Zeitschrift: Acta Tropica
Herausgeber: Schweizerisches Tropeninstitut (Basel)
Band: 17 (1960)
Heft: 3

Artikel: Miscellanea : Biological notes on the cryptotermes species of Indonesia
Autor: Kalshoven, L.G.E.
DOI: https://doi.org/10.5169/seals-310880

Acknowledgement.

The author would like to extend his thanks to Prof. Dr. H. Ş. OYTUN, the head of the Department of Parasitology, and Prof. Dr. B. T. SIMMS for their very valuable suggestions.

Also, thanks are due to the Smithsonian Institute in Washington, D.C., for the identification of the snails.

References.

1. FAUST, ERNEST CARROLL. (1956). Animal agents and vectors of human disease. — Philadelphia: Lea & Febiger, pp. 420 ff.
2. FUAT, K. (1934). Mesanede Bilharzia hastaligi ve fuadin ile tedavisi. — Urol. Kilinig., I, 22.
3. GÜNALP, I. (1954). Bir bilharzia vak'asi. — Hek. Yen. Görüş., 3-4, 2138.
4. GÜRSEL, A. (1956). Türkiyede Bilharioz. — Türk ijiyen tecrübi biyol. dergisi., XVI, 195.
5. KUNTZ, ROBERT E. & MALAKATIS, GEORGE M. (1955). Susceptibility studies in Schistosomiasis. III. Infection of various experimental hosts with *Schistosoma haematobium* in Egypt. — Exp. Parasit. *4,* 1-20.
6. OYTUN, H. Ş. (1958). Tıbbî Parazitoloji, 2 nci basım, Kültür Matbaası, Ankara, 293.
7. STOLL, NORMAN R. (1947). This Wormy World. — J. Parasit. *33,* 1-18.
8. WELLS, WILLIAM H. (1956). A cursory survey of human intestinal parasites in the nomadic people of Southern Turkey. — J. Parasit. *42,* 535.

Biological Notes on the Cryptotermes Species of Indonesia.

By L. G. E. KALSHOVEN, Blaricum, the Netherlands.

Introduction. In the material on which HOLMGREN based his paper "Termiten aus Java und Sumatra" (1913) he found some small imagos, collected on Mount Gedé by E. JACOBSON in 1911, a similar imago from the volcanic Krakatau Island in the straits between Java and Sumatra (leg. JACOBSON 1908) and a dry mounted imago from Deli, Sumatra (leg. DE BUSSY), which specimens he assigned to two species of *Cryptotermes, C. jacobsoni* n.sp. and *C. domesticus* (Hav.) Apparently the material had been taken at light and no colonies had been found.

In 1923 my friend A. T. J. BIANCHI, wood technologist at the Forest Research Institute in Bogor, brought me a sample from the collection of wood specimens which was thought to be hollowed out by a drywood borer, as frass in the form of small pellets had been ejected from some holes in its surface. Split in two the little block appeared to contain a complete colony of a small termite species, the soldiers showing the stunted head which is characteristic of *Cryptotermes* species. Similar pellets, the size of small seeds, cylindrical in form and with impressed sides, had already often been noticed in the houses on window sills,

skirtings and the like, but their origin had not been investigated. It soon became evident, however, that the infestation was very common in all structural timber and furniture where cheap wood had been used, and that its origin was very well known to the indigenous people. Two different kinds of termites were found to cause this common damage, often living side by side. In subsequent reports (KALSHOVEN 1924a, b, c) they were referred to as "bubuk-termites", bubuk being the Indonesian word for the powdery frass produced by insects attacking dry material.

As later appeared from his monograph on the Java termites, published in 1934, KEMNER had collected the same two species living together in dry timber ("in trockenem Nutzholz") during the time he worked in Bogor in 1920. He had not become aware, however, of the frequent occurrence of the insects.

It may be thought somewhat surprising that these common drywood termites had not been detected much earlier by the entomologists, but then the study of timber and wood destroying insects had scarcely begun, and timber merchants and builders were not much interested in materials of poor quality. A "furniture termite" occurring very abundantly in houses in Singapore and later to be known as *Cryptotermes domesticus* was introduced in the literature as early as 1896 (HAVILAND & SHARP) and it was mentioned in agricultural reports soon afterwards (RIDLEY 1900, ROBERTSON 1905). In the Philippines attention was drawn to the existence of "house termites" in 1921 (LIGHT).

The first complaints by private persons and firms in Java about damage done by drywood termites reached official quarters in Bogor in 1927, and several more were received in subsequent years.

No extensive investigations of the *Cryptotermes* species have been carried out by me, but I think the details gathered during more or less incidental observations in the course of the years are of sufficient value to be published here. A short general account of the habits and importance of *Cryptotermes* has already been inserted in my handbook on the pests of Indonesian crops (1950).

