soon be devoured by the myriads of its inhabitants, who leave nothing but a skeleton as if prepared for an anatomical museum.

The common garden ant, *Formica nigra* (*Lasius niger*), is omnivorous, as may be gathered from what has already been narrated. It delights to milk its cows, and it luxuriates in larvæ in fine condition. The *Myrmica domestica* (*Diplo-rhoptrum domesticum*) also, the pest of many a London house, as it is often reckoned, yet renders friendly service, for while it rejoices in almonds and sugar, it considers a cockroach a delicacy.

The Madeira ant, *Tapinoma gracilescens*, also, does not object to any kind of food. Sugar is its ordinary diet, yet I have seen it, assisted by a companion, bearing along in triumph, for the benefit of the home circle, many a fine house-fly. The slave-making ant has a taste for animal food as well as a sweet mandible. I have seen it in my *formicarium* devouring a wasp, as well as sipping at a tray of moistened sugar; and in its native haunts I have seen it hurrying along with a rare beetle, *Cænopsis fusirostris*, a dainty meal, to tempt the appetite of the old folks at home. Into the extraordinary history of this interesting species of ant I propose to enter in the next chapter.

CHAPTER XV.

The slave-makers—How *Formica sanguinea* may be distinguished from *Formica rufa*—The author's visits to Shirley Common in search of the *Formica sanguinea*—Discovery of a nest—The slaves—Other species of ants besides *F. fusca* found in the slave-maker's nest—The workers, males, and females of the slave-makers described.

THOUGH it is twenty years since I commenced the study of ants, it was not till 1877 that I discovered the habitat of *Formica sanguinea*—the slave-maker. In 1876 I visited Weybridge, where it used to be abundant, and though I followed strictly the explicit directions of Mr. F. Smith, I did not find *sanguinea* at home. *Formica rufa*, the common wood-ant, I found in abundance, but not the slave-maker. *Formica sanguinea* is very similar in its general appearance to *Formica rufa*, and it may easily be taken for it by the uninitiated, especially the small workers.

There is, however, a distinct, well-defined characteristic, by which Charles Darwin identified the species, and with which characteristic he was furnished by Mr. Smith, who also pointed it out to me, and which enabled me to distinguish it from any number of *F. rufa*. While describing the construction of an ant's mouth, I mentioned that the upper lip, or labrum, is protected by its shield, the clypeus. The clypeus extends from beneath the frontal area (see *a*, in Fig. 29*b*), a triangular plate at the insertion of the antennæ, to the upper lip, which it conceals. Now

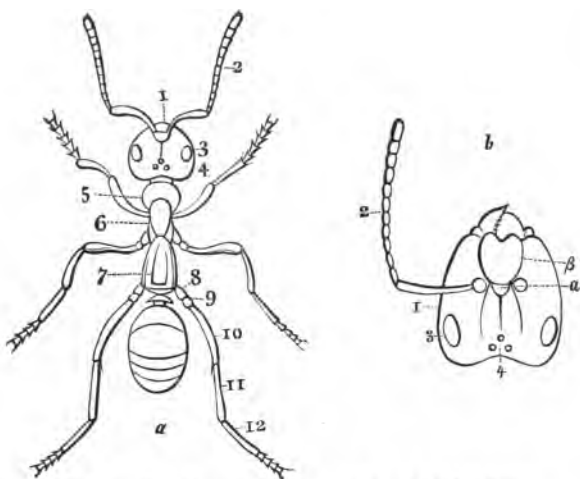


FIG. 29.—*Formica sanguinea*. *a*, worker; *b*, head of ditto.
a—1, scape, and 2, flagellum of antenna; 3, lateral eyes; 4, ocelli; 5, prothorax; 6, mesothorax; 7, metathorax; 8, coxa; 9, trochanter; 10, femur; 11, tibia; 12, tarsus.
b—1, scape, and 2, flagellum of antenna; 3, lateral eyes; 4, ocelli; *a*, frontal area; *β*, emarginate clypeus.



FIG. 30.—*Formica rufa*. The wood-ant.
a, male; *b*, female; *c*, worker.

the anterior margin of this clypeus is distinctly emarginate in *F. sanguinea*—i.e. instead of having an even edge, and lightly keeled, as in *F. rufa*, it is decidedly notched. (See Fig. 28, β .)

Furnished with this unfailing characteristic, I started from London on June 5, 1877, in search of the slave-maker, being supplied also with a plan of Shirley Common and its neighbourhood, whither I was bound; and on the plan sketched by Mr. Smith were two spots indicated, where he assured me I should be certain to find *sanguinea*. I soon reached Croydon by rail, and lost no time in hastening past well-kept gardens bright with rhododendron and scarlet may, through open fields, to the first spot indicated, between Croydon and Shirley, at the stump of an old oak-tree. I searched most carefully, but, alas! in vain. *Sanguinea* had either migrated or become extinct. I went forward and reached the elevated common—a lovely piece of broken ground, covered with heather and fern and gorse, studded here and there with the aromatic and picturesque Scotch firs, fringed with the tender green of umbrageous oak, elegant silver birch, and other deciduous trees, and commanding an extensive view of a well-wooded, undulating country; and full of hope that my search after *sanguinea* would be crowned with the much-coveted success, I examined and re-examined the second spot in my plan indicated as its habitat. At the very spot I found what might surely prove to be the little people I longed to meet with. I brought my lens to bear upon the clypeus of many, but, alas! they proved to be members of a somewhat extensive colony of *Formica rufa*, every one.

Having now lost all clue to the object of my search, I returned to London. Nothing daunted, I presented myself again at the British Museum and received fresh instructions from my kind friend, and a third habitat was explicitly described; and on June 9 I again sallied forth, sustained with a new hope and fired by a fresh enthusiasm. One

more I reached Shirley Common, and hurried to the dry ditch and its associated bank, where I was assured the slave-maker had established itself in strong force, and this time my patience and perseverance were most happily rewarded. My attention was soon arrested by ants of an unusual appearance and peculiar gait traversing the ground with wondrous expedition, and I felt sure I must be within the charmed circle of *sanguinea's* domain. The head and thorax, of a blood-red colour, attracted me, and with a confident assurance that I had at last realised the desire of my heart, I seized one of the little creatures with the utmost tenderness and care, and scrutinised it through my lens, and oh! the joy of that moment I am utterly unable to describe. The clypeus is emarginate; the unfailing characteristic is clearly revealed to my wondering gaze. I see another, and another, and another. They come thick and fast, and I trace them to a stump of an old gorse bush.

After identifying the species around the gorse stump, on the sunny bank at Shirley, I watched it more closely, and was gratified in finding it very numerous represented in this locality. The ants abounded and were in constant motion; and how were they occupied? Wondrous to relate, two of the workers were carrying each a black ant, called *Formica fusca*. And I watched also individuals of *Formica fusca* on most friendly terms with those of *Formica sanguinea*, going in and coming out of the entrances of a common domicile, while workers of *sanguinea* were busily and laudably engaged in replenishing the larder, one carrying a beetle, of a very rare species, and which I presented to Mr. Smith, since he had not a representative in his collection. Two other workers carried between them a caterpillar, which would form, doubtless, a most delicious banquet for the hungry inmates of the formic castle. A worker of *Formica fusca* was carrying material for either the repair or the enlargement of the messuage.

I had thus furnished me unmistakable evidence that

Formica sanguinea is a slave-holder ; and to set the matter at rest, I thought I would inquire within, and rapped, as it were, at the door by tapping the bark where the nest was situated ; and out came the slave-holders in large numbers to see what was the matter. I then disturbed their equanimity by unceremoniously intruding upon their privacy. I discovered within, numbers of the workers of *F. fusca*. These were the slaves, or, rather, the domestic

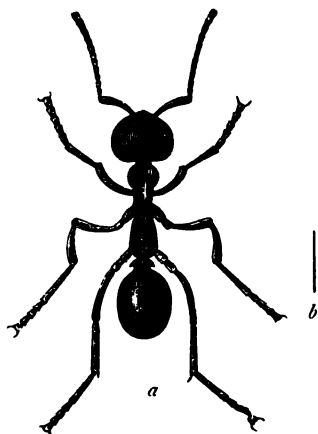


FIG. 31.—a, *Formica sanguinea* (large worker) ; b, natural size.

servants of *F. sanguinea*. I came upon another nest, and with the same result. In the second, however, I did not find quite so many as in the first nest investigated. I here observed a slave assisting to replenish a larder by carrying a fly. This nest, as well as the first, was formed around a gorse stump.

Other species of ants are sometimes found in the nest of *sanguinea*. In the stump which formed the central support of the first nest I examined I found a species of the family *Myrmicidæ*, called *Leptothorax acervorum*, both its pupæ and larvæ being contained in perforations in the wood. I

discovered this ant also, about two years ago, in a post of an old fence of my kitchen garden, which post, and its tenants, I had until lately in my greenhouse. I have come across the species also at the root of a Scotch fir at Bournemouth, and I twice met with it at Lynmouth, in the valley of the East Lynn; on one occasion in an old stump, the workers being very busy in enlarging the chambers of their habitation; and on another occasion I found a party of the species enjoying themselves on the top of a rock,



FIG. 32.—*a*, *Formica sanguinea* (male); *b*, natural size.

males, females, and workers being represented in what was evidently a family gathering.

The head, thorax, and legs of the large worker of *F. sanguinea* are blood-red; in some examples of the worker the vertex in the region of the *ocelli* is dusky. This is especially noticeable, however, in the smaller workers. There seems to be a graduated scale observed in the size of the workers, varying from about four lines to three, or even less. In fact, some of the small workers seem to be less than half the size of the largest individuals. The abdomen is dark-ash coloured, and slightly red at the extremity, and characterised by a glittering sheen. The males and winged females are to be found, as a rule, in the

months of July and August. The female has the head, thorax, and legs red; the head, however, being dusky on the vertex, or in the region of the ocelli. The head is broader than that of *rufa*, the abdomen being shorter, the antennæ a little longer, and the wings a shade darker towards their base, being of a pale brown. The abdomen is coloured as in the worker. The head and thorax of *rufa* are of a rusty-red colour—the abdomen as well as the scutellum (a little plate in the middle of the thorax) being shining black; the tibiæ, tarsi, and tips of the femora



FIG. 33.—*a*, *Formica sanguinea* (female); *b*, natural size.

being of a reddish brown. The male of *sanguinea* is black, and the legs entirely red; antennæ longer than in male of *rufa*, and abdomen broader and shorter. The venuration of the wings is slightly different, the marginal and submarginal cells being complete. The male of *rufa* is blackish ash-coloured, with rufous or reddish legs; the base of femora, the tibiæ and tarsi, being more or less fuscous.

Mr. G. A. James Rothney, of Calcutta, who for several years most carefully examined the *formicaria* of *F. sanguinea* at Shirley and its neighbourhood, discovered the followin

species in one nest—I quote now from a paper on ‘Hymenoptera,’ by Mr. Smith, contained in the *Entomologists’ Annual* for 1868, which contains a record of Mr. Rothney’s captures—‘*Formica fusca*, common; *F. nigra* and *F. flava*, several specimens; *Tapinoma erraticum*, *Myrmica ruginodis*, and *M. scabrinodis*, common; *M. lobicornis*, the workers very abundant, but only one female; *Leptothorax acervorum*, all the sexes abundant in August; *L. Nylanderi*, several specimens. No nest of *Formica fusca* or of *F. flava* could be found near that of *F. sanguinea*, but those of *F. nigra*, *T. erraticum*, *Myrmica ruginodis*, and *M. scabrinodis*, were all within the distance of a few yards.’

Though I have only found *L. acervorum* besides *F. fusca* in the nests of the *sanguinea*, I have discovered all the species in Mr. Rothney’s list on Shirley Common or its neighbourhood, with the exception of *L. Nylanderi*. This uncommon species I have met with near Lee, Blackheath, in an unusual position—viz. inhabiting an old stump, since Mr. F. Smith says that it has never been found in any other situation than in ants’ nests.

Mr. Smith adds: ‘I have not found *F. cunicularia* in nests of *F. sanguinea*, but I have found a few *Myrmica scabrinodis*; in all nests I have found *fusca*, and I have seen a few *flava*.’ Strange to say, though I have not seen *flava* in *sanguinea*’s nest, I discovered in the summer of 1879 a few of their species in the heart of a nest of *F. rufa* in the delightful valley of the Horner, near Porlock, where the red deer come down from the wilds of Exmoor to quench their thirst.

Having verified the well-attested fact that *F. sanguinea* is a slave-owner, it now became my strong desire to verify the still more marvellous, and no less well-authenticated fact, that *F. sanguinea* is a slave-maker, though there have as yet been but few witnesses of so extraordinary an instinct.

I resolved to pay another visit to Shirley on my return from Suffolk, whither I was bound, after a short sojourn

in London. In Suffolk, at the pleasant watering-place of Lowestoft, I discovered what I believe will prove to be the metropolis of *Formica aliena* (*Lasius alienus*), an ant which has not many years been identified as British, which I have found also at Bournemouth, and on Stinchcombe Hill, Gloucestershire, and Symond's Yat, and in strong force under stones near Minehead, as I have already mentioned, the three last-named localities, as well as Lowestoft, being new habitats.

On July 3, the same year, I again made my way to Shirley with one of my sisters, to prosecute researches. We soon reached the dominion of *sanguinea*, stormed one of the slave-holders' citadels, and captured a large number of the slaves with their owners, and many infant charges—viz. the pupæ, which had evidently become developed since my last investigations, for then I saw none. The contents of this nest of *sanguinea* I carefully preserved in a tin box, bringing away also the old gorse stump, which formed a part of the common habitation, for a chamber in the wood formed a nursery, where lay the babies of *sanguinea* reposing sweetly beneath their silken coverlids. Both the slave-owners and the slaves were still in existence on July 11, 1879, living together most happily, and associated in labour most harmoniously in a crystal vase in my study. But to return. While carefully examining the *sanguinea* ground—for there were several nests besides the one I had secured—I was not a little interested in observing a worker of *sanguinea* carrying a pupa smaller than the pupæ I had appropriated from the captured citadel, and I was still further interested in noticing another worker of *sanguinea* hastening along with a similar burden, and yet another and another, each laden with what evidently was a precious charge.

The little carriers were hurrying forward with a jubilant and triumphant air, and a peculiar cantering motion, and nothing would turn them from their course. Soon we

noticed that numbers of *sanguinea* were carrying burdens,

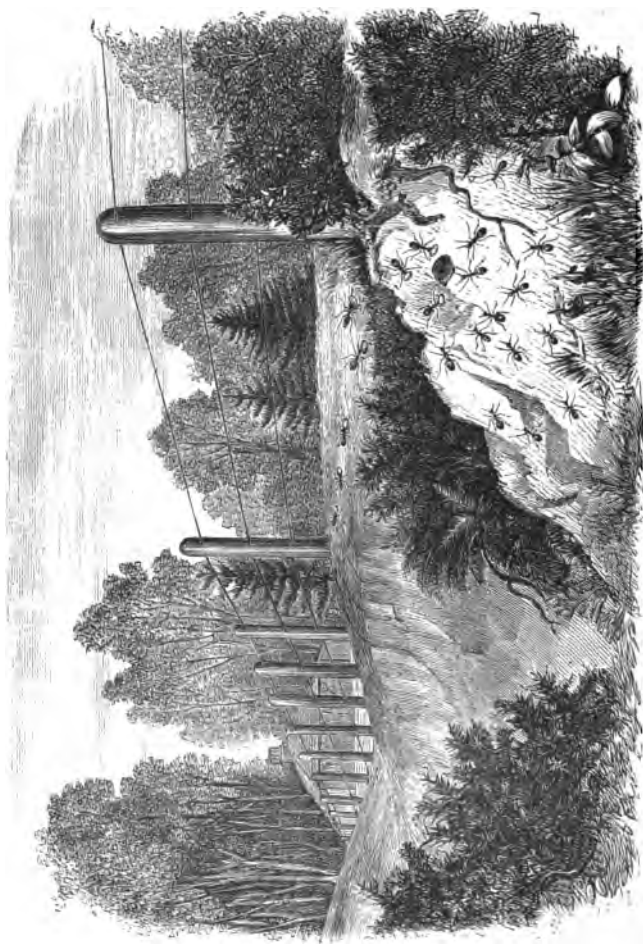


FIG. 34.—Slave-makers returning home after a victorious expedition on Shirley Common.

a few being larvæ, but almost all the burdens were pupæ. The jocund little people seemed all eager to reach their

home, which as usual was formed around a gorse stump. Some were marching quicker than the rest; their powers of endurance were evidently greater, and those who lagged behind were perhaps weary with their long journey and with the weight of their burdens, since we could see that they had come from far. I watched one worker, who travelled thirteen of my paces in three minutes, stopped a little to converse with a slave it met with on its way, and hastened on to its nest. I watched one worker of *sanguinea* travel twenty-three paces or yards, and carry the pupa to its nest. On its way it fairly outstripped two others who were journeying in the same direction and on the same errand. I was determined to trace back the scattered file of *sanguinea* to the spot from whence they had come, and so ascertain from whence they had obtained their precious burdens. I walked back forty-six paces, and discovered that they were filing out of a nest among the fern, and from this nest to their own there was constant motion, constant activity, and constant excitement.

