TERMITES

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It is intended to publish some notes on *Neotermes militaris*, commonly found in up-country tea. The present paper gives an account of Termites in general, which will serve as an introduction, so that the special position of *N. militaris* may the better be seen in relation to the whole group.

INTRODUCTION

Many people know that the name, "*termite*", is synonymous with the term, "*white ant.*" Yet there are not a few who think they are different and suppose that a "white ant" is an ant which is white. This is a complete misconception, since ants and termites are widely separated in the insect class; for whereas the former may be considered the culmination of insect life, termites are very primitive. Apparent similarity arises from similar conditions of life which have lead to interesting analogies in the social organization of the two groups; but in structure and development they are entirely unalike. The use of the term "white ant" has doubtless been responsible for this confusion, and "termite(s)" will in future be used in connection with them.

Distribution.—Termites are mainly tropical, although a few species are found as far from the Equator as the warm temperate zone in both Old and New World. It is in the tropics that they reach their greatest communal development, and they are particularly conspicuous in Africa and Australia. In Ceylon, termites of different kinds are found from sea level up to nearly 6,000 feet elevation.

BIOLOGY

Social Life.—All known species of termites live in social communities, whose habitations are of two main sorts, either in wood or in the earth. The wood-dwelling species are the earlier or more primitive kinds, while the earth-inhabiting forms, especially those which also build mounds, are more advanced. The members of the former type of colony may be numbered in hundreds, the latter sometimes in hundreds of thousands.