But what of the nest which was evidently being pillaged of its infant inmates? There were two workers of *F. fusca* running frantically about upon the surface, with pupæ in their mandibles; and, in order evidently to escape from the fell determination of the marauders who were desolating their home, they hurried into the fern, and so endeavoured to ward off from themselves and infant progeny the threatening danger. I opened a portion of the nest, and found a nursery crowded with pupæ some depth below the surface of the nest; only one or two workers of *fusca* were left. The rest had evidently escaped with as many of the pupæ as they could manage to take charge of and save. I noticed several wandering over the desolated nest with pupæ and larvæ in their mandibles. I watched a *fusca* carrying off a pupa from behind the entrance whence the *sanguineæ* were issuing forth. Immediately it saw one of the enemy approaching, it dropped its charge and left it to its

fate. The *sanguinea* then gave it a push, and drove it off in double quick time. I then saw another *fusca* wandering over the nest, and trying to escape, as it were, by the back door, with a larva in its mandibles, but it was seen and overtaken by a small worker of *sanguinea*, who seized the baby from its perturbed and luckless foster-mother, and bore it off in triumph. I noticed a *sanguinea* coming up out of the nest with a pupa; and a *fusca* observing it, went up a fern-frond with the utmost expedition. My sister then observed a tussle between a *fusca* and a *sanguinea*. The *fusca* tried to force an entrance into its pillaged home; but, meeting with an antagonist, thought discretion the better part of valour, and turned tail with all speed.

These observations were made in the afternoon from 2.30 to 4.20. I now noticed a *sanguinea* take off a pupa from the same entrance into which the *fusca* vainly endeavoured to force its way; and I noticed, further, another pupa within the same entrance; hence was explained the persistency and anxiety of the *fusca*. It had most likely concealed these pupæ in the hope that they would be saved from the general wreck. A *sanguinea* had evidently found these out, and the *fusca* was endeavouring to rescue them from their inevitable fate. Several *fusca* were wandering over the disturbed nest. One took off a pupa, and fled with it in a direction contrary to that taken by the marauders; at the same time I watched a *sanguinea* frighten off a *fusca*. Another *fusca* met a *sanguinea* on the nest, and ran away precipitately. Another *fusca* then appeared wandering over the nest with a pupa locked in its embrace, knowing not which way to turn for succour and safety. One thing was patent from our observations—that between the *fusca* and the *sanguinea* there was a well-defined and clearly pronounced antagonism. In presence of the *sanguinea* the *fusca* were terror-stricken. In fact, the depredators had it all their own way, and were able in this instance, at least, to carry out their marvellous instincts without destroying

a single life. I now clearly understood that my most sanguine and anxiously cherished hopes had been fully realised, and that I had confirmed in my own experience the wondrous fact that *F. sanguinea* is not only a slave-owner, but a slave-maker. ✓

CHAPTER XVI.

The slave-making instinct first observed by M. P. Hüber in *Rufescens*—Hüber's historical sketch of the Amazon ants—A slave-making expedition described—Sir J. Lubbock's experiment—Mr. Frederick Smith the first in England to witness the slave-making instinct in active exercise—Charles Darwin also observed it—The important relation the whole history of ants bears to Darwin's theory of the origin of species—The author's experiences—Sir J. Lubbock witnesses *Polyergus* in captivity carrying off the pupæ of *F. fusca*—Other slave-makers—Forel's account of *S. testaceus*—A conflict between a mixed community of *S. testaceus* and *T. cæspitum* and an independent colony of *T. cæspitum*—Strange history of *Anergates atratulus*—Two alternatives proposed for the solution of the mystery—*Cataglyphis viatica* a slave-maker—*Aphenogaster barbara*, the harvester, a slave.

It should be known that the slave-making instinct was first observed by M. P. Hüber in *Rufescens*, which is not a British species; it belongs to an allied genus, viz. *Polyergus*, which may be distinguished from *Formica* by having the maxillary palpi four-jointed instead of six, and the labial palpi two-jointed instead of four. The mandibles being slender and curved, acute at the apex, and not dentate within, *Polyergus rufescens*, as *Formica sanguinea*, is associated with the family *Formicidæ*. It is found in France and Switzerland, and it was in the latter country that Hüber studied its marvellous economy. He says in his historical sketch of the Amazon ants:¹ 'On June 17, 1804, whilst walking in the environs of Geneva, between four and five in the evening, I observed close at my feet,

¹ *The Natural History of Ants*, pp. 248-252.

traversing the road, a legion of *rufescent* ants. They moved in a body, with considerable rapidity, and occupied a space of from eight to ten inches in length by three or four inches in breadth. In a few minutes they quitted the road, passed a thick hedge, and entered a pasture-ground, where I followed them. They wound along the grass without straggling, and their column remained unbroken, notwithstanding the obstacles they had to surmount. At length they approached a nest inhabited by dark ash-coloured ants—*i.e.* *Formica fusca*—the dome of which rose above the grass at a distance of twenty feet from the hedge. Some of its inhabitants were guarding the entrance, but on the discovery of an approaching army, darted forth upon the advanced guard. The alarm spread at the same moment in the interior, and their companions came forth in numbers from their underground residence. The *rufescent* ants, the bulk of whose army lay only at the distance of two paces, quickened their march to arrive at the foot of the ant-hill. The whole battalion in an instant fell upon and overthrew the ash-coloured ants, who, after a short but obstinate conflict, retired to the bottom of their nest. The *rufescent* ants now ascended the hillock, collected in crowds on the summit, and took possession of the principal avenues, leaving some of their companions to work an opening in the side of the ant-hill with their teeth. Success crowned their enterprise, and by the newly made breach the remainder of the army entered. Their sojourn was, however, of short duration, for in three or four minutes they returned by the same apertures which gave them entrance, each bearing off in its mouth a larva or a pupa. They retraced the route by which they had arrived, and proceeded, one after another, without order or regularity. The whole army might be readily distinguished in the grass by the contrast afforded by the *rufescent* ants and the white larvæ and pupæ they had captured. They repassed the hedge and the road in the place they had previously crossed it, and then

directed their course through a field of ripened corn, where I experienced the regret of not being able to follow them. I now retraced my steps towards the scene of the recent assault, and there found a small number of ash-coloured labourers, perched upon the stalks of plants, holding in their mouths a few larvæ they had rescued from pillage; these they shortly carried back to their former station.' 'This feature,' he adds, 'so prominent in the history of *rufescent* ants, of whose real name I was then ignorant, induced me to give them the appellation of Amazon or Legionary ants, as being most analogous to their martial character.'

Hüber shows how utterly dependent these Amazon ants are upon their slaves, which spring from the captured larvæ and pupæ, and which they sometimes draw from the colonies of the *Formica cunicularia* as well as the *Formica fusca*, both being mining ants. The *F. cunicularia* is very similar in appearance to the small workers of the *F. rufa*, but its habits are different from the wood-ant, which is more of a builder than a miner, though some of its chambers are subterranean—these, however, are merely the underground offices of their thatched dwelling, into which they retire during hibernation. The auxiliaries are alone employed in establishing a new domicile, and in carrying thither the *rufescent* ants with their pupæ and larvæ, whenever their masters wish to change their abode. As a rule they build the nest, rear the young, and furnish them with provisions, and even feed their masters. Hüber says,¹ 'I have never seen the Amazons take nourishment but from the mouth of the negroes. I have presented to them honey and fruit, which they left untasted. When hungry they approach their auxiliaries, and these disgorge in their mouths the juices they have obtained from the aphides, the ant-cows which they milk for the common benefit.'

Sir John Lubbock records² how he had a nest of this

¹ *Ants*, p. 286.

² *Ants, Bees, and Wasps*, pp. 83, 84.

species under observation for a long time, but never saw one of the masters feeding; how he kept isolated specimens for weeks by giving them a slave for an hour or two a day to cleanse and feed them, without which assistance they would have perished in two or three days. He says, 'I know no other case in nature of a species having lost the instinct of feeding.' Hüber also discovered the slave-making instinct in *F. sanguinea*, which, as we have seen, is not nearly so dependent upon its auxiliaries as *F. rufescens*, since it shares with its slaves the work of the common home. Other continental entomologists have verified Hüber's observations, especially Auguste Forel, who has recorded the results of his investigations in his interesting work on the ants of Switzerland.

Mr. Frederick Smith was the first in England to witness the slave-making instinct in active exercise. In a letter dated March 7, 1878, he gave the following information about the species in answer to my inquiries as to his knowledge of its habitat: 'I have found *F. sanguinea* in four localities—Blackwater, Hants, Weybridge, Chobham Heath, and Shirley Common, all on the Bagshot sands.' It was at Blackwater that he witnessed a slave-making expedition. 'It was,' he says,¹ 'in the summer of 1843 I discovered a colony of this slave-making ant, and very closely I watched it, in the hope of witnessing what others had described; not that I doubted the truth of such relations, but it almost seemed necessary that I should myself be a witness of such a fact before I could attribute to these creatures such an extraordinary and odious instinct. Three successive years passed without any satisfactory result. In the nests I found plenty of slaves, or, at least, plenty of a very different species to the *F. sanguinea*, all being black and smaller. One morning, on passing the nest, swarms of ants were spread over the bank in which the nest was situated. The larger ants, the soldiers, were very active,

¹ From an unpublished manuscript in the possession of the author.

and constantly assuming the most threatening attitudes, standing erect,' occasionally springing up on their hinder feet, and snapping their jaws with great ferocity. The sun burst out, and the whole host rapidly retreated to their subterranean abode. Again, in the evening, I visited the spot, and to my delight I found the army again in battle array. Numbers of the largest ants at length separated from the rest, and formed the advanced guard or van, and the whole body was in motion. At a distance of about twenty yards was a nest of *Formica fusca*. This was the object of their attack. Without the slightest pause, the advanced warriors boldly entered the nest, and in poured swarms after them. After a few moments had elapsed numbers issued forth, each carrying their slaves in their jaws. Occasionally, a number of black ants rushed out of the nest and gallantly attacked their invaders, but they were quickly overcome, and carried off to the nest of the victors. Frequently, however, they were torn limb from limb, in which case their mangled bodies were borne off, no doubt as food, to the nest. In plundering a nest, although numbers of ants are carried off, by far the greater number convey the pupæ, or young brood, of the black ants, and I have some suspicion that it is these which, being born in the nest, become slaves from birth.'

This suspicion is undoubtedly correct. While watching the triumphant procession of *F. sanguinea* returning from the successful marauding expedition, I did not observe a single black worker being borne along. The spoils of conquest consisted almost entirely of pupæ, a small proportion being larvæ.

Charles Darwin was the second naturalist who observed in England the slave-making instinct of *sanguinea* in active exercise. Charles Darwin was a most accurate observer, and has rendered brilliant services to science by the diligent accumulation of facts in the domain of zoological research ; but while we welcome his facts, we are forced to repudiate

his theory of the origin of species, since it is not borne out by the result of scientific inquiry. For its establishment it demands transitional forms of life when none have been proved to exist in the historical era, and when no trace of their existence has been found in the stony records of pre-historic or geological epochs.

In passing I cannot refrain from alluding to the important relation which the whole history of ants bears to this theory. It is my conviction that as surely as the Brazilian Saübas defoliate, and thus jeopardise the life of the orange trees of Pará, so surely do the ants rob the theory of development of its seemingly fair proportions and fancied triumphs. Darwin himself, with that candour which ever characterised him, acknowledges¹ that the existence of several forms or castes among the workers having different functions presents the greatest difficulty to the acceptance of his theory of the origin of species by natural selection.

The supposition he hazards to solve the problem and overcome the difficulty seems to me to be destructive of the very essence of the theory he desired to establish. As a rule, this worker class of different forms and varying instincts, whose existence seems so advantageous to the species, has not the power to lay eggs, and so is unable to transmit the beneficial modifications to be garnered up and carried forward for the permanent advantage of future generations. The scene would to a certain extent be changed, and the prospect would in a slight degree brighten in favour of his theory, if instances could be recorded of the production of ova and the subsequent development of the perfect insect by the worker caste. Such instances have been noted by scientific observers, Sir J. Lubbock among the number. But what do we find? Strange to say, all the ants that are matured from these worker eggs in nowise resemble the parent with its beneficent function

¹ *Origin of Species*, pp. 235, 236.

and beneficial instincts and endowments—for they are all males!

Another difficulty the little people offer to the acceptance of the theory of evolution as interpreted and illustrated by Darwin, is the constantly manifested and clearly defined antagonism between members of the communities of the different families, genera, and species, nay, even between the members of the different colonies of the same species, which seem to forbid peremptorily a common origin or ancestry. And lastly, the marvellous intelligence of the little people, which seems so closely allied to reason as to differ from it, as Sir J. Lubbock justly observes, in degree though not in kind, and which places these aculeate *Hymenoptera* next to man in the ranks of intelligent being, rather than the anthropoid apes, which resemble him only in anatomical structure and physiological endowment, appears still further to disturb the conclusions of the advocates of the evolutionary philosophy, and leads the earnest and unprejudiced searcher after scientific truth to pause before adopting it as his creed.

Darwin has recorded¹ how, during the months of June and July, in three successive years, he had watched many hours several nests of *F. sanguinea* in Surrey and Sussex, and in the year on which he wrote his narrative he witnessed a migration from one nest to another, the masters carrying instead of being carried by their slaves, as is the case with *P. rufescens*. Another day he watched about a score of the slave-makers haunting the same spot. They approached, and were vigorously repulsed by an independent community of the slaves (*F. fusca*), sometimes as many as three of these ants clinging to the legs of the slave-making *F. sanguinea*. The latter ruthlessly killed their small opponents and carried their dead bodies as food to their nest, twenty-nine yards distant, but were prevented from getting any pupæ to rear as slaves. He then mentions how he dug up a small

¹ *Origin of Species*, p. 220.

parcel of the pupæ of *F. fusca* from another nest and put them down on a bare spot near the place of combat. These were eagerly seized and carried off by the tyrants, who perhaps fancied that, after all, they had been victorious in the late combat. 'One evening,' he says,¹ 'I visited another community of *F. sanguinea*, and found a number of these ants returning home and entering their nests, carrying the dead bodies of *F. fusca*—showing that it was not a migration—and numerous pupæ. I traced a long file of ants burthened with booty, for about forty yards, to a very thick clump of heath, whence I saw the last individual of *F. sanguinea* emerge, carrying a pupa. But I was not able to find the desolated nest in the thick heath. The nest, however, must have been close at hand, for two or three individuals of *F. fusca* were rushing about in the greatest agitation, and one was perched motionless, with its own pupa in its mouth, on the top of a spray of heath, an image of despair over its ravaged home.'

The wonderful instinct of *F. sanguinea* witnessed by Messrs. F. Smith and C. Darwin has been observed in active exercise in England only, I believe, by one other student of God's marvellous works, viz. the humble member of the Entomological Society who is now placing on record an account of his experience of the ways and doings of the little people.

Mr. Rothney, who discovered so many species of ants in *sanguinea* nests at Shirley, has not witnessed the manifestation of its slave-making instinct. In his letter dated March 9, 1879, he writes: 'I am glad to hear you were fortunate in finding *sanguinea* on a slave-making expedition, and I should much like to read your account of it. I must say that, after spending hours per week for even four years, and never seeing any sign of such military expeditions, although I knew and visited the nests of all the *fuscas* on the heath, I began to feel sceptical on the subject, and

¹ *Origin of Species*, pp. 222, 223.

fancied that either these expeditions required French or German eyes to see, or were a matter of pure romance, and that *fusca* took up its quarters in the nest of *sanguinea* from a love of mixing in good society, viz. that they were a little better than toadies, and were glad to do the dirty work, to be seen in the company of the great. There is one point I particularly noticed in my rounds of the nests, and that was, that *F. fusca* seems at home as a quiet, easy-going ant, with a strongly developed sense that discretion is the better part of valour. But the *fusca* found in the nest of *sanguinea* is a very different sort of fellow, and the bravest of the brave; *sanguinea* is bold, but the retainer, *fusca*, is bolder. Is this not strikingly like native troops and English officers? the black require the lead of the white or red.'

On March 11, 1878, I heard from Sir John Lubbock, and it appears that he has not witnessed *F. sanguinea* in its native haunts conducting a slave-making expedition. He says, however, 'I have had a nest of *Polyergus* a long time, and having put a colony of *F. fusca* near it, they made an expedition and carried off the pupæ.' He adds, 'I have never found it on the Continent. *F. sanguinea* and *P. rufescens* feed well on honey. I also occasionally give them meat.'

In addition to *F. sanguinea* and *P. rufescens*, there are several other slave-makers among the little people. Sir John Lubbock, in a paper read before the Royal Institution of Great Britain, on January 26, 1877, thus refers to two remarkable species: 'In *P. rufescens*, the so-called workers, though thus helpless and stupid, are numerous, energetic, and, in some respects, even brilliant. In another slave-making species, however, *Strongylognathus*, the workers are much less numerous, and so weak that it is an unsolved problem how they contrive to make slaves. Lastly, in a fourth species, *Anergates atratulus*, the workers are absent, the males and females living in nests with workers belonging to another ant, *Tetramorium cæspitum*. In these cases, the

*Tetramorium*s, having no queen, and consequently no young of their own, tend the young of *Anergates*. It is, therefore, a case analogous to that of *Polyergus*, but it is one in which slave-owning has almost degenerated into parasitism. It is not, however, a case of true parasitism, because the *Tetramorium*s take great care of the *Anergates*, and, if the nest is disturbed, carry them off to a place of safety.'

The *Strongylognathus* here spoken of is doubtless the *S. testaceus*. Mr. F. Smith thus wrote in a letter to me, dated March 7, 1878:—'*Strongylognathus testaceus* is the only species belonging to that genus. It is a minute species of *Myrmicidæ*, and I had not known of its having been discovered to be a slave-making ant. What species can so minute a creature carry off? *Anergates astratulus* is unknown to me.' Forel has given¹ most interesting details of the economy and habits of these two species. With reference to *S. testaceus*, he mentions how it holds in servitude *Tetramorium cæspitum*. He describes a spirited contest between the mixed community and a colony of *T. cæspitum*, which he had placed near their nest, and which contest, I think, may throw light upon a hitherto insoluble mystery, viz. as to how the *S. testaceus* procures its slaves. The workers of *Strongylognathus* displayed undoubted courage in the attack, and were on the winning side. Their victory, however, was owing entirely to the skill and endurance of their auxiliaries, and though many of the *Strongylognathus* perished in the conflict, they were not able to kill a single opponent; and, further, it was the auxiliaries, the *Tetramorium*s, of the mixed community who carried off the pupæ from their antagonists, the independent colony of the *Tetramorium*s. Forel tells² us how the faithful record of the combat serves to show that the new

¹ See *Les Fourmis de la Suisse*, chapters xv. and xvi.

² *Ibid.*, p. 347. These are his words: 'Je crois que le récit fidèle de ce combat suffit pour montrer que cette nouvelle Amazone n'est qu'une triste caricature du *P. rufescens*.'

Amazonian ant (*S. testaceus*) is but a poor caricature of *P. rufescens*. I may add that it has the advantage over the *rufescens* in being able to feed itself, though it seems that it cannot, unaided, like the historic Amazonians, capture slaves.

This incident seems to show that *testaceus* is able to procure slaves, and thus perpetuate its mixed community through the unwilling and effective co-operation of its auxiliaries.

Forel has made a most interesting discovery of another species¹ of *Strongylognathus*, which is undoubtedly a slave-making ant, and which is able, unaided, to engage in military expeditions and increase the number of its auxiliaries, and so satisfy the exigencies of its economy. Sir J. Lubbock alludes to this species in his recent work, and well summarizes its interesting habits. He tells² us that this species, discovered by Forel, and which is designated *Strongylognathus Hüberi*, very much resembles *Polyergus rufescens* in its habits, that 'they have sabre-like mandibles, like those of *Polyergus*, and their mode of fighting is similar, but they are much weaker insects; they make slaves of *Tetramorium cæspitum*, which they carry off as pupæ. In attacking the *Tetramoriums*, they seize them by the head with their jaws, just in the same way as *Polyergus*, but have not strength enough to pierce them, as the latter do. Nevertheless, the *Tetramoriums* seem much afraid of them.'

The strange and anomalous species, *Anergates atratulus*, which was unknown to Mr. Smith, I have briefly referred to, under exceptional forms in ant-life and structure, in a former chapter. The history of the ant, its economy, and the constitution of its *formicarium*, is fully chronicled by Forel.³ The colony consists of males and females, the

¹ See *Les Fourmis de la Suisse*, chapter xvii.

² *Ants, Bees, and Wasps*, p. 84.

³ *Les Fourmis de la Suisse*, chapter xv.

males being apterous, and having no workers, their place being supplied by the workers of that invaluable species *Tetramorium cæspitum*, upon which the males and females of the colony are entirely dependent. Mr. Smith has unconsciously alluded to the species in his *Catalogue of Hymenopterous Insects*, part vi., '*Formicidæ*,'¹ where it is called *Myrmica atratula*, according to Schenk. The ant was, in fact, first discovered by Schenk, who took the workers to be of the same species. Sir J. Lubbock mentions² how Mayr first pointed out that the workers were those of *Tetramorium cæspitum*. The question arises whether *Anergates atratulus* is a guest-species, living with *Tetramorium cæspitum*, or a slave-making ant, holding *T. cæspitum* in bondage. If the former, how is it that only workers of *Tetramorium*, and not also larvæ, pupæ, or apterous females, have been discovered in the mixed communities by observers such as Forel and Vons Hagens? If the latter, how can it secure a supply of slaves, being too weak and too few in number to organise and successfully undertake a marauding expedition? Sir J. Lubbock suggests³ the tragic hypothesis that *Anergates* might enter the nest of *Tetramorium*, assassinate the queen, and remain an unbidden guest. But this, I think, is quite untenable, since it would not have the power to execute so daring a plan, and its violent intrusion would be followed by instant extermination. Two alternatives I would suggest: 1st, that *Anergates* is a guest-species, living with *Tetramorium*, the queen of the *Tetramoriums* having died, and in her place a permanent welcome been accorded to the males and females of *Anergates*, or the apterous *Tetramorium* female, by whose presence an adequate supply of workers might be secured, may have been overlooked by observers; or, which is more likely, being more in accordance with precedent, the *Anergates* is a slave-maker, with habits similar to *S. testaceus*, using its auxiliaries,

¹ P. 117. ² *Ants, Bees, and Wasps*, p. 86. ³ *Ibid.*, pp. 87, 88.

upon whom it is absolutely dependent, to capture the pupæ of *Tetramorium*, and so keep up a supply of servitors, without whose help the species would soon become extinct.

There is another slave-making ant, which has not yet been brought into prominence or received that attention which its interesting history deserves. Mr. Smith first brought it under my notice. He says:—‘In the sixth volume of the *Journal of the Proceedings of the Linnean Society* I published descriptions of species of ants from the Holy Land; amongst them was *Cataglyphis* (or *Formica*) *viatica*, or slave-making ant.’ The slave in this case is the harvesting species, *Aphenogaster barbara*. The identification of the harvester as the slave of *viatica* might be overlooked by the ordinary reader, since in the paper, the ant, in dependent association with *viatica*, is called the *Atta cephalotes*, which Mr. Smith gave me to understand is Latreille’s designation for *A. barbara*. *Viatica* is a magnificent ant, considerably larger than *barbara*, with long legs. It has a black shining abdomen and brilliant mahogany-coloured head and thorax, some specimens being paler than others, while some, again, have those parts as dark as the abdomen. I have beautiful specimens both from Algeria and Syria, one fine form being from Acre. Thus runs Mr. Smith’s record¹:—‘This ant and the *Atta cephalotes*, according to the information that I have been able to obtain, are usually, if not always, found in the same localities, and it would appear that, in some degree, they are dependent on each other. It is now a well-ascertained fact that other species, in the fulfilment of their economy, require the aid of a distinct race, or, rather, are dependent on slave labour for the rearing of their young brood, and for the performance of many other offices connected with the duties of their *formicarium*. The connection between the *F. viatica* and *Atta cephalotes* appears to be similar to

¹ *Proceed. Linn. Soc.* for 1861, vol. vi. pp. 2, 3.

that which exists between *F. sanguinea* and *F. fusca*. The substance of the following account was communicated by M. Roussel to Dr. Nylander. M. Roussel observes that both species are common in Algeria, that they live in numerous societies, and construct their *formicaria* usually in banks, frequently at roadsides. It would appear that fierce combats take place occasionally between the *Formicæ* and the *Attæ*, the former being always victorious and carrying off captive members of the *Attæ*, which henceforth become the nurse-slaves of *F. viatica*. M. Roussel frequently observed evidences of fierce encounters between these species of ants, having found the ground in the vicinity of the nests of the *Attæ* strewn with the mangled remains of both combatants; but he does not appear to have ascertained whether the *F. viatica* carries off the *Atta* in the pupa or perfect condition. Probably the former, since, judging from analogy, it would appear necessary that such should be the case, as under such circumstances the *F. fusca* in the nests of *F. sanguinea* appears to form, as it were, an absolutely necessary part of the community. Probably such perfect individuals as are sometimes carried off by slave-making ants are not intended to form part of the living population. Mr. Bates, who resided several years in Brazil, communicated to me some very interesting accounts of the habits of various predaceous species of ants. Not only did he observe the slave-makers carrying off pupæ from the nests of more peaceable communities, but he also witnessed the slaughter of the defenceless species—their furious assailants tearing the larger and more weighty females limb from limb, and then carrying away the mangled remains to their own habitations. Such, probably, is the fate of such living examples as may be frequently observed vainly struggling with their more warlike invaders. M. Roussel observed *Atta cephalotes* in great numbers living in perfect harmony in the nests of *F. viatica*.

Slave-making ants are found in America. Dr. McCook

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mentions¹ how the nests of six species of true ants and of the northern species of white ant, *Termes flavipes*, are found parasitic upon the nests of the occident ant, the agricultural ant of the American plains, *Pogonomyrmex occidentalis*. He says: 'On three separate pavements I found colonies of the sanguine slave-maker, *Formica sanguinea*. Each colony was located upon the clearing not far from the mound, and was marked by openings into the earth quite surrounding the bases of one or two tall weeds or wild flowers—one of them a sunflower. The openings were large, three-fourths of an inch wide, and served as the gates into the interior of the formicary. The sunflower nest had an opening around the plant one and one-eighth inch in diameter. The branches of the plant were covered with aphides, who were attended by numbers of the slave species, *Formica Schauffussi*, intermingled with whom were many of the slave-makers. Another slave species, a small black *Formica*, new to science (apparently), occupied one of the colonies in lieu of *F. Schauffussi*. The number of ants in these compound nests was quite large, judging from those in sight; and the territory occupied by them, as determined by an outside example explored, embraced a goodly portion of the interior nest-space. Yet there was nowhere upon any of the three formicaries at any time discerned the slightest trace of antagonism to these guests on the part of their Occident hosts. The species were not greatly unequal in size, but the disparity in numbers was such that the Occidents could soon have exterminated the Sanguines and their kidnapped retainers. That they did not do so seems to indicate a peaceful and tolerant nature. Again, in the larger nest of *Occidentalis* explored by me (Excavated Nest No. 2) there were found three nests of a small red species, one of a small black ant, and one of a large blue-black *Formica*—all within the compass of the

¹ See *The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains*, pp. 152, 153.

underground nest-space, all showing full organisation, with queens, males, cocoons, and larvæ, and all having galleries and chambers perfectly formed and wholly undisturbed. Besides these, three colonies of the erratic ant were established upon the clearing. The nests of the small red ants were found within the cone itself, and one of them extended for eight inches directly across it. The small black ants were also nested within the cone, and had a domicile which was almost a miniature reproduction of the interior of an Occident nest.'

In conclusion, though we cannot exactly sympathise with the *sanguineæ* in their kidnapping proclivities, yet we are forced to commend their wisdom in taking off their slaves when in an unconscious state, their diligence in educating them, their kindness to them at all times, as evidenced by the affection of the slaves towards their masters, for though possessing ample opportunities to escape, being at perfect liberty to go in and out of the common home, according to their pleasure, they yet never attempt to run away. In fact, from personal observation, I can confidently assert, without fear of contradiction, that the masters treat their auxiliaries as Seneca tells one of his correspondents that he should treat his slaves, not like beasts of burden, but as humble friends.

CHAPTER XVII.

The variety in the architectural designs of the ants—Habitation of the common yellow ant described—*F. aliena* (*L. alienus*) a miner and a mason—Typical nest of *Formica*—Dimensions of the nests of the wood ants—The common garden ant storming Exsecta's castle and destroying the garrison.

LET us now notice the construction of the houses of the little people. The extraordinary variety in their architectural designs must necessarily constrain us to be brief in describing each. The young folks of the ant colony are weavers, and the labourers careful nurses. Not only are the young or larvæ of ants—as a rule those of the family *Formicidæ*, and among the *Myrmicidæ* those belonging to the genus *Myrmecia*, skilful weavers,—but, what is not so generally known, sometimes even the workers are weavers also, viz. those of the genus *Polyrachis*. I have a beautiful nest of *P. lævissimus* from Calcutta. It is in form and texture very similar to the shuttle-shaped, pale yellow cocoons which the larvæ of the British moth called the Drinker (*Odonestis potatoria*) fashions and hangs upon the grass stems in the late spring-tide. It is about twice the size, being rather more than $2\frac{2}{3}$ inches in length, and two-thirds of an inch in its largest diameter, the cocoons of 'the drinker' being $1\frac{1}{8}$ inch in length and half an inch in diameter at its thickest part. The nest is pale buff in colour, like that of the cocoon of *Myrmecia piliventris*, and leathery in texture, but when a portion of the outer surface is removed,

it is found to be composed of a web of fine white silk. It was Mr. T. C. Jerdon who first brought to light the constructive habits of this interesting genus. He thus¹ describes the nest of the species *nidificans*: 'This ant makes a small nest, about half an inch, or rather more, in diameter, of some papyraceous material, which it fixes on a leaf. I have opened two, each of which contained one female and eight or ten workers. It is very rare, and I have only seen it in Malabar.' Mr. F. Smith adds, 'Since the publication of these remarks, a nest of one of the species has been received from Malacca; it was discovered by Mr. Wallace, and exactly agrees with Mr. Jerdon's description.' Among the labourers are found not only weavers but miners, masons, bricklayers, plasterers, carpenters, wood-carvers, thatchers, and tent-makers, and some there are who combine the profession of civil engineer with that of architect.

The reader is doubtless familiar with the habitations of the common yellow ant, *Formica flava*, which are frequently found adorning—some would say disfiguring—the surface of meadows and commons and slopes of railway cuttings and embankments. Generally they look like grassy mounds; in form they are, as a rule, conical, but sometimes, like the old Irish round towers, cut down and protected with a semi-spherical roof. They vary in height, being sometimes less and sometimes more than a foot. They are so constructed as to ensure perfect drainage. Innumerable chambers and passages are formed within the dome and beneath it. The dome increases in height and circumference as the colony multiplies, the growing population requiring additional accommodation. The waste material caused by the enlarged chambers is thrown upon the surface by the provident labourers, and while adding to the height of their dwelling, gives greater protection from

¹ See *Catalogue of Hymenopterous Insects*, part vi. '*Formicidæ*,' by Frederick Smith, p. 58.

the variable climate. At the same time they take good care that the symmetry of the building is not destroyed.

Having placed the habitations of this little people in glass vases of different sizes, and created artificial darkness by covering the transparent surface of their prison-house, either with green baize or brown paper, which answers equally as well, and so leading them to believe their dwelling to be underground, I have oftentimes induced indefatigable labourers to work against the glass with vigour and animation. As to the many thousands of bricks they prepare with their tiny saws and feet, the many labyrinths of chambers and corridors they construct in their densely-peopled houses, all leading into each other, like the halls and galleries of some lordly castle, all fashioned with accurate precision, of differing dimensions, yet of uniform symmetrical proportions, and the many bricks of their numerous vaulted galleries and departments supporting each other effectually on the scientific principle which keeps the arch in true position, no words of mine can give any adequate description. The reader must see their handiwork in order rightly to appreciate how, in the construction of their dwellings, the little people are exceeding wise.