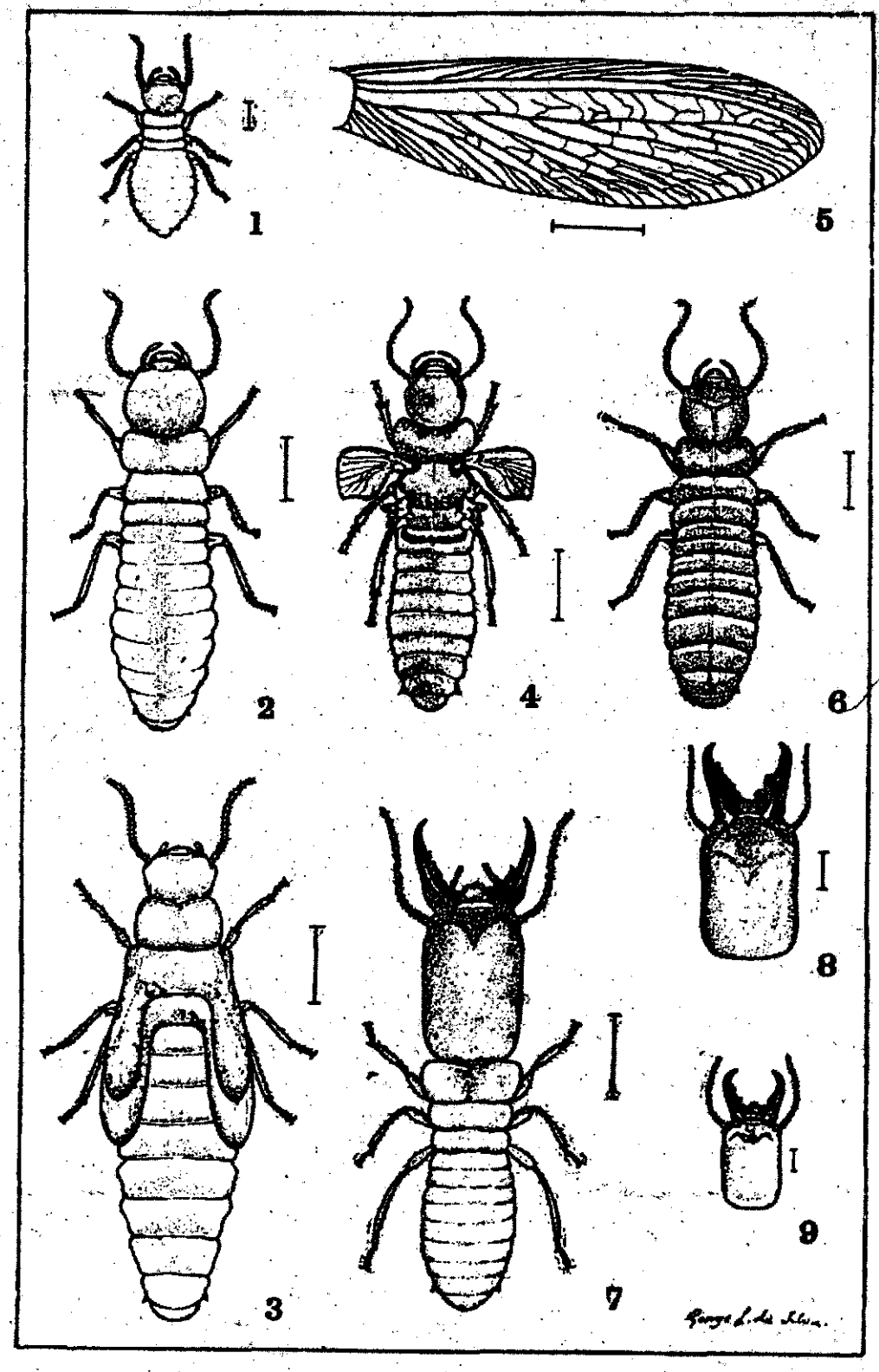

PLATE I.

(Figures 1 to 7 *Neotermes militaris*).

Fig. 1. Nymph, early stage, × 6. Fig. 2. Nymph, full-grown, ×6. Fig. 3. Nymph of winged adult, × 6. Fig. 4. Winged adult which has shed wings, × 5. Fig. 5. Forewing of adult shown in Fig. 4, × 5. Fig. 6. Complementary functioning sexual nymph, × 6. Fig. 7. Soldier. Fig. 8. Head of soldier of *N. greeni*, × 6. Fig. 9. Head of soldier of *Glyptotermes dilatatus*.

On breaking open a nest, more than one type of individual may be seen. The majority will probably be of a whitish colour all over, some may have large brown or blackish heads, or there may be brownish wingless forms, and some, perhaps quite a number, with wings. This differentiation of types is also to be found in the true ants, and in a lesser degree in bees and wasps, and is correlated with the gregarious existence of these insects.

What then, are these various forms? The adult forms can be divided into three different castes: (1) workers, (2) soldiers, (3) reproductives, the first two being sterile, although male and female. The *workers* (Pl. II. Fig. 1) are by far the most numerous, and it is their job to build and repair, to forage, and to feed the young, the soldiers and the so-called royal pair. They are lightly chitinised, their heads and bodies being whitish, except the mandibles (or jaws), which are strong and robustly developed for their work. The *soldiers* may be at once recognised by their large and powerful-looking heads (Plates I and II). Their function appears to be that of resisting invasion by predatory insects; but so well is a colony protected by its fortress home that very often they must have little or nothing to do. For this rôle, there is, in most termites, a corresponding development of the jaws, but there are some which defend themselves and the colony in a different way. In these the jaws are quite small; and a poison gland occupies most of the head, and sometimes of the whole body as well, the contents of which appear at an orifice situated at the front of the head, often at the end of a beak-like process (Pl. II Fig. 8). In some forms the liquid is discharged in the form of a jet.

The *reproductives* are of two sorts. One kind is readily recognised, being brown in colour and having long wings (Pl. II. Fig. 2). Their purpose is to found new colonies. They are said to be promoted to the fully-winged condition shortly before the time of flight, which is usually associated with particular meteorological conditions. Certainly in places where there is a clear-cut rainy season, the period immediately before is one of high temperatures and increasing humidity, and it is at this time the winged termites are chiefly found ready for the colonising flight. In the earth-nesting species, the nest is opened up in many places, sometimes as small holes, the galleries leading to them being lined by patiently waiting alates, as the winged forms are called, and sometimes as chimneys, feverishly built by the workers, and in which large numbers of parents-to-be will be found just prior to flight. I have used the expression "parents-to-be," for it indicates that although adult and fully functional, the sexes do not pair off till after the flight.