It is said that they sometimes utilise mole-hills for the purpose of constructing their houses. This may very possibly be the case. The only instance I have met with of an ant colony taking possession of a mole-hill was in 1879, when I found one side of a mole-hill occupied by *M. lævinodis* in strong force. *M. scabrinodis* sometimes shares the grassy mounds above referred to with *F. flava*, and fashions its less numerous chambers and galleries upon a similar plan. In hilly districts, where many flat stones are lying scattered over the undulating ground, *F. flava* oftentimes dispenses with the usual mound or tower, and utilises the stones for comfort and protection. Such I find to be the case on the sunny slopes of the Cotswolds, not only with *F. flava*, but with many other species of *Formica* and

Myrmica before enumerated. *F. cunicularia*, a true miner, takes advantage of such a shelter, as also *F. nigra* and *F. aliena*. *F. nigra* is most common in gardens at the side of gravel paths, the entrance to its burrows being at once discovered by the little heaps of refuse earth which it casts up from its subterranean chambers. *M. levinodis*, which I have also found under stones, throws up usually among the growing grass masonry of an ovate form.

The *F. aliena*, which is both a miner and a mason, I have found occupying a mound at Bournemouth; when in the open sand it, however, forms circular entrances to its subterranean domicile, which is sometimes funnel-shaped, the rim of the funnel being formed of masonry cast up with its waste building material, which it thus utilises. This is the case more especially in Suffolk. *F. umbrata*, for the greater part of the year, lives underground, but when swarming in the autumn it appears in large numbers on the surface, issuing from its subterranean chambers by innumerable entrances, which it at that season arranges in the soil, throwing up a perfect fretwork of masonry, which I have before alluded to when describing the habits and work of the species in my artificial *formicarium*. The workers, however, sometimes issue forth at night earlier in the season. In the year 1879 I found in a net, with which my little boy had in the dusk captured moths from the vicarage shrubbery, several specimens of this species closely allied to *F. flava*. They were possibly foraging for the benefit of the home party; perhaps gathering honey-dew or searching after *aphides*. This ant is well named *umbrata*, when we take note of its love of retirement and shade.

One other ant is, perhaps, a still greater lover of privacy—the *Diplorhoptum (Solenopsis) fugax*, the smallest British species—which prefers sometimes trodden pathways to burrow in, and I believe has only once been seen above ground in England. This was by Mr. F. Smith, who captured a female on the sand-hills at Deal. He it was

who first discovered it at Southend by digging. We have already incidentally mentioned that *F. sanguinea*, with the assistance of its auxiliary, *F. fusca*, constructs its residence around the stumps of the golden gorse. Its chambers are fashioned with much skill out of the friable soil of the Bagshot sands, though bits of stick and chips of fern-root are introduced and worked in according to the discretion of the little builders. At Crowthorne I have found its nest fashioned in a turf bank, many chambers full of pupæ, and two or three winged females among the number, being arranged between the layers of turf.

When in the Crown Woods, Eltham, I chanced to strike my foot against a stump of quaint and rugged twist. It split, and I found myself for the first time in presence of a colony of negro ants, their dusky skins brought out into bold relief by a fine skirt of brassy silk upon their loins. I captured two queens, and numbers of their sable subjects. These negroes are really miners, but they had taken up their winter quarters in the stump. It may be that this power of adapting itself to circumstances, which is, as we shall see, possessed by many other species of the little people, may be enjoyed by *F. sanguinea*, or it may be that the versatility of the negro's architectural genius may have been introduced into the master's home by the black dependant, and there have manifested itself to the common advantage; since in the mixed ant-hill I have found the central gorse stump channelled and tenanted by the two species, some of the chambers being set apart as nurseries.

The *F. rufa*, so closely allied to *F. sanguinea*, I have discovered more than once occupying a stump of an old tree, and heaping up its singularly-constructed nest both above it and around it, for though the conical nest looks like a small hillock formed of bits of stick and pine-needles, it is built upon a well-conceived plan, and executed with undoubted architectural skill. The conical structure is a rule not around a stump, but on the open

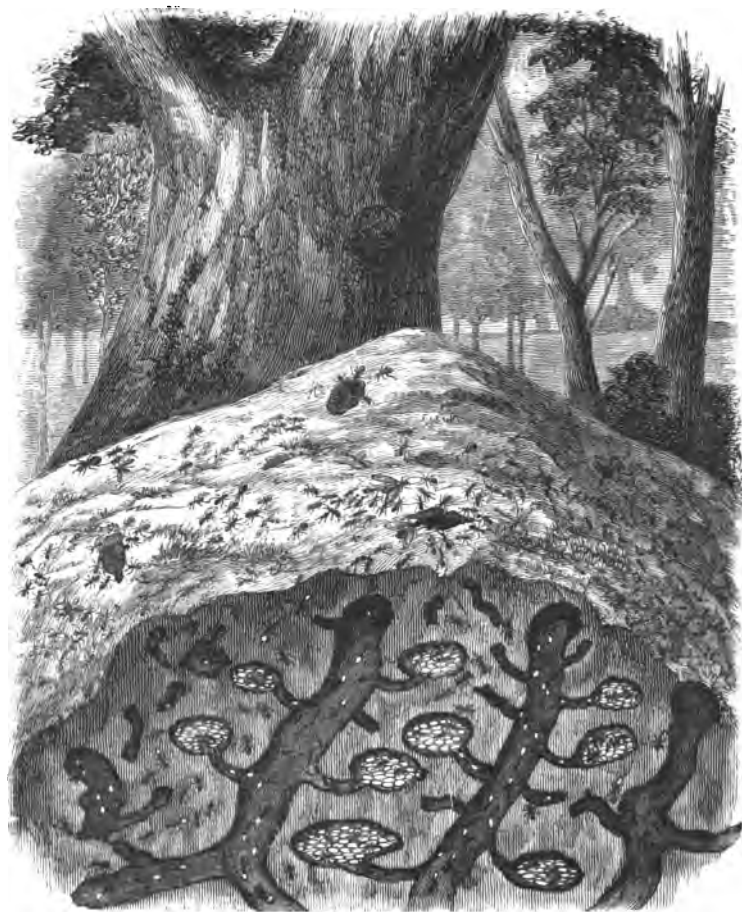


FIG. 35.—Section of nest of *Formica rufa*.
From a drawing of the late Mr. F. Smith, of the British Museum.

ground in the shades of pine woods or in their neighbourhood, and covers a space of considerable extent. I have found them full forty feet in circumference. The ground beneath the dome—as is also the dome itself, about two feet in height—is wrought into chambers and connecting passages, amply sufficient to accommodate the many thousands of its inhabitants. The entrances to the marvellously-constructed domicile are as a rule in the well-thatched dome, for never was hay-stack or corn-rick thatched with more consummate art than is the nest of the wood-ant; and what is most worthy of notice about these entrances is that as the shadows lengthen and the twilight intervenes, they are closed by the intelligent little people, and so closed that while they secure protection, the air is not excluded. The shutters and doors are formed of lattice-work, the labourers crossing and recrossing little sticks, until free ingress and egress is completely barred. I have watched the inhabitants of a palatial residence of *F. rufa* in the valley of East Lynn thus putting up their shutters and closing their doors at eventide as the sun was hastening to its setting, and its departing golden glory was reflected in the running stream which made pleasant music on its journey to the sea.

The drawing of Mr. F. Smith, from which Fig. 35 was engraved, forms the representation of a typical nest of *Formica*, doing service for the constitution of a nest both of *F. rufa* and also of *F. fusca*. In the former case the conical roof is the thatched dome of the heaped-up nest of the intelligent builder, and in the latter, the conical-shaped bank which forms the upper surface of the subterranean habitation of the ingenious miner. The chambers and corridors of the formic castle, as disclosed in the section, being in each case constituted upon a similar plan. I have found *F. rufa* acting as a miner by arranging its nest in a bank at Budleigh, Devon, and at Weybridge, Surrey. And I have also discovered an allied species, *F. congerens*,

acting as a miner in a turf bank at Bournemouth. This ant, and also *F. exsecta*, constitute the two other British species of wood-ant. The former (*F. congerens*) is the common wood-ant of Bournemouth, and, as a rule, constructs its habitation on the same architectural principles as *F. rufa*. The common wood-ant (*F. rufa*) is very rare at Bournemouth. That it is found there I know, since Mr. C. W. Dale has kindly given me a specimen of the queen of this species, which is readily distinguished from *F. congerens* by its glabrous abdomen, which his father, the late Mr. J. C. Dale, discovered in the locality. A very large nest of *F. congerens* I discovered on a sloping bank of fern and heather and gorse, on the margin of the running stream which gives the name to this charming retreat on the southern coast. A careful measurement gave the depth at the crown of the nest twelve inches, and eighteen inches down the slope of the bank seven inches across the nest; from the upper part to the base on the declivity seventy-two inches; and a foot from the crown, fifty-three inches across. The circumference measured eighteen feet and four inches. There were seven entrances through the cleverly-arranged thatch, and as my wife sketched the nest, we watched the busy workers arranging the trellis at the entrances with narrow sticks and the long pine-needles of the Scotch fir for doors and shutters.

This species is very difficult to distinguish from the common *rufo*. It is more pubescent, and the abdomen of the male and female is not so shining as is that of the more familiar species. Besides Bournemouth, it has been met with at Loch Rannoch, in Perthshire, and other localities. The third wood-ant, *F. exsecta*, seems to belong almost exclusively to Bournemouth and its neighbourhood, having been discovered also at Poole and on the outskirts of the New Forest, near Ringwood, by myself, on the heathy carpet of the neighbouring woods, its interesting nest rising up gracefully from the heather. The thatched dome

is very much smaller than that of the two other species, and formed of little bits of grass, fern-frond, and ling.

I discovered a little nest at Boscombe, near Bournemouth, the dome of which was charmingly situated among the heath and the bracken, and measured in circumference



FIG. 36.—Nest of *Formica exsecta*, Boscombe, near Bournemouth.

thirty-two inches, and in height only three inches. *F. exsecta* is a brilliant ant, having a blood-red thorax and legs, the occiput widely notched, and the scale of it is smaller than the two allied species. Mr. F. Smith¹ endeavoured to establish a colony in his garden at Islington, which he

¹ See *Ent. Annual*, 1869, pp. 70, 71.

transported safely from Bournemouth, but unhappily his intentions were frustrated by the common garden ant, *F. nigra*, who resented the trespass upon what it doubtless considered its own rightful domain, and in strong force attacked and stormed *exsecta's* Lilliputian castle, and took the whole garrison prisoners, forming a triumphal procession from the citadel to its subterranean stronghold, each warrior of *F. nigra* bearing in its mandibles a captive *exsecta*. Strange to say, not a single member of the captured garrison ever reappeared, and the inevitable conclusion drawn from the incident was, that the conquerors devoured their luckless prisoners, and not, as Mr. Smith had hoped, that he had discovered *F. nigra* (*L. niger*) in the act of conducting a slave-making expedition.

CHAPTER XVIII.

F. rufa and *F. sanguinea* take in lodgers—Distinct species found in the nests of other ants also—The jet ant both carpenter and wood-carver; sometimes a miner—The garden ant discovered to be a wood-carver—The author also discovers *F. umbrata* (*L. umbratus*) as wood-carver and carpenter—The plasterer and tent-maker from Sierra Leone—The umbrella ant—The thorn-nests of *Pseudomyrma modesta* from Panama—The ‘bull-dog’ ants in South Australia—The driver ant of Africa.

WE have noticed in a previous chapter, while investigating the domestic arrangements of *F. sanguinea*, how its mansion is sometimes transformed into an hotel, this enterprising ant, with the help of its sable dependants, offering accommodation to many other species, who seem well satisfied with their comfortable quarters. *F. rufa* takes in lodgers also. I have already called attention to the presence of a small party of *F. flava* in the commodious domicile of *F. rufa* in the valley of the Horner. You must know that a very distinct species of ant, pale-reddish, smooth and shining, is found in the nests of *F. rufa* and *F. congerens*. I have only heard of its being discovered in association with *F. rufa* in this country. They have been found in the nests of *F. rufa* in some abundance at Weybridge. The name of the species is *Stenamma Westwoodii*. I have already referred to the rare ant, *Tetramorium lippula*, which I found at Lynmouth in the year 1878, and many years before, when I first began my researches, in a nest of *F. umbrata*, at Charlton, Kent. Others have found it in

association with the jet ant (*F. fuliginosa*). The jet ant is both carpenter and wood-carver. It fashions the chambers and colonnades of its beautiful habitation in the heart of forest-trees. I have already mentioned having found a strong colony established in an oak on Hampstead Heath. This ant sometimes departs from its usual habit, and arranges its many-chambered home in the ground.

I have discovered extensive colonies of this species following the trade of a miner in the pleasant copses at Clevedon. It should be noted that when established in a tree, its carved work is always stained black, and I have noticed that when prepared for the cabinet a dark stain is left upon the card on which it is extended. The perfume of this ant is most agreeable, similar to the fragrance of the brilliant and long-horned musk-beetle. Other species adapt themselves to circumstances, and change their trade to meet the peculiar exigencies of their surroundings. To give but two illustrations of this change of habit and happy aptitude in ants to adapt themselves to altered conditions of life.

When at Bournemouth, in 1876, I sauntered up the valley of the Bourne. I soon reached the outskirts of the pleasure-grounds, entered upon the open heath, and came upon the sunny bank near the spot where I discovered the extensive and interesting colony of *F. congerens*. I was watching the little people busily employed in putting up their shutters, when my attention was attracted by an old Scotch fir stump in the midst of the purple heath, golden gorse, and antlered fern. I removed some of the bark, and, to my delight, I discovered the common garden ant (*F. nigra*) in full force, which, though usually a miner, was here following most intelligently the trade of a wood-carver. Passages and chambers innumerable were wrought most skilfully in the wood, which, though firm, was in some places somewhat soft, and bordering on decay. There were many nurseries crowded with larvæ. My wife sketched

the picturesque stump, and before the work of art was completed every larva had been removed by the careful and indefatigable nurses. The girth of the top of the stump was thirty inches, the height above ground was twelve inches, the extent of the chambers exposed was twenty-four inches, and hundreds of larvæ were reposing snugly in their nurseries. I had removed the greater part of the stump with the aid of spade, chisel, mallet, and the willing shoulder of a stalwart labourer, to my lodgings, whence it was in due course transported to my study, and as I write I can plainly see and admire the skilful work of the little wood-carvers.

Again, *F. umbrata*, as a rule, is found following the occupation of a miner. Lately, when cutting down what was once a magnificent willow adorning my paddock, but which for the last year or so had been gradually losing its beauty and hastening to decay, I was astonished at discovering in the very heart of the tree a strong colony of *F. umbrata*. It was here occupied as a carpenter as well as a miner. The work of destruction had been commenced, I believe, by a wood-boring beetle, but had been effectually continued and well-nigh completed by the little people, who had shown their wisdom in utilising the decaying wood and fine comminuted particles, which it had doubtless accumulated by its mandibles, which acted as sharp saws, to fashion its many chambers and accommodate the countless numbers of the rapidly-increasing family. In fact, the tree measured ten feet ten inches in circumference; its centre, to the height of four feet six inches, was tenanted by a formic population of unnumbered thousands. The rich, brown, honeycombed, finely-wrought woody material occupied a space of about one foot four inches in diameter.

But what is more remarkable, the same year, 1878, was memorable in that I discovered *F. umbrata* to be not merely a carpenter, but a wood-carver, and a workman as skilled in his craft as the famous jet ant. I had been noticing for

some little time that a fine shrub of the *Weigela rosea*, indigenous to the Flowery Land, identified with the name of 'Fortune,' who imported it into this country, and which for many years had ornamented with its beautiful rose-coloured blossoms the left side of my dining-room window, had been for a while languishing until almost all the



FIG. 37.—Nest of *Formica virescens* (*Ecophylla*), on mango-tree.— $\frac{1}{2}$ natural size.

branches had perished, and most reluctantly I had to give orders for it to be cut down and uprooted; what was my astonishment to find, when the stock was split open, that *F. umbrata* (*L. umbratus*) had made it its residence, and most beautifully had the hard wood been chiselled into numerous chambers and corridors. I have it before me, and I can count as many as twelve different storeys to this exquisitely-fashioned formic mansion. The ceiling of one chamber forms the floor of the next, and the passages are so constructed as to give perfect access to the different

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chambers, and at the same time to occupy as little space as possible, so that the wants of the increasing colony may be most economically, yet perfectly, provided for.

Though I am giving an account of the British ant-world, I cannot forbear referring to two foreign species which are abundantly represented in my collection, and specimens of whose architectural skill I have also in my possession. Both I have received from Sierra Leone by a friend, the

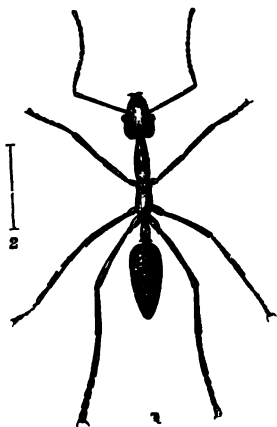


FIG. 38.—1. *Formica virescens*, larger worker (*Ecophylla*). 2. Natural size.

Rev. J. Hamilton. One of the species is a plasterer, the other a tent-maker.

The plasterer belongs to the genus *Crematogaster*, which walks with its abdomen over its thorax, hence the name, and makes its nests in trees, of laminæ of manure or prepared earth. The nest is of a dark-brown colour, and of a spherical form, and has, as I have mentioned, acquired the name of the negro-head, on account of its marked resemblance to the woolly hair of our sable brother. In the Brazils it generally goes by this cognomen.

The tent-maker is the *Formica virescens* of Africa and

Australia. It is also called *Æcophylla*, and most appropriately too, since it forms its nest of leaves, by drawing them together and keeping them in true position by means of a fine web. I have a fine series of each order of the colony from Sierra Leone: the large females, the small males, and the larger and smaller workers. I have many of the commodious tents of this clever artificer.

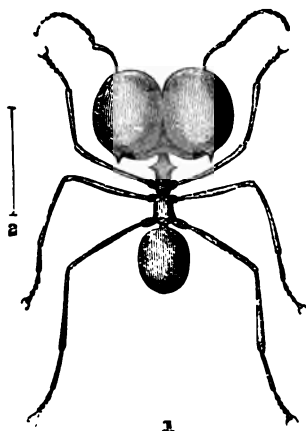


FIG. 39.—1. Umbrella ant (Male). 2. Natural size.

I must again refer to the umbrella ant of Brazil, *Æcodoma cephalotes*, which as we have seen thatches its house with circular bits of leaf cut with accurate precision from coffee and orange trees, which they oftentimes defoliate to carry out their bold architectural designs, their mansions being forty or fifty yards in circumference, though only two feet in height. This enterprising tribe of the little people are wont to carry each a piece of leaf in an upright position, apparently utilising their burden as an umbrella or parasol to shield themselves from the burning heat of the tropical sun. When numbers of these wondrous ants walk in procession with their little umbrellas, a very grotesque

effect is produced. I have conversed with a gentleman who graphically described these ants at work upon their umbrellas. In their preparation they observe a division of labour. While some of the little workers are in the trees cutting the little circles from the leaves, their companions are below waiting for the tiny umbrellas to fall, that they may pick them up and carry them to their homes. These little people are civil engineers as well as architects, excavating as they do a tunnel under wide and rapid rivers as broad as the Thames at London Bridge, their triumphs of engineering skill having been executed long before such



FIG. 40.—Umbrella ant (female).

subfluvial thoroughfares were even heard of by the human family.

The singular nest of another noteworthy ant I desire to call attention to, and it is that of a species of the genus *Pseudomyrma* called *modesta*, which constructs its habitation in the long thorns of a kind of acacia. I have in my collection two thorns from Panama just four inches long, gradually tapering to a point, which have been hollowed out and utilised as a dwelling by the inventive genius of the little people, who gain access to the interior of the thorn through a small perforation which they make towards its pointed end. Mr. Smith¹ tells us that 'the number of pupæ found in one nest was twenty-nine, and about twenty

¹ *Trans. Ent. Soc.*, vol. i. 3rd series, pt. i.

mature ants ; all of these were workers. The pupæ are not inclosed in cocoons. These ants sting very violently.'

There is another ant of the same genus with a similar habit, which Mr. Belt mentions¹ as having been found in Nicaragua. This species is called *P. bicolor*. It inhabits the curved spines of the bull's-horn thorn, a species of acacia which receives its name from the spines, which are set in pairs and bear a strong resemblance to the horns of a bull. Mr. Belt tells us that 'these thorns are hollow, and are tenanted by ants, that make a small hole for their entrance and exit near one end of the thorn, and also burrow through the partition that separates the two horns, so that one entrance serves for both. Here they rear their young, and in wet seasons every one of the thorns is tenanted ; and hundreds of ants are to be seen running about, especially over the young leaves. If one of these be touched, or a branch shaken, the little ants, *Pseudomyrma bicolor*, Guer., swarm out from the hollow thorns, and attack the aggressor with jaws and stings. They sting severely, raising a little lump that does not disappear in less than twenty-four hours. These ants form a most efficient standing army for the plant, which prevents not only the mammalia from browsing on the leaves, but delivers it from the attacks of a much more dangerous enemy—the leaf-cutting ants. For these services the ants are not only securely housed by the plant, but are provided with a bountiful supply of food ; and, to secure their attendance at the right time and place, this food is so arranged and distributed as to effect that object with wonderful perfection. The leaves are bi-pinnate. At the base of each pair of leaflets, on the mid-rib, is a crater-formed gland, which, when the leaves are young, secretes a honey-like liquid. Of this the ants are very fond ; and they are constantly running about from one gland to another to sip up the honey as it is secreted. But this is not all ; there is a still

¹ See *The Naturalist in Nicaragua*, p. 218.

more wonderful provision of more solid food. At the end of each of the small divisions of the compound leaflet there is, when the leaf first unfolds, a little yellow fruit-like body united by a point at its base to the end of the pinnule. Examined through a microscope, this little appendage looks like a golden pear. When the leaf first unfolds, the little pears are not quite ripe, and the ants are continually going from one to another examining them. When an ant finds one sufficiently advanced, it bites the small point of attachment; then, bending down the fruit-like body, it breaks it off and bears it away in triumph to the nest. All the fruit-like bodies do not ripen at once, but successively, so that the ants are kept about the young leaf for some time after it unfolds. Thus the young leaf is always guarded by the ants; and no caterpillar or larger animal could attempt to injure them without being attacked by the little warriors. The fruit-like bodies are about one-twelfth of an inch long, and about one-third of the size of the ants; so that the ant bearing one away is as heavily laden as a man bearing a large bunch of plantains.'

As the workers of the *P. bicolor* form a 'standing army' for the protection of the acacia in Nicaragua, so, strange to say, those of another ant—called from its combative habit and the form of its head the bull-dog ant—is found to protect the blackberries in South Australia. This I have been told by a lady who has recently returned from a sojourn in that country. She with a party of friends were in the bush thirty miles from Melbourne, and while attempting to pick the luscious and tempting fruit, were warned off and unable to effect their purpose by the defiant attitude and determined attack of the little 'bull-dogs' who swarmed over the richly laden briars.

Neither would it be right to pass over without further notice the driver ants of Africa, *Anomma*, who are totally blind, and whose sting is said to be like the puncture of a red-hot needle, who, like the Arabs of the desert, have no

certain dwelling-place. These are truly the scavengers of the deserts, before whom rats, mice, lizards, cockroaches, and every kind of vermin fly in terror, but are soon overpowered and destroyed—before whose deadly advance the largest serpent is driven, and, if gorged, soon falls a victim to its countless hordes, in whose presence horses and mules

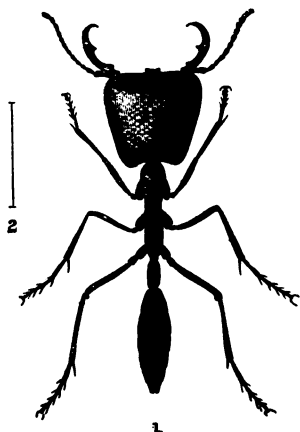


FIG. 41.—1. Driver ant. 2. Natural size.

become unmanageable. On occasion of their visit families have to leave their houses, only to return and find their visitors their greatest friends, being as they are the certain death of every noxious and unclean intruder within the sacred domestic precincts. Before the dauntless and determined progress of these driver ants every obstacle is overcome, every difficulty vanishes—onwards, still onwards, is their motto. In their *blind* career they pass through houses, over hill and dale, and across water—and how? Not simply like the little sugar-ant, which passes over the floating mass of the bodies of its companions who have accidentally fallen into the tiny trench which environs the food it is intended to preserve from their attack; such a

method would be simply impracticable where running streams and rapid torrents have to be crossed. They actually link themselves together until the living chain reaches a length equal to the breadth of the stream, and thus form a floating bridge more marvellous than the bridge of boats across the Rhine, and over which the serried ranks of their resistless army passes. Over rapid torrents this would not be possible. So in this case an animated suspension-bridge is formed, more astonishing in its construction than that which spans the Menai Straits, or that at Clifton, which gracefully connects the opposite shores of the River Avon. This bridge, as in the former case, is formed of the living bodies of some of the countless legions of this valiant and triumphant little people, one end being fastened to an overhanging branch, while the other, assisted by a friendly breeze, is wafted to the opposite shore of the brawling waters, and there safely and securely anchored for the benefit of the passing crowd.

CHAPTER XIX.

The white ants of tropical climes—The four classes found in the colony of the white ant described—The destructiveness of the white ants—How the true ant as well as the 'white ant' becomes a blessing in the tropics—The concluding summary of the ways of the little people.

OUR narrative would not be complete without some reference to the white ants of tropical climes—Africa, America, and India. These are not true ants, *i.e.* they do not belong to the order *Hymenoptera*, which embraces the industrious bee and the crafty ichneumon, as well as the little people we have been particularly discoursing upon, but they belong to the order *Neuroptera*, which embraces the brilliant though voracious dragon-fly, the ephemeral May-fly, and the wily ant-lion. They are called ants because they are similar to them in their habits and in the constitution of their colonies.

They erect buildings on a most magnificent scale, being sometimes five hundred times the height of the builders, it having been computed that if our houses were built according to the same proportion, they would be twelve or fifteen times higher than the London Monument, four or five times higher than the Pyramids of Egypt, with corresponding dimensions in the basements of the edifices, comprehending an area just ten times that of Lincoln's Inn Fields. These habitations are, as a rule, of a conical or

sugar-loaf form. They are worked up from the soil of the country by the ants, and are of the consistency of stone, and so strong that a buffalo has been known to take up its position on the top of the conical knoll for the purpose of observation. I have several specimens of these nests; some are conical, some of the form of turrets, of different stories, with overhanging eaves; one of them is of the form of a negro-head, though of course considerably heavier than the nest usually going by that designation: and another is of the form of a mushroom. All these came from Sierra Leone, and were presented to me by Mr. Hamilton. The different forms answer to different species of the white ants, or termites, as they are called.

There are four classes found in the colony of the white ant. The king and the queen, who live together in a central chamber near the ground, after having lost their wings; the workers, who build and nurse their young; the soldiers, who never build or nurse, whose duty consists in defending the nest when attacked. Neither the workers nor the soldiers have wings. The largest worker is supposed to be a fifth of an inch long. The soldiers, which have an enormous head and formidable mandibles, are at least twice as long, and are said each to weigh as much as fifteen workers. The male is reported to weigh as much as thirty workers, attaining the length of nearly four-fifths of an inch. While the female, when she has become a queen and about to form an extensive colony, attains the length of six inches, and lays eggs at the rate of sixty a minute, or more than eighty thousand a day.¹

The white ants are most destructive to houses, furniture, clothes, and books. I have a piece of wood from West Africa honeycombed by them, and the journal of a native catechist similarly treated; and in 1879 I noticed an appeal from the Bishop of Sierra Leone for funds in order to repair the churches, which, he said, are 'ant-eaten.' The following

¹ See *The Insect World*, by Louis Figuier, Eng. Trans., pp. 406, 407.

letter, which, many years ago, I received from the late Colonel Mann, long resident in Ceylon, will convey a very good idea of their destructive habits :—‘ Anything that is reducible to powder will, where they have located themselves, fall to certain destruction. I was once proceeding from Ceylon on duty somewhere that would entail an absence of

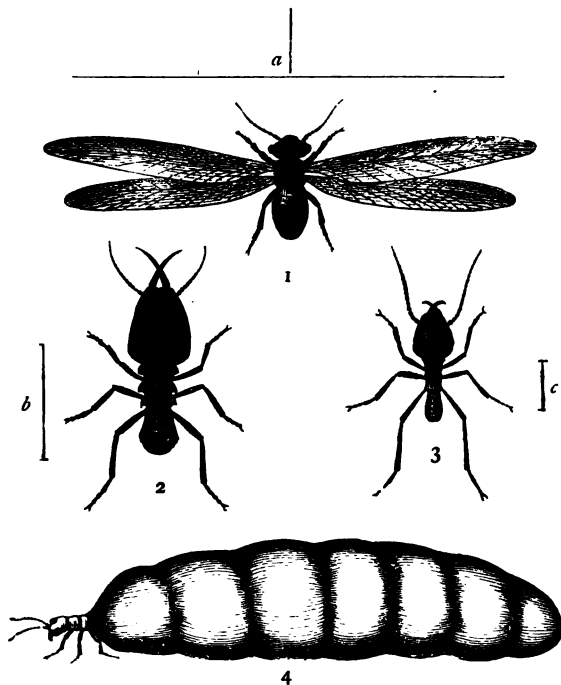


FIG. 42.—The white ant (*Termes bellicosus*).

1. Male. 2. Soldier. 3. Worker. 4. Female, half natural size.
a. Nat. size. b. Nat. size. c. Nat. size.

From a diagram by the late Mr. Frederick Smith, British Museum.

some months, and it became necessary that I should pack up and stow away all my belongings, that they might be placed in safety during the time I was away. Among other things, a large chest about four feet square was applied

especially to my books, and because I had not sufficient to fill it entirely, the vacancy was supplied by a quantity of what we used to call European clothes—viz. thick coats, shooting jackets, and such things as would never be used except in the hills, where the climate requires warm clothing as much as in England. This box or case was thus filled, secured down, and left to its fate. I was absent quite a year, and on my return had occasion to have the box removed to a new residence. My attention was first drawn to it by my observing that two men lifted it and carried it in, while I felt confident that the box of books and clothes I had left had taken at least six to move it to the cart that took it away! I had the case opened, and when the lid was taken off it was a little more than one-third full of a reddish dust, with a very few remains of unfinished works, sufficient to show that the leather was the first point of attack; not a vestige of the clothes remained, and the only two volumes that were rescued from utter ruin were a Bible and a volume of Shakespeare. The Bible I still have, though of course rebound. This was thought at the time (even by those accustomed to the destructive character of these creatures) a singular instance of their power. They work unseen. Wooden pillars and beams are continually made perfect shells by their operations, and the safety of houses is frequently affected, though externally they would appear strong and good.' Mr. Hamilton assures me that the library at the Fourah Bay Church Missionary College, Sierra Leone, was in a great measure destroyed by their instrumentality. Though these little people are so annoying that hardly anything is proof against their attacks, they are a great blessing in tropical climes, their office being, in the economy of Nature in those hot countries, to hasten the decomposition of the woody and decaying parts of vegetation, which, without their intervention, would render these regions uninhabitable by breeding a pestilence.

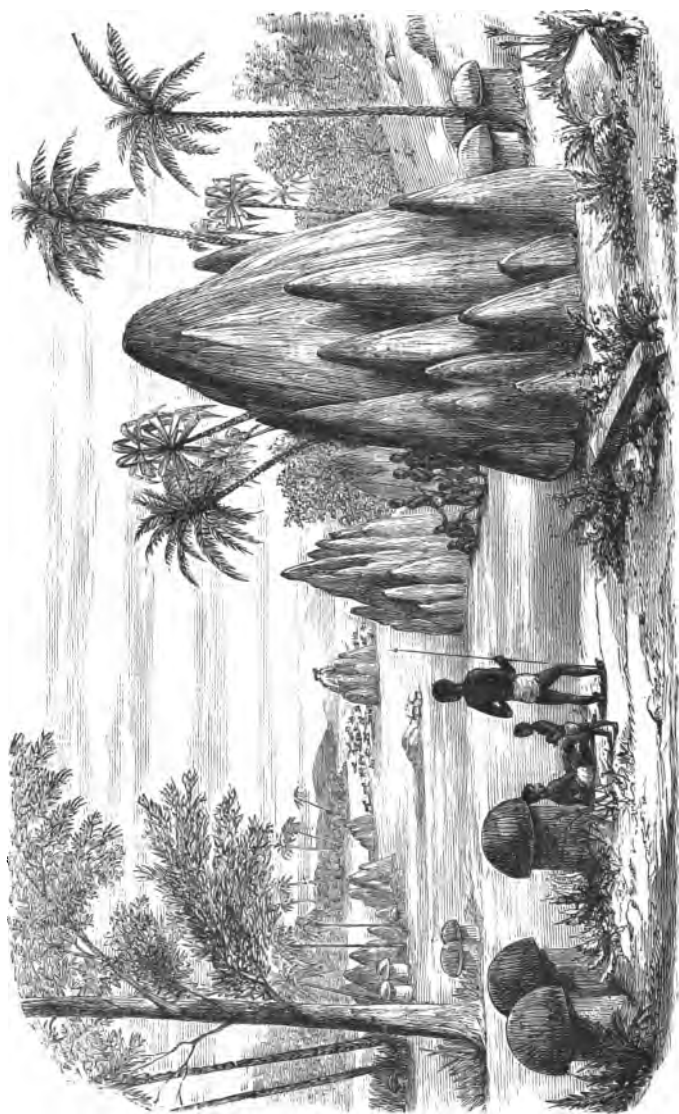


FIG. 43.—Nests of white ants.
From a drawing by the late Mr. Frederick Smith, British Museum.