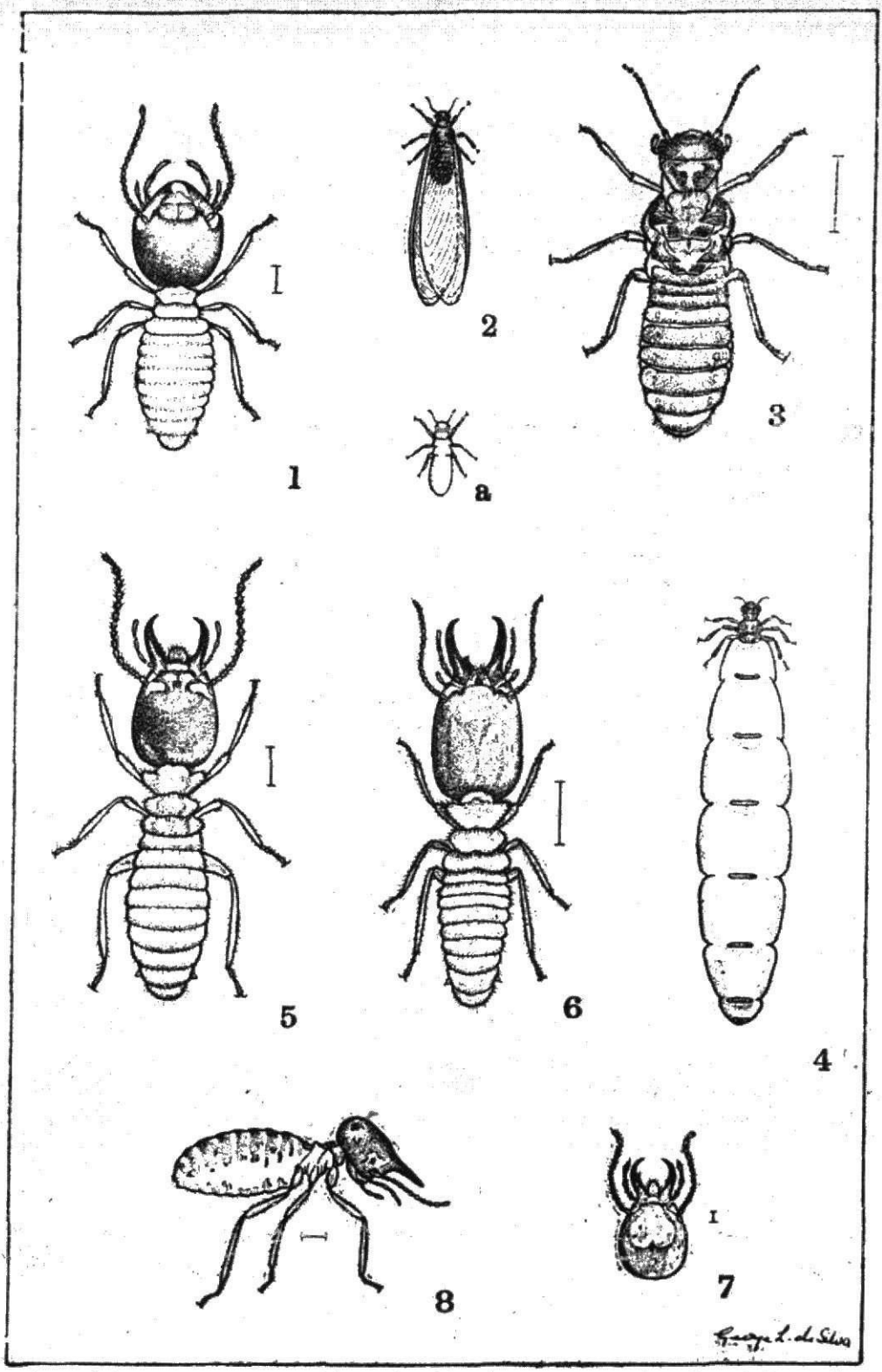

PLATE II.

(Figures 1 to 5 *Termes obscuriceps*).

Fig. 1. Worker, × 10. Fig. 2. Winged adult. Fig. 3. Winged adult after shedding wings, × 4. Fig. 4. Queen, after development (original size shown at "a"). Fig. 5. Soldier, × 10. Fig. 6. Soldier of *T. horni*, × 6. Fig. 7. Head of soldier of *T. redemanni*, × 10. Fig. 8. Soldier of *Eutermes* sp.

The second kind of reproductives are wingless and do not leave the nest. They are said only to be produced when the colony mother is dead or removed. They never grow to the vast size of the queens of earth-nesting termites, and as on account of their smaller size eggs are laid at a greatly reduced rate, this is made up, at least in part, by having several of these "complementals," as they are called (Pl. I. Fig. 6). Thus we see one great difference between the winged and wingless kings and queens that whereas the winged ones are waiting to leave the nest before fulfilling their function, the wingless and sexually mature forms are retained in the home nest.