Before drawing my remarks on the termites to a close, I should not omit to state that two species, viz. the *Termes lucifugus* and *Termes flavicollis*, exist in France. The former, which is described as a little insect of brilliant black (in the males), is said to be common enough in the moors of Gascony, and to attack oak and fir trees; and the latter, which is known as the yellow-necked white ant, and which is reported to live in the interior of trees, is gravely charged with doing a great deal of mischief in the South of France, and in Spain also, to olive and other precious trees. Latreille has established the fact that it is the *Termes lucifugus* which causes such havoc at La Rochelle, at Rochefort, at Saintes, at Tournay, Charente, in the Isle of Aix, etc., where many houses have been completely undermined by these terrible insects. Louis Figuier, from whose interesting record, entitled *The Insect World*, I have gathered the above information, assures us that 'at La Rochelle these insects took possession of the prefect's house, built by the brothers Poupet (rich shipowners, in whose merchandise it is supposed these termites have been imported into France from St. Domingo), and of the arsenal. There they invaded offices, apartments, court, and garden. They could not drive in a stake or leave a plank in the garden but it was attacked the next day. One fine morning the archives of the department were found destroyed without there being the smallest trace of the damage to be seen in the exterior.'

We have pointed out how the discovery of the remains of the white ant in the coal-measures is an evidence that it was, to a certain extent, through their destructive agency that the tropical vegetable matter was accumulated which went to form our coal. And as the white ant, by hastening the decomposition of vegetable substances, has ever proved a friend to man, so the true ants we have seen prove themselves a boon to the inhabitants of tropical climes, especially by destroying what are popularly classed as

vermin ; and this their friendly and beneficent office is recognised, their visit being called by the natives 'de blessing of God.'

And now, surely, enough has been said, ample evidence has been brought forward, my own personal testimony having been confirmed, when necessary, by the experience of others, to warrant me in earnestly demanding for my little clients a favourable verdict. When you bear in mind the self-devotion of the queen for the commonwealth ; the loyalty of her subjects, their affection towards their youthful charges, preserving as they do a happy medium between undue severity and over-indulgence ; their liberal system of education without the aid of privy councils and revised codes ; their plan of drainage, most effectual before boards of health and city corporations had ever been heard of ; their public works and national enterprises, planned and executed with the most surprising promptitude uncontrolled by parliamentary committees, orders in council, and circumlocution offices ; their social institutions, their provident clubs and savings banks, gathering as they do their meat in the summer—the continental and foreign ants, grain and honey ; the British ants, their aphides for future use¹ :—when you bear in mind their perseverance under difficulties, that no poor-house or assessment committee or sanitary authorities are needed, for all live as brethren, all sympathise with each other in trouble and difficulty, and share everything in common as members of the same happy family, 'he that gathers much having nothing over, and he that gathers little having no lack : '—when you remember their habits of early rising, of cleanliness, of moderation, of economy, of temperance, their love of fresh air, their skill and industry in their many trades, the magnificent scale on which they construct their houses ; their language, which though more difficult to acquire than

¹ My discovery at Branscombe (see Preface and footnote on p. 101) seems to indicate that they may occasionally store seeds.

Chinese, yet is to them so intelligible that there are no misunderstandings, all speaking it fluently, and by means of its mysterious agency communicating their ideas to each other :—when you recall how they carry out concerted plans thoroughly, noiselessly, uninterruptedly, not resting till their work be finished, animated by one spirit, pursuing thus the end, fulfilling thus the law of their brief existence,—you must allow that surely this ‘little people’ are ‘exceeding wise.’

And what may we learn from all this? May we not learn wisdom? Wisdom to behold the presence and the glory of the Omnipotent reflected in His works; and find that while we have been discoursing upon the little people of our enraptured observation, we have in deed and in truth been communing with our God?

‘The Lord of all, Himself through all diffused,
Sustains and is the life of all that lives.
Nature is but a name for an effect,
Whose cause is God.’

May we not also recognise the beautiful alliance that exists between the facts of science and the statements of Revelation, and acknowledge that the Redeemer of men is the Lord of the material universe?

‘One spirit, His
Who wore the platted thorns with bleeding brows,
Rules universal nature.’

And as we are made glad through God’s works, may we grow in wisdom by having our faith confirmed in that glorious Being in whom are hid all the treasures of wisdom and of knowledge, and seek more earnestly, by the help of His life-giving Spirit, to fulfil the law of our being by shining in His radiant image, anticipating the happiness of that joyous season when they that be wise shall shine as the brightness of the firmament, and when the brilliant atmosphere of the better country shall be vocal with the

praises of a ransomed and a jubilant throng to Him that sitteth upon the throne and to the Lamb, this being the burden of the entrancing anthem, 'Worthy is the Lamb that was slain'—'Great and marvellous are Thy works, Thou King of saints'—'Thou art worthy, O Lord, to receive glory and honour and power: for Thou hast created all things, and for Thy pleasure they are and were created.'

APPENDIX.

THE Author of this work believes he is right in stating that the following will be found to be the most complete list of Genera and Species of the British Ants yet published. In the preparation of this list as well as in the subsequent differentiation and description of species, though he has exercised an independent judgment, as the sequel will show, he desires to acknowledge the assistance he has received from the scientific works and correspondence of the late Mr. F. Smith, the *Synopsis* of Mr. E. Saunders, and the record of the captures of the Messrs. J. C. and C. W. Dale, which the latter kindly placed at his disposal. The Author desires to add, that all the species described have passed under his review, and that all but three species have been discovered and observed by him in their native habitats.

HYMENOPTERA BRITANNICA.

ACULEATA.

DIVISION I. HETEROGYNA.

Phalanx I. *Socialia*. Phalanx II. *Solitaria*.

<i>Socialia</i>	{	Family I. <i>Formicidæ</i> .
		„ II. <i>Poneridæ</i> .
		„ III. <i>Myrmicidæ</i> .
<i>Solitaria</i>	„	IV. <i>Mutillidæ</i> .

FAMILY I. FORMICIDÆ.

Genus I. Division I. *Formica*.

- „ „ Division 2. „ or *Lasius*.
 „ 2. *Tapinoma*.

PHALANX I. *SOCIALIA*.Genus I. Division I. *Formica*.

- (1.) *Formica rufa*.
 (2.) „ *congerens*.
 (3.) „ *exsecta*.
 (4.) „ *sanguinea*.
 (5.) „ *cunicularia*.
 (6.) „ *fusca*.
 (7.) „ *glabra*.

Genus I. Division 2. *Formica* or *Lasius*.

- (1.) *Formica fuliginosa* or *Lasius fuliginosus*
 (2.) „ *nigra* „ „ *niger*.
 (3.) „ *aliena* „ „ *alienus*.
 (4.) „ *flava* „ „ *flavus*.
 (5.) „ *umbrata* „ „ *umbratus*.

Genus 2. *Tapinoma*.

- (1.) *Tapinoma erratica*.
 (2.) „ *polita*.
 (3.) „ *gracilescens*.

FAMILY II. PONERIDÆ.

Genus, *Ponera*.

- (1.) *Ponera contracta*.
 (2.) „ *punctatissima*.

FAMILY III. MYRMICIDÆ.

Genus 1. *Myrmica*.

- (1.) *Myrmica ruginodis*.
- (2.) „ *scabrinodis*.
- (3.) „ *lævinodis*.
- (4.) „ *sulcinodis*.
- (5.) „ *lobicornis*.

Genus 2. *Tetramorium*.

- (1.) *Tetramorium Kollari*.
- (2.) „ *cæspitum*.
- (3.) „ *lippula*.

Genus 3. *Leptothorax*.

- (1.) *Leptothorax acervorum*.
- (2.) „ *Nylanderi*.
- (3.) „ *unifasciata*.
- (4.) „ *simillimus*.

Genus 4. *Stenamma*.

Stenamma Westwoodii.

Genus 5. *Solenopsis*.

Solenopsis fugax.

Genus 6. *Diplorhoptrum*.

Diplorhoptrum domesticum.

Genus 7. *Myrmecina*.

Myrmecina Latreillii.

Genus 8. *Pheidole*.

Pheidole lævigata.

PHALANX II. SOLITARIA.

FAMILY IV. MUTILLIDÆ.

Genus 1. *Mutilla*.

- „ 2. *Myrmosa*.
- „ 3. *Methoca*.

Genus 1. *Mutilla*.

- (1.) *Mutilla Europæa*.
- (2.) „ *ephippium*.

Genus 2. *Myrmosa*.

Myrmosa melanocephala.

Genus 3. *Methoca*.

Methoca ichneumonides.

HETEROGYNA.

I have fully discussed the significance of the designation *Heterogyna* in the body of the work. I would simply state now that in this great division of the *Aculeata* the female is diverse from the male, as the name implies. In the *Phalanx socialia*, which includes the three families of the social species, viz. those ants living in society, having males, females, and workers, the latter called neuters or immature females, laying eggs only exceptionally, the females, though originally fully equipped for flight, become apterous before founding or perpetuating a colony, either unassisted depriving themselves of their wings or being deprived of them by the workers. The neuters are always apterous, or without wings; the males always winged. In the solitary species the females differ from the males in being always apterous; the males being always winged.

PHALANX I. SOCIALIA.

FAMILY I. FORMICIDÆ.

The *Formicidæ* contain those species of ants which are stingless, having a single node or flattened scale, the pupæ being inclosed in cocoons.

Genus 1. *Formica*.

Maxillary palpi are six jointed; the labial palpi are four jointed; antennæ, twelve jointed in the females and workers, thirteen in the males; ocelli, three on vertex.

The wings contain one marginal, two sub-marginal, and one discoidal cell.

Division 1. *Formica*.

Males about same size as or only slightly smaller than the females, and both males and females much larger than the

workers. In *male*, the first joint of flagellum about same thickness as rest; female and workers with first joint of flagellum longer or as long as the terminal joint.

(1.) *Formica rufa*.¹—*Worker-major*.—Head and thorax rust-red; antennæ, head above their insertion, middle of clypeus, prothorax and mesothorax are stained blackish brown; and legs and abdomen are blackish brown; the frontal area is shining; the scale of the petiole slightly notched and the edges rounded and in colour rust-red. By careful measurement I find it to be in length $4\frac{1}{2}$ English lines, 4 French lines or 8 millimetres.

Worker-minor.—As a rule, coloured similarly to larger worker, but darker and not so brilliant in its hues. In length I find it to be $2\frac{1}{2}$ English lines, $2\frac{3}{4}$ French lines or $5\frac{1}{2}$ millimetres. Between the worker-major and minor there are gradations in size.

I should mention that there are a few scattered hairs on the thorax and a close-set pubescence on the abdomen, with a few scattered erect hairs.

The *female* in colouring is nearly uniform with that of the worker-major, except the scutellum and abdomen, which are black and glabrous or shining, the latter being globular. The wings are stained with brown towards their base. Length about 5 lines, or 10 millimetres.

The *male* is dark-brown with legs reddish; base of femora, tibiæ, and tarsi more or less brown or ash-coloured; abdomen ovate in form, and wings tinted like the female. Length about $4\frac{1}{2}$ lines, or 9 millimetres.

This ant is generally found in pine-woods or their immediate neighbourhood. Sometimes their conical nests of little sticks and pine needles are seen heaped up against a tree or around an old stump. I have found the ant working in a bank. The sexes are found in the month of June. I have found the winged ants during this month at Tunbridge Wells and near Symond's Yat.

(2.) *Formica congerens*.—This ant is very similar in its habits and structure and colouring and size to the former.

The *worker* may be distinguished from it by a more abundant

¹ See Fig. 30, p. 168.

pubescence of an æneous or brassy colour, which is very conspicuous and distinctive in the sunshine. The eyes are also distinctly hairy.

The *female* has a dull abdomen, which at once distinguishes it from that of *rufa*, which is very shining.

The *male* has also a dull abdomen.

The sexes are developed later than *rufa*. I have noticed the winged females and males in the nest in the month of August at Bournemouth.

This is the common wood-ant at Bournemouth. Its nests, though often seen in the pine-woods, are as often found on the open heath. The ant has also been found at Loch Rannoch, and Mr. C. W. Dale has met with it at Holnest, Porlock, and Exmouth.

(3.) *Formica exsecta* is our third wood-ant. This is known at once from the two former by its small size and brighter red head and thorax and the dimensions of its nests, which are very much smaller and formed of dried grass and ling. It is more pugnacious also. The structure of the head is very distinctive, being emarginate or deeply notched behind. The scale also is notched above. The length is between 2 and 3 lines, or about 5 millimetres.

The *female* is coloured very similarly to the worker, except the head above and mesothorax, which is blackish-brown. The nervures of the wing are yellowish-brown. The length is about 1 line, or 2 millimetres, more than the worker.

The *male* is black, shining, and hairy, with the legs pale-reddish.

This ant seems peculiar to Bournemouth and its neighbourhood. I have, as I have mentioned in the work, found it as far east as Ringwood, and Mr. F. Smith as far west as Poole. These points at present seem to form the extreme limits of its distribution. The sexes are to be found in July and August.

(4.) *Formica sanguinea*.¹—This ant I have so fully described in the work, that I will merely mention that it is at once distinguished from *rufa* by its emarginate or notched clypeus; its brighter colour, which is blood-red, hence its name; its gait is different, being much more rapid and elastic; its habits also

¹ See Fig. 29, p. 168; Fig. 31, p. 171; Fig. 32, p. 172; and Fig. 33, p. 173.

are very distinctive ; its nests are in a great measure subterranean, though the entrances are heaped up with loose sand and peat fibres ; its slave-making instinct, which has been witnessed by Mr. F. Smith, Mr. Charles Darwin, and myself, I have fully described. It makes slaves only of *F. fusca* in this country, though many other species are found in its nest. It seems distributed throughout the Bagshot Sands area. I have found it at Wellington College, where it is most abundant, and at Shirley Common, where I witnessed a slave-making expedition. The winged sexes are found in July and August. I have found a few winged females just emerged on June 30 at Crowthorne, near Wellington College.

(5.) **Formica cunicularia.**—*Worker.*—The bright examples very like the small workers of the *rufa*, the dark examples most difficult to distinguish from the *fusca*. I have a specimen of this ant and a small worker of *rufa* on the same card given to me by Mr. F. Smith, which, without close examination, it would be impossible to say were not belonging to the same species. In the present species, however, the frontal area is not shining, as in *rufa*. This is the most distinct characteristic. It will be noticed also that the margins of the segments and the end of the abdomen are slightly reddish. The abdomen, I have noticed in recent specimens, carries a fine, silky gloss. In specimens that have been in the cabinet for many years I cannot detect this. Length about $3\frac{1}{2}$ lines, or between 7 and 8 millimetres.

Female, mandibles, sides of face, base of flagellum, legs, and base and apex of abdomen, rust-red ; thorax, either wholly brown or striped with brown above. Length about 4 lines, or 9 millimetres.

Male, black, very like the following species, with antennæ rather longer and more slender, the scale longer and transverse, face not so projected before the eyes, wings smoky at their base. Length $3\frac{1}{2}$ lines, or about 7 millimetres.

This species, though not near so common as the next, is widely distributed. I have found it on Hampstead Heath, Halesworth in Suffolk, Bournemouth, Hastings, and at Brimscombe, near Stroud. It is a miner.

(6.) **Formica fusca.**—It is distinguished from the last by having a bright, brassy tinge in all the sexes. The general colour in each is dark-brown or ash-coloured. The legs are

red ; the scale in the male is thickened and rounded. Some of the workers are pale liver-coloured. The small worker is about half the size of the larger, which is not far from 5 lines, or 10 millimetres.

This ant is very widely distributed, and is remarkable from living in servitude with *sanguinea*, by which it is enslaved in a pupa state. It is, as a rule, a miner, though I have found it at Eltham in a stump.

(7.) *Formica glabra*.—This ant is about the size of the large worker of *fusca*. It has a bright glabrous abdomen. It is dark brown, with the shining abdomen of a pitchy hue, with a few stiff bristly hairs.

Mr. F. Smith, on his first examination after his son had found it in Bournemouth, recorded the capture in the *Ento. Annual* as *F. gagates*, but he changed his view afterwards, and did not include it in his published list in 1876. In a letter I received from him on the subject he says that he considered it to be only a strange form of *fusca*. Mr. E. Saunders, in his *Synopsis*, restores it to the British list, but having compared it with the continental specimens of *gagates*, I have no hesitation in confirming Mr. Smith's reversed judgment. It is, I think, sufficiently distinctive to form a new species, and I have called it provisionally *glabra*. The Bournemouth specimens were found by the side of a road. In 1892 I re-discovered this species at Bournemouth. I captured many workers and the queen on the open heath. I also found a small nest tenanted by workers. In 1893 I again found workers among the gorse and heather. See Preface.