In addition to the adult forms described one also finds a number of others in various stages of development. These are *nymphs* (Pl. I) which are at first fed by the workers, but later probably lead a life similar to that of the workers. In due course they become either fully grown workers, soldiers or sexually mature adults.

The Founding of a Colony.—The flight of winged termites usually takes place after the onset of heavy rain. For insects they are feeble fliers and do not rise very high nor fly very far. The presence of a swarm in daylight is therefore a conspicuous affair, and attracts the attention of birds and other predatory beasts, which gorge themselves at such a banquet, thus suddenly provided. They are also considered a delicacy by man. Prior to swarming the African negro prepares a light cage of sticks about the places of exit, and when the termites come forth they are easily caught on the framework. Waiting for this moment the negro then crams himself with the insects, using both hands, and the next day is unfit for work. They are said to have a sweet and nutty flavour, and Sharp [1], quoting Smeathman, says: "I have discovered with several gentlemen upon the taste of the white ants; and on comparing notes we have agreed that they are most delicious and delicate eating. One gentleman compared them to sugared marrow, another to sugared cream, and a paste of sweet almonds."

In spite of the wholesale slaughter a few survive. They alight on the ground or on a tree, according to their kind, pairing off, the male closely following the female. Having effected entry, copulation ensues and egglaying begins. After this, in many species, the queen begins to grow and ultimately becomes enormously distended and in this connection is probably familiar to many people (Pl. II. Fig. 4). The growth of a colony must be at first slow, and the parents feed and look after the young. At a later stage these functions are taken over by the workers and it is probable that not until then does the queen begin to grow. In the mound building

species sometimes vast edifices are erected in the course of time made from particles of soil cemented together with either saliva or fæcal matter or both. In Africa and Australia these mounds may be conspicuous features of the landscape, reaching up to 20 feet in height and composed of this very hard and tough material. One particularly curious species in North Australia, *Hamitermes meridionalis*, constructs lofty wedge-shaped mounds which are invariably aligned in the north-south direction.

Not only are these cement nests made on the ground, but by some termites are constructed in trees. Many ground-nesting types explore above ground level by means of plaster tubes. These may be seen in buildings as well as in the open. The tubes may run up a tree to a nest constructed out of the same material on a branch or fork some distance up. In such cases connection is always kept up with the subterranean part of the nest, for a continuous water supply is necessary to the community. Snyder [2] tells of the investigation of a nest of this sort, and incidentally reveals himself the intrepid explorer. His account is as follows: "After a fairly inactive winter, I was soft and out of condition, so I became nearly exhausted struggling in the hot sun up and under the dense tangle of felled trees and brush of a recent clearing of a banana plantation to reach a patch of jungle . . . . . Finally emerging from the forest growths, I spied an elongated inverted cone-like carton nest in an isolated tree growing in a pasture. I had never before seen a nest like this, so I started up the tree. A brier-like vine growing on the tree penetrated my skin, and when half way up a small nest of wasps (*Polistes* sp.) was disturbed; the wasps stung me viciously. I fell down from the tree. Still determined, I knocked down the cone-like nest with a branch and broke it. Out swarmed legions of a tropical ant (*Azteca* sp.) which soon covered me, biting viciously. I had expected to find termites in the nest. Chagrined, I turned away just in time to see a bull charging towards me. I fled, and climbed the fence. Covered with young or seed ticks which were boring into my skin, and itching with 'chigger' or red bug bites, I called it a day." This type of nest is not found in Ceylon, but the earth mounds are not uncommon in the low-country.

Food.—In these mounds are found galleries and chambers of various sorts, including one which houses the royal pair. In the most advanced termites the chambers in the mounds are used as store rooms, in which is to be found a strange-looking reticulated framework, like a very open sponge, which is made of comminuted vegetable matter, and on this substance a fungus grows which is used as food by the termites. These structures are known as "fungus gardens," and in them the fungus grows and produces small

white knobs like minute mushrooms, and on these the termites feed. "What evidently appeared to be a species of mushroom" was first recorded, or at least commented upon, in 1781 by Smeathman in his central African journey. This special development is only to be found amongst the highest or most recently evolved termites.