Division 2. Formica or Lasius.

Males nearly equal in size to the workers, and, with the exception of the first species, considerably smaller than the females. In the male first joint of flagellum thicker than the rest, and in females and workers the first joint of flagellum shorter than the terminal one.

(1.) *Formica fuliginosa*, or *Lasius fuliginosus*.—This is the jet ant, and, as its name denotes, it is jet-black in colour, and highly polished. The worker has the flagellum, tarsi, and articulations of the legs pale rust-red. The head is much wider than the thorax, and emarginate or notched behind, and thus appears heart-shaped.

By careful measurement I find that the *large worker* is $2\frac{3}{8}$ English lines, $2\frac{1}{2}$ French lines, or 5 millimetres.

The *smaller worker*, $1\frac{1}{4}$ English lines, $1\frac{1}{2}$ French lines, or 3 millimetres.

The *male*, 2 English lines, $1\frac{3}{4}$ French lines, or $3\frac{1}{2}$ millimetres.

The *female*, $2\frac{1}{4}$ English lines, $2\frac{1}{2}$ French lines, or 5 millimetres.

The wings, both of the male and female, are smoky to half their extent. The head of the female is wider than the thorax, though not so wide in proportion as that of the worker. I have a specimen of an apterous female, given me by Mr. F. Smith, which is blackish-brown in colour. This species is a very slow walker; has a very fragrant scent, like that of the musk-beetle, and as a rule fashions its chambers and corridors in an old tree or post. I have, however, found it as a miner at Clevedon, and at White Notley, Essex. The sexes I have found towards the end of June at Clevedon; and in August I have noticed numbers of males sunning themselves with the workers on an oak at Hampstead Heath.

(2.) *Formica nigra*, or *Lasius niger*.—This is the common garden ant. The worker is dark-brown in colour, with a glittering silky sheen, as is also the female.

The *male* is nearly black.

The *female* is about 4 lines, or 8 millimetres, exactly twice as long as the worker and male. The wings of the female and male are white with brownish-yellow nervures. The margins of face, flagellum, articulation of legs, and tarsi in female, and thorax in worker, pale brownish-yellow; the mandibles with a clear yellowish-red tinge; the flagellum in worker, dark brown; the scape of antennæ and legs, with erect hairs.

(3.) *Formica aliena*, or *Lasius alienus*.—I have entered into a full description of this ant in the text. I will here mention that it is distinguished from the former by its wanting the erect hairs in the antennæ and legs, and its paler colour. The most distinctive characteristic which I have been able to discover, and which I find to be constant, is the tinted costal area of the female, which is yellow. I have also noticed the costal area in the male a very pale neutral tint. The occasional obliteration of the discoidal cell I find to be common to the two species. It usually makes its burrows in sandy places, with a raised

funnel-shaped gate. I have also found it occupying a small mound at Bournemouth, where I discovered the males in November. It is widely distributed, as may be seen from the text. The sexes usually first seen in August. Mr. G. A. J. Rothney has found them in July.

(4.) *Formica flava*, or *Lasius flavus*.¹—This is the common yellow ant, which throws up its mounds in meadows and lawns, the flat tops of hills, and the sides of railway cuttings and embankments.

The *worker-major*, yellow, about 2 lines, the *small worker*, pale, and sometimes but a little larger than one line in length.

The *female*, about 3 lines in length, brown, with antennæ and legs pale brownish-yellow; wings, brown at base.

Male, nearly as large as the worker-major, black, with a slight tinge of brown; wings, white, with pale yellow ochre nervures. The sexes I have found in July and August.

(5.) *Formica umbrata*, or *Lasius umbratus*.—The *worker*, a rich yellow, very like the former, but stouter in form.

The *female* has its head as wide, and sometimes wider, than the thorax, while that of the former is decidedly narrower; the legs in this species, and also the eyes, are pubescent. It varies in colour.

I have a specimen, given me by Mr. Smith, pale mahogany colour; one from Mr. C. W. Dale, brownish-yellow; and the swarm this year in the Vicarage dark sepia-coloured. This is much the same tint as that recorded as *L. mixtus* by Mr. G. C. Bignold, found by him at Stonehouse, Plymouth.

The males and workers of this ant being, however, similar to those of the usual type, I cannot separate it from our species.

The sexes are found as a rule in August and September.

GENUS 2. *Tapinoma*.

This genus is separated from *Formica* by its decumbent scale and longer and more slender antennæ. It has the same number of joints in the maxillary and labial palpi as in *Formica*.

(1.) *Tapinoma erraticum*.—*Worker*.—Black, with close-set grey pubescence, and base of tibiæ and tarsi paler.

It is difficult to distinguish these species from *F. nigra* without examination with a lens, when the decumbent scale at

¹ See Fig. 2, p. 31; Figs. 8, 9, p. 79; Figs. 10, 11, p. 80.

once separates it. I have always found it running rapidly in the sunshine; when the sun goes behind a cloud it suddenly disappears. In length it is $1\frac{1}{2}$ to $2\frac{1}{2}$ lines, or 3 to 5 millimetres.

The *male* is dark brown; antennæ, long and filiform; its wings, hyaline; the tibiæ and tarsi, coloured as in workers.

The *female* is black with grey pubescence.

The males and females are about the same size, from $2\frac{1}{2}$ to 3 lines or from 5 to 6 millimetres long. They are found in July and August. I have met with this ant at Bournemouth, Lulworth, and Shirley, and Mr. C. W. Dale at the Land's End.

(2.) *Tapinoma polita*.—Through the kindness of Mr. C. W. Dale, I had an opportunity last year of visiting Glanvilles Wootton, and examining the unique specimen of this species which is in his extensive and valuable collection, and I can testify to the accuracy of Mr. F. Smith's description. The ant is pale reddish-brown in colour, and highly polished, as its name denotes. The thorax is slightly strangulated between the meso- and meta-thorax; the decumbent scale I distinctly noticed is long and rounded above; the abdomen is ovate, and sprinkled with a few long hairs. The length is about 2 lines, or 4 millimetres.

Mr. Saunders gives the habitat of this single specimen as Wales. So Mr. Smith has it. It should, however, be *Bournemouth*, where Mr. J. C. Dale found it. Mr. Dale, his son, told me that Mr. Smith read the recorded habitat as *Barmouth*, hence the mistake. The spot where this ant was found is now built over, so I fear that the species is extinct. I keep Mr. Smith's name, since he considered the ant distinct from *nitens*, though closely allied to it.

(3.) *Tapinoma gracilescens*.—If this ant has been originally imported into this country from Madeira, it certainly is now naturalised. For many years a large colony has been established in my brother's Rectory in the city, and in the Christmas of 1878 the apterous female or queen was discovered in a sugar-basin with several of her attendants, and sent to me. The species is to be found, Mr. Smith informed me, at the Crystal Palace, and Kew hot-houses is given as a habitat. I have found it in the Lily House at Kew, and also in a hot-house at Cheltenham. I have the species from Exeter, and Mr. C. W. Dale from Hastings, so it seems to be widely distributed. It is black,

smaller than *T. erratica*, with much longer antennæ and legs. The former are very brittle, requiring the greatest care in extending them for the cabinet to avoid mutilation.

The *female* is considerably larger than the worker. The colour is the same. The lower segments of the abdomen bristle with long hairs; the upper segmental plates overlap the ventral plates; the overlapping edges being beautifully rounded. These plates seem loosely attached to the membrane, which connects them so as to allow of its expansion, giving the impression that should it serve its economy, it might assume the phenomenon of the honey-ant, with widely sundered abdominal plates. The petiole of the abdomen is attached to its ventral side, and expands into a lozenge-shaped process at its junction. The ant is omnivorous, as may be seen from the text. The six-jointed maxillary palpi, I observe, terminate in two hairs.

FAMILY II. PONERIDÆ.

The species belonging to this family have a single scale or node, the females and workers being furnished with a sting, and the pupæ are inclosed in silk cocoons.

Genus, *Ponera*.

The body is elongate; the single scale is nodose, being elevated to a level with the first segment of the abdomen, which is constricted; the maxillary palpi one or two jointed, the labial two-jointed. The anterior wings of the males and females have one marginal, two complete sub-marginal, and one discoidal cell.

(1.) *Ponera contracta*—*Worker*.—Shining, reddish-brown, eyes and ocelli obsolete, widely scattered and distinct puncturation.

Female, same colour, rather larger, eyes ovate, placed anteriorly at the sides of the head; three ocelli; antennæ in both female and worker approximating at their base, and clubbed.

Male, shining black, with brown legs; mandibles and tarsi pale-brown; eyes large. Length of male and female about 2 lines or 4 millimetres, and the worker is a little smaller, about $1\frac{1}{2}$ lines or 3 millimetres. Very rare.

Prof. Westwood, it is believed, first discovered it in this country. Dr. Power met with it at Brighton, and at Merton, Surrey. Mr. C. W. Dale sent me specimens which he found

at Deal. Mr. Janson found it in company with *F. fuliginosa* (*L. fuliginosus*). I have a specimen found in the same situation presented me by Mr. Shepperd, of Fleet Street.

(2.) *Ponera punctatissima*.¹—Very similar to former in structure and colour, but with one-jointed maxillary palpi. The puncturation decidedly finer. The larger worker darker than the smaller. Eyes in smaller workers obsolete, in the larger, seemingly formed of one lens only. About same length as preceding species, between $1\frac{1}{2}$ and 2 lines, or 3 to 4 millimetres.

Mr. Charsley found a *Ponera* in his hot-house at Oxford; he submitted it to Mr. F. Smith, who, upon a first examination, thought it a new species, the fact being that on account of the method adopted in killing it, the pubescence was so laid that the specimen seemed wrinkled instead of smooth and finely punctured. Mr. Charsley gave it the name of *tarda*. At Mr. Smith's request I gave the insect a thorough examination, and came to the conclusion that it was identical with *punctatissima*. Mr. Smith entirely endorsed this conclusion. I have since discovered a large colony of *punctatissima* in Mrs. Frith's hot-house at Minchinhampton.

FAMILY III. MYRMICIDÆ.

Number of joints in labial and maxillary palpi differ in the species. Eyes, as a rule, present in all the sexes. Workers wanting ocelli—the petiole of abdomen furnished with two nodes—females and workers with sting. Pupæ naked, with delicate membranous vesture instead of silken cocoons.

Genus 1. *Myrmica*.

Labial palpi, four-jointed, maxillary six-jointed. A transverse nervure divides the marginal cell in the male and female. The five species of this genus, though closely allied in general appearance, and requiring a Coddington lens for their identification, yet possess distinctive features, and are not, I think, as Emery and Forel suggest, races of one species.

(1.) *Myrmica ruginodis*.—The *worker* and *female* have the nodes longitudinally rugose, and the spines of the metathorax long. In length, female about 3 lines or 6 millimetres; worker about $2\frac{1}{2}$ lines or 5 millimetres.

¹ See Fig. 12, p. 83.

The *male* has two blunt spines to the metathorax and the nodes shining. Frontal area not grooved. Scape of antennæ curved at base and attenuated. Length same as female.

A widely distributed species. I have found it in Kent, Devonshire, Suffolk, Sussex, and Gloucestershire in the neighbourhood of Stonehouse, where it is not, however, common.

(2.) *Myrmica scabrinodis*.¹—The *worker* and *female* are pale rust-red with darker head, and adorned with bright yellowish hairs. The scape of the antennæ is distinctly elbowed. The nodes are rough and striated. The spines are long. The wings are dusky at the base.

The *male* is dark brown, scape of antennæ very short, about one-half the length of the scape of the former, and one-fourth that of the flagellum.

This ant is smaller than the preceding. Length of worker from $1\frac{1}{2}$ to 2 lines, or about 4 millimetres; males and females about same size, $2\frac{1}{2}$ lines or 5 millimetres.

It is very common. It abounds in the neighbourhood of Stonehouse. It is frequently met with under stones. I have found it occupying one side of the raised mound of *flava*, and also sharing with this species the shelter of the same stone. I captured the male of this species in the August of 1879, flying over the cairn which crowns the head of Snowdon.

(3.) *Myrmica lævinodis*.—This ant, as the name denotes, has smooth nodes. The workers and females have shorter spines. The males want them. The antennæ of the latter are shorter than in *ruginodis*.

This species I find widely distributed, and in the neighbourhood of Stonehouse very common. The vicarage garden abounds with it. I find it in the flower-beds, beneath the bark of an old tree, in the stonework of the house, in the corollas of the flowers, and in the fruit. The sexes are found in the nest in August.

(4.) *Myrmica sulcinodis*.—The *female* about the same size as *ruginodis*. Deep rust-red in colour. Head, dark reddish-brown. Abdomen, nearly black and shining. The head, thorax, and nodes, very coarsely striated and deeply furrowed, as the name denotes. The spines are long, sharply pointed and slightly curved. The wings are clear, with the nervures and stigma pale brown.

¹ See Fig. 1, p. 31, and Fig. 7, p. 55.

The *worker* has the thorax more roughly furrowed, and the spines more erect.

The *male* is very dark brown, nearly black. Antennæ, abdomen at its termination, and legs, pale red. Thorax and frontal area longitudinally grooved, and first node of the petiole rough and second node smooth. Area of distribution very restricted. The sexes are found in August.

I have the ant from Mr. C. W. Dale, who found it in Dorsetshire, near Wareham, and in Hampshire, near Bournemouth. Mr. J. C. Dale met with it at Holyhead. I have found it in strong force at Bournemouth. It has been said that it raises a mound like the turf dwellings of the common *flava*, but according to my experience its nest is but very slightly elevated above the surface of the soil.

(5.) *Myrmica lobicornis*.—This ant is very similar to the preceding in colour, rather smaller in size, and very readily distinguished from it by the structure of its antennæ. Those of the female and worker are elbowed at their base, and at the angle of geniculation are furnished with a distinctly marked acute lobe or spine. Hence the specific name. The antennæ of the male are but slightly curved or elbowed.

Mr. Curtis found it in Scotland in the year 1825. Mr. J. C. Dale also found it in Scotland at Rannoch, where he discovered its habitat. It has been discovered in the nest of *sanguinea* by Mr. Rothney at Shirley, and Mr. F. Smith has taken four specimens of the female at Lowestoft, Suffolk, in 1859. I have found many specimens running in the sunshine on Shirley Common, and I am, I believe, the first who discovered its habitat in England. This I have done twice. In the first instance on the borders of Exmoor, where I found a colony under a stone with the pupæ. In the second instance near the Aber Waterfall, North Wales, also under a stone, when I captured many workers and one male. This was in the month of August. I also have taken a single worker both on Brendon Common, and on the road near Aber.

Genus 2. *Tetramorium*.

Antennæ : thirteen-jointed in male, twelve-jointed in female ; and in worker, maxillary palpi four-jointed, and labial palpi three-jointed.

(1.) *Tetramorium Kollari*.—The *worker* has its head and thorax pale red. The head is finely channelled and reticulated. The thorax is coarsely punctured. The antennæ are uniformly pale. The eyes are unusually large and numerous faceted.

This species was first discovered by Mr. J. Brewer at Sheerness in 1866, and recorded as British by Mr. F. Smith, in the *Ento. Annual* for 1871. I have since found it in great numbers in a hot-house at Stroud, and in 1882 it was sent me from a hot-house at Eastington, near Stonehouse. In 1894 I found it in the Botanical Gardens, Regent's Park. Its length is about $1\frac{1}{2}$ lines, or 3 millimetres.

(2.) *Tetramorium cæspitum*.—The *female* is shining black or dark brown, with mandibles, antennæ, joints of legs and tarsi pale red. The head narrower than the thorax, and finely and longitudinally striated. Metathorax is also striated. The abdomen is ovate in form ; spines are short. It is about 3 lines, or 6 millimetres in length.

The *worker* has the head and thorax finely and longitudinally striated, dark brown in colour, some specimens paler than others, head wider than the thorax, nodes smooth, and the abdomen also smooth and shining. It is between 1 and 2 lines, or 3 millimetres in length.

The *male* is polished black. Abdomen dark brownish-red ; mandibles, antennæ, and joints of legs, pale red ; head narrower than the thorax. The former being rugose and the latter striated.

Mr. Saunders separates this and the following species, considering the antennæ of *cæspitum* ten-jointed ; but Mr. Smith embraces them in the same genus, pointing out how the second joint in *cæspitum* is really formed of three joints, which are, as it were, soldered together. I therefore retain Mr. Smith's generic name, both for this species and *lippula*, instead of adopting with Mr. Saunders the *Asemorhoptrum* of Mayr as its genus. As I have mentioned in the body of the work, *T. cæspitum* is usually found at the seaside. I have met with its thickly-populated formicaria at Shoeburyness near Southend, at Bournemouth, at Folkestone and Deal. I have also discovered it on Hampstead Heath. I have found it also at Sandown, Isle of Wight, and Lynmouth ; at Branscombe, South Devon, manifesting harvesting instincts, and abundantly in the Scilly Isles ; so that it is widely distributed.

(3.) *Tetramorium lippula*.—This species is very distinct by reason of its minute eyes and petiolated first node. It is dark reddish-brown in colour. The head and thorax are reticulated, and the spines of the metathorax short and pointed. It is very rare. Mr. Janson has found it in company with the jet ant, *F. fuliginosa* (*L. fuliginosus*). I have found it at Charlton, Kent, in company with *F. umbrata* (*L. umbratus*). I have also found it in the Valley of Rocks, Lynton, with a dead companion in its mandibles.

Genus 3. *Leptothorax*.

This genus is distinguished by having the maxillary palpi five-jointed, and the labial palpi three-jointed. The female is only slightly larger than the worker; the pubescence on the body above is somewhat remarkable, the hairs, being in a measure clubbed, gradually tapering to this base. The club of the antennæ is three-jointed. The number of joints in the antennæ vary in this genus. In the male they are either twelve or thirteen jointed, and in the female and worker either eleven or twelve jointed.

(1.) *Leptothorax acervorum*.—*Worker*, red head; club of antennæ and abdomen very dark; also dark stain on top of thorax. Clothed with scattered, stiff, whitish hairs; head striated longitudinally, and thorax and nodes rugose; metathorax with two blunt and short spines. Antennæ twelve-jointed, about $1\frac{1}{2}$ lines, or 3 millimetres in length.

Male, black; nodes of petiole and abdomen smooth and polished; wings, white. About 2 lines, or 4 millimetres in length.

Female, brownish-red head; thorax and abdomen nearly black; mandibles, scape, and legs paler. Antennæ, eleven-jointed; head, finely and longitudinally rugose. Thorax and nodes rugose. Metathorax with short blunt spines. Abdomen and legs with scattered bristly hairs.

This species is very widely distributed. It is said to be common in Scotland under bark. It is certainly common in Stonehouse and its neighbourhood. I have found it in my garden fence, in Leonard Stanley parish in an old post, and at Haresfield in an old stump. I have found it, in the borders of the Forest of Dean, tenanted a gate-post in the picturesque Wye district between Lydbrook Junction and Symond's Yat,

and also in an old stump close to the Buckstone near Staunton. I have also met with it at Bournemouth, and on the Wellington College estate in the ground, and at Shirley Common in the same situation, and also inhabiting a gorse stump in the centre of a nest of *sanguinea*. Also at Lynmouth in an old stump, and all the sexes sunning themselves on a rock on the banks of the East Lynn.

(2.) *Leptothorax Nylanderi*.—As a rule with the *Myrmicidæ*, the mesothorax of the male has two deeply-impressed oblique lines, forming a V-shaped space. Now, in the present species this space is smooth and polished. The colour of the male is very dark brown, with antennæ, mandibles and legs pale reddish-brown. With the exception of the head the body is polished. Length about $1\frac{1}{2}$ lines, or $2\frac{1}{2}$ millimetres.

The *female* is pale reddish-yellow, the head tinged with brown; the abdomen is beautifully banded with brown, having a broad belt on first segment, and a narrow marginal belt on the two succeeding ones. Wings perfectly colourless and transparent, so that it is with difficulty that they are seen when extended on a card. Length about 2 lines, or 4 millimetres.

The *worker* is coloured as in the female. Some specimens are rather larger than others, and these have the abdomen banded as in the female; the smaller specimens have the base of the abdomen pale yellow, and the rest brown. The length of the larger worker is about $1\frac{1}{2}$ lines, or $2\frac{1}{2}$ millimetres, the smaller 1 line, or 2 millimetres.

On September 9, 1861, I made the interesting discovery of its habitat at Lee, Blackheath, Kent. It was in an old stump. I captured nine females and sixteen workers. Mr. Saunders has obtained specimens of this worker by sweeping at Chobham and Wimbledon, and Mr. G. A. J. Rothney has found the worker in the nest of *sanguinea* at Shirley.

(2.) *Leptothorax unifasciata*.—Very like the preceding, but readily distinguished from it. In the female and worker the club of the antennæ is dark brown, and the abdomen is not so distinctly banded.

The *male* has the V-shaped space on the mesothorax finely rugose.

I have found a large colony of this very rare ant between the laminæ of a boulder of Portland stone on the Isle of Portland,

at the foot of the cliff on which stands the prison. Mr. C. W. Dale has found it on this island, and also at Lulworth, and at the 'Burning Cliff' near Weymouth, and he sent me a colony of the same from Seaton, which he found in a nodule of sandstone. Mr. Saunders has taken it at Ventnor, Isle of Wight.

(4.) *Leptothorax simillimus*.—This is about the same size as the two preceding. It is pale reddish-yellow, with nodes and edge of thorax dark reddish, and abdomen dark reddish-brown. The spines are very short. The abdomen shining with scattered hairs.

Mr. Saunders has kindly sent me this ant, which he captured at Kew. It has also been taken at Exeter by Mr. Parfitt, and I have since found it in a hot-house at Cheltenham.

Genus 4. *Stenamma*.

Maxillary palpi, four-jointed; labial palpi, three-jointed; female and worker, eleven joints to antennæ. Anterior wings with open marginal cell—one complete sub-marginal and one discoidal cell—second node of petiole furnished with a spine underneath.

Stenamma Westwoodii.—*Female*, reddish, smooth, and highly-polished; spines short and pointed; wings hyaline, head very delicately grooved.

Male, blackish brown; antennæ, thirteen-jointed; spines very short and erect; wings milky white. Body with fine scattered hairs; same size as female, viz. about 2 lines, or 4 millimetres.

Worker, paler in colour than female. Highly polished as in female. Abdomen clouded with brown, oblong ovate. First segment large, second node spined beneath. First node grooved.

This ant is rare, found in nest of *rufa*. Mr. Smith gave me specimens of worker from Weybridge. The ant has also been taken by Dr. Capron of Shere, near Guildford, in the neighbourhood of *rufa's* nest, by sweeping.

Genus 5. *Solenopsis*.

Workers very small, females and males more than twice their length; labial maxillary palpi two-jointed. Males with no oblique lines on mesothorax, and females and workers without

the spine. The number of joints in the antennæ, twelve in male, eleven in female, and ten in worker.

Solenopsis fugax.—*Male*, black, and polished, and hairy; antennæ, mandibles and legs, brown; head, thorax and nodes rugose. About $2\frac{1}{2}$ lines, 5 millimetres, in length.

Female, brownish-black; club, two-jointed; head, and thorax, and abdomen, punctured as well as polished. Length about $2\frac{3}{4}$ lines, nearly 6 millimetres.

Smaller *worker*, in colour and appearance like pale yellow polished amber. The larger workers of a darker tint and reddish; whole insect, hairy; head and thorax, punctured; clypeus, toothed. Smaller worker, not quite 1 line; larger worker, a little over 1 line, about 2 millimetres.

I received two large workers from Mr. F. Smith, who found a colony by digging at Southend. A female he picked up at Deal, and in 1882 the Rev. W. W. Fowler found a large colony under a stone near Sandown, Isle of Wight. He sent me a large worker and three smaller workers, and a larva. The large workers were few in number. I have also, since this date, taken it in large numbers at Sandown.

Genus 6. *Diplorhoptrum*

This genus is closely allied to the former in that it possesses no spines, and the male has no oblique lines on the mesothorax, and the maxillary and labial palpi have each two joints. It differs from the former in the structure of the antennæ, which have in the male thirteen joints, and in the female and worker twelve joints, and the club three-jointed.

Diplorhoptrum domesticum.¹—This is the common house ant. Shuckard called it *Myrmica domestica*, and Mr. F. Smith, in his catalogue of 1858, *Myrmica (Diplorhoptrum) molesta*, identifying it with the *M. molesta* of Say, which it closely resembles; but since Say's ant has only a two-jointed club, Mr. Smith has separated it, and given it the name which we have adopted, in his catalogue of 1872. He rejected Linneus's designation of *Monomorium Pharaonis*, which Mr. Saunders has adopted in his *Synopsis*, because the description of Linneus is not sufficiently distinctive. I retain, therefore, Mr. Smith's name. It may at once be distinguished from *fugax* by its

¹ See Fig. 18, p. 116.

body being destitute of hairs, and the form of the antennæ. I have so fully described this ant and its habits in the body of the work that I will merely point out that the worker is about 1 line or 2 millimetres in length, and the female twice as long. It is very widely distributed. I have received it from Stonehouse, Plymouth, and from Stroud; and I have found it, as I have mentioned, in several parts of London, both in the City and at the West End, and at St. Leonard's and Folkestone.

Genus 7. *Myrmecina*.

Maxillary palpi four-jointed, and labial palpi three-jointed; upper wings with complete marginal cell petiolated or stalked at the apex; metathorax of females and workers with spines, and the clypeus toothed.

***Myrmecina Latreillii*.**—*Female*, black, with anterior part of head, antennæ, mandibles, metathorax and nodes, reddish-brown; scape, thickened and elbowed at base; head and thorax, longitudinally grooved; scutellum, smooth and polished; wings, tinted blackish-brown, sprinkled with hairs and ciliated, or fringed with hairs. Length nearly 2 lines, or 4 millimetres.

Worker, black; front of head, antennæ and legs, red; head and thorax grooved as in female, and clypeus formed as in same. Length, $1\frac{1}{2}$ lines, or 3 millimetres.

Male, same length as worker; black, with pitchy tint, polished and slightly pubescent; reddish mouth, flagellum, and legs; grooved on side of metathorax; nodes, finely rugose, wings blackish-brown and sprinkled and fringed with hairs.

This species was first discovered by Mr. Curtis, who took the male at Blackgang Chine, Isle of Wight. Mr. Smith took two males and two females in the vicinity of London, and one of each sex at Luccombe Chine. The male and female were taken by Mr. C. W. Dale at Hurst Castle in August. A colony was discovered since near Sir J. Lubbock's place in Kent, and I have found it under a stone in company with the common yellow ant, *F. flava* (*L. flavus*), on Stinchcombe Hill, near Dursley, where the following year, as I have narrated in the work, my elder son drew my attention to a colony of black ants under a stone in the same locality, which I identified as this rare species. It was an interesting establishment, there being workers, an apterous female, and many males, together with larvæ of different sizes. I have also found a single specimen in my garden at Stonehouse, in the middle of a strawberry.

Genus 8. *Pheidole*.

Labial and maxillary palpi each two-jointed, antennæ with three-jointed club, twelve-jointed in worker and female, seventeen-jointed in the male. The larger worker with very large head. The smaller worker with head of ordinary size. Wings with two sub-marginal cells.

Pheidole lævigata.—*Worker*, reddish-brown; mandibles, antennæ, joints of legs, and tarsi, paler; head, thorax, and abdomen, polished; metathorax, very finely reticulated; larger than the house ant, especially the worker-majors, which have heads of extraordinary size.

I have found representatives of both forms in a baker's shop in the Borough. Mr. Smith's son has also found specimens in an eating-house in the City. Specimens have been forwarded to Mr. Smith from a hot-house in Exeter. An example has been taken on a wall at Battersea, and three on a garden wall at Hampstead. This ant is identical with the house ant of Madeira, *Æcophthora pusilla*. And if it has been imported it is now undoubtedly naturalised and must be retained on the British list.

PHALANX II. *SOLITARIA*.

FAMILY IV. MUTILLIDÆ.

I have at some length stated my reasons for retaining Mr. F. Smith's grouping of the solitary ants under the division *Heterogyna*, and have given also a general description of the genera and British species of the family, and shall, therefore, be as succinct as possible in the following *résumé*.

The males are winged, the females apterous; the legs of female robust and adapted for burrowing; tibiæ toothed, and the tarsi furnished with hairs.

Genus 1. *Mutilla*.

Head in female roundish, compressed in males; eyes smaller in females than in males; ocelli wanting in females; antennæ tapering to a point; wings containing three sub-marginal cells; first segment of abdomen constricted.

(1.) *Mutilla Europæa*.¹—*Female*, head black, punctured with black hairs; prothorax black, rest of thorax rust-red abdomen black, polished, and punctured with three bands of

¹ See Fig. 13, p. 86, and Fig. 14, p. 87.

golden, glittering hair on first three segments, the second and third interrupted, scattered black hairs between the bands. Length from 5 to 8 lines, or 10 to 16 millimetres.

Male, head, chalybeous or steel-coloured ; sides of mesothorax and metathorax, *black* ; top of same parts of thorax, red ; wings, tinted with brown ; bands of pale yellow hairs on first three segments of abdomen, those on second and third only slightly interrupted.

Mr. Smith has recorded that this species is found most abundantly in the sandy lanes of Kent, and frequently taken about Darenth and Birch Woods. The male has been taken as late as September 13. I have taken the male and female at Bournemouth in August, and have met with the female in June on the Wellington College estate.

(2.) *Mutilla ephippium*.—*Female*, black ; head and thorax roughly punctured ; prothorax and metathorax black with mesothorax red ; antennæ, rust-red, with six or seven of the terminal joints black ; mandibles, rust-red, also with the tips black ; legs also red, with long hairs ; abdomen with fringe of silvery hairs in centre of basal portion and at opposite side of second segment, and third segment adorned with same pubescence ; the terminal segment reddish. Length about 3 lines, or 6 millimetres.

Male, black ; puncturations, coarse ; mesothorax and collar, rust-red ; wings, tinted brown ; fringe of silvery hairs on second, third, and fourth segments. There is a variety entirely black, with same silvery hairs. Length of male about $2\frac{1}{2}$ to 5 lines, or 5 to 10 millimetres.

I have found the female at Charlton, Kent, Bournemouth, and near Christchurch, Hants, on the Deal sands, and in Sandown Bay. Mr. F. Smith has found the species also at Charlton and Sandown Bay, in which latter locality, in the middle of July, 1851, both sexes were captured, amongst them a specimen of the male 5 lines in length, and also the very rare black variety. He also found the species at Weybridge. Mr. Saunders has met with it at Hayling Island.

Genus 2. *Myrmosa*.

Female very similar to *Mutilla*, but differing from it by possessing ocelli. Male, black ; abdomen with constricted segments ; wings, possessing four sub-marginal cells.

Myrmosa melanocephala.—*Female*, head black, as name denotes ; coarse puncturations ; thorax, black ; abdomen also black and punctured, with first segment, base of second, anterior margin of second, third, sometimes fourth, red, and two terminal segments entirely red. Lower margins fringed with silvery hairs ; lower half of antennæ and legs, red. Length about $1\frac{1}{2}$ to 3 lines, or 3 to 6 millimetres.

Male, black and punctured strongly, and pubescent ; wings, tinted and iridescent. Length about 3 to $4\frac{1}{2}$ lines, or 6 to 9 millimetres.

I have taken this species at Charlton and Bournemouth. Mr. Smith records its capture, in addition to Charlton, at Hampstead, Coombe Wood, Weybridge, Hawley Green, Hants, Sandown Bay, Luccombe Chine, Deal, Lowestoft, and Southend. At Weybridge he mentions how twelve specimens of the female were taken in a small sand-pit, the males being plentiful on flowers in the second week in August. Mr. C. W. Dale took both male and female at Glanvilles Wootton in July.

Genus 3. *Methoca*.

Female, head nearly round, with ocelli ; antennæ, long and slender ; abdomen, doubly constricted so as to form three nodes ; the abdomen ovate and conical, with acute apex highly polished. *Male*, head compressed transversely ; ocelli large ; antennæ long and slender ; wings, three marginal cells ; abdomen long and narrow with acute spine at apex.

Methoca ichneumonides.—*Female*, head and abdomen black and polished ; thorax, legs, and antennæ, red.

Male, black and polished with grey pubescence and more or less punctured ; wings slightly tinted brown ; margins of segments of abdomen slightly constricted.

This is a very rare insect. I have taken several specimens of the female at Bournemouth. Mr. Smith captured five females and three males on one occasion at Weybridge on August 8, also another male in the same month at Blackwater. He also records it as having been captured at Blackgang Chine and Sandown Bay, at Hampstead Heath, Southend, and Lyme Regis. Mr. J. C. Dale captured both male and female in July, at Lulworth, and the Rev. F. G. Morris has taken the female at Charmouth in August.

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