A great many termites depend on rotten wood for their principal subsistence and it seems probable that the important part of this consists of the fungi which produce the rot. A few species are able to attack sound wood even if old and well seasoned. These make their nests completely in the wood they attack. They are characterised by a very extensive fauna of protozoa in the intestine, the function of which, or at any rate of some of them, is to break down the cellulose obtained in the wood and make it available for digestion by the termites, as was demonstrated by Cleveland in 1924. Such termites are able to live and develop on pure cellulose. Now cellulose is a carbohydrate, that is to say, a substance consisting of carbon, and hydrogen and oxygen in the proportion in which these two are found in water. The element nitrogen is almost completely missing from such a dietary, and as this is necessary for growth and reproduction one may well wonder how they manage to thrive.

In addition to the staple aliments mentioned above, there are other sources of food available. The nymphs on hatching from the egg at first receive only saliva, followed by regurgitated and fæcal liquid matter. In the case of dry-wood termites, fæcal fluid is given almost from the start to young nymphs by the royal pair, and this provides them with the protozoa, which, as we have seen, is so indispensable to them in the digestion of wood.

One other requirement remains to be mentioned, namely, water. All those which nest in soil have little difficulty in preserving a connection with a water supply, which appears to be an essential not only for drinking but for maintaining a humid atmosphere. Even those, which while ground-dwelling in type, make their way up trees or the walls of buildings, must retain connection with water below. If such connection be severed in such a way that they cannot regain that connection, the termites will die. I have had a few termites under observation in a small chamber, in which were a few small pieces of wood on some fine soil to which water could be supplied from below. When the soil became rather dry the termites cemented up the pieces of wood forming a totally enclosed chamber. When water was added they made holes in the roof: when again the soil began to dry, they closed up the holes again. Termites must therefore be sensitive to the degree of humidity of the air, and are able to control this in their habitations.

It will be noted that the dry-wood termites are not linked to a water supply, and their excreta are in the form of hard, dry pellets, almost like dust; accumulations of them outside infested wood are the only external signs of the insects within, and betrays not only their presence but their type.

THE RAVAGES OF TERMITES.

The habit of using wood for food by so many species of termites has led them to direct conflict with man. The amount of damage, with the consequent cost of repair and rebuilding, must be simply colossal. Large areas of land formerly under forest, and now cleared and built over, found termites deprived of most or all of their natural food supply in the shape of dead trees and branches. This, however, was replaced by building timbers, which were quickly discovered by the insects which now turned to this class of wood for subsistence.

It might be as well here to point out that termites gain ingress to buildings in two different ways. Those which have their main nest in the ground explore upwards, always retaining their connection with the earth. If timbers are found in direct contact with the soil, access is easily obtained (unless the wood is resistant or immune). Otherwise their plaster exploration tubes may be found running in or over walls, or even thrown up or down into space in order to reach some fresh place. This type of attack may be prevented by special attention paid to insulation of all woodwork from the ground. Mr. F. P. Jepson has discussed various ways of doing this, particulars of which are to be found in Bulletin 85 of the Department of Agriculture [3].

The other method of attack is more insidious, and is carried out by dry-wood termites. In this case the winged adults after their mating flight bore straight into the wood to found their nest. Such colonies have no connection with the ground.

The ground-nesting termites may do extensive damage in other directions and Snyder [2] gives a list of things liable to injury which is truly formidable in length but by no means complete.

In addition, there is also a fairly extensive list of cultivated plants, including crops, garden plants and trees subject to attack.

It will be seen, therefore, that termites have for us a profound interest on account of their habits, their habitations, the different kinds met with in a single colony, and the general economy of a colony.

From a different outlook we view their activities when they appear in factories and bungalows. With reference to the latter, one might mention the close association believed to exist between the dry-wood termites which eject small dry fæcal pellets from the galleries and the complaint known as "sprue." The evidence for this is set forth in a paper by Jepson [4], but so far it lacks support on the medical side since up to now the causative organism has not been discovered.

Finally, they attack a variety of living plants, both herbaceous and woody in which man also has considerable interest. The discovery of them in the tea bush, which is included among the latter, is therefore of immediate concern to us. Of the three species which nest inside the tea bush, *Neotermes militaris*, *N. greeni* and *Glyptotermes dilatatus*, the first-named is selected for exposition.

I have to acknowledge with gratitude the use of blocks of the two plates of Termites, kindly loaned by the Director of Agriculture.

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