Acknowledgments. The present paper was written as part of a working programme which could be undertaken thanks to a grant received from the Netherlands Organization for the Advancement of Pure Science (Z.W.O). I am much indebted to Dr. W. V. HARRIS, London, for his verifying of the identifications of some of my specimens and for his comments after the perusal of my manuscript. The *Cryptotermes* specimens collected by COLLIER in Java in 1931 and mentioned in KIRBY's papers on the Protozoa have been identified by S. F. LIGHT (1937), and those collected by KIRBY & KALSHOVEN in 1935, also listed in the first author's papers, by A. E. EMERSON, Chicago (see KIRBY 1941 p. 3). Professor EMERSON has been kind enough to check the names assigned to various collection numbers found in my notes. The study of the duplicate samples of material used by KIRBY has been a great help in the arrangement of other samples in the small collection still at my disposal.

New records. The following data have been taken from notes still available and referable to identified specimens. They comprise only a small part of all the material which has passed through my hands.

Cryptotermes domesticus (Hav.) 1898, originally described from Borneo and Malaya (Singapore), since found to be widely distributed in S.E. Asia, and the Papuan and S.W. Pacific area, here recorded from Java for the first time. *Java:* in a severely infested balk of kisampang wood, *Evodia* sp., Bogor, XII. 1923; a single soldier found in a mixed sample of drywood termites, Bogor, VII. 1932; in wood samples at the Forest Research Institute at Bogor, VIII. 1934. *S.E. Borneo:* destroying woodwork in an industrial plant in Balikpapan, VII. 1935.

In all these instances the species was found in the company of *C. cynocephalus*.

C. dudleyi Banks 1918 (syn. *C. jacobsoni* [Holmgr.] 1913 and *C. javanicus* [Kemn.] 1934), first described from tropical America, but since found in several wide-spread localities in the Indomalayan, Papuan and Australian regions, which may include the original habitat, as well as in E. Africa (cf. HARRIS 1958 p. 165). *Java:* in timber species of various kinds in the collection of wood samples, VI. 1923, and in logs and sawn timber stored in a shed, IX. 1923, at the Forest Research Institute in Bogor; in a skirting board, already partially destroyed by *Macrotermes* in a house in Bogor, VII. 1923; in balk of sampang wood, *Evodia* sp., in a native house, Bogor, XII. 1923; in the wooden frame of a piano, Bogor, XII. 1926; in a balk of suren timber, *Toona* sp., Bogor, II. 1928; in round rafters of teak, *Tectona grandis,* obtained during the thinning out of young plantations and already in use for 8 years, Djogjakarta, V. 1931; two colonies collected from the woodwork of native houses by the personnel of the field station at Gedangan near Telawa (nos. 4556 and 4572 in KIRBY 1941 p. 33, 39, and 1942 p. 191); in the frame of a piano at Madiun, VII. 1939 (leg. P. A. BLIJDORP). *S.E. Borneo:* in samples of drywood termites collected from different timber species including damar putih, *Agathis alba,* lanan, *Shorea leprosula,* and keruwing, *Dipterocarpus* sp., Bandjermasin, III. 1933 (submitted by the Forest Officer ZONDAG).

The specimens Bogor VI, IX, and XII. 1923 and Bandjermasin III. 1933 were found to be mixed with *C. cynocephalus*.

C. cynocephalus Light 1921 (syn.: *C. buitenzorgi* Kemn. 1934), originally described from the Philippines. *Java:* from the same source as *dudleyi* in Bogor, VI, IX, and XII. 1923; in wooden racks used for storing textiles in a godown at Batavia (to-day Djakarta), 1927; in a balk of suren, *Toona* sp., and in a board of durian wood, *Durio zibethinus,* Bogor, II. 1928; in old woodwork from demolished houses, Bogor 1931 and VII. 1935 (mentioned under nos. 4537 [leg. COLLIER] and 4582 in KIRBY 1941 p. 47, 66, and 1942 p. 191); in old woodwork of a shed at Tapos, Mount Gedé, 750 m., VII. 1935 (no. 4553 in KIRBY 1941 p. 47, 57, and 1942 p. 191); in dry part of damaged trunk of a coconut palm, *Cocos nucifera,* on the coast at Angke near Tandjong Priok harbour, VII. 1935 (leg. KIRBY/KALSHOVEN). *S.E. Borneo:* from the same source as *dudleyi,* Bandjermasin, III. 1933; destroying woodwork in an industrial plant at Balikpapan, VII. 1935, in the company of *C. domesticus. Sumatra:* in old stump of coconut palm, *Cocos nucifera,* at Manna, near Benkulen, IX. 1934; in sample of keruwing, *Dipterocarpus* sp., received from Simalur Island off the N.W. coast of Sumatra, 1936.

If not indicated otherwise the details given below apply to all the three species of *Cryptotermes* met with. It appears, however, that *C. cynocephalus* was present in the majority of cases observed in Bogor.

Description of the nests. In long pieces of timber the galleries and cavities are extended in the direction of the grain of the wood, and are made more or less concentrically with growth rings if present. When there is no crowding of the termites a sequence is formed of flat chambers which are wide in the middle and tapering at both ends, where a narrow passage way leads to the next chamber. If the colony lives in small pieces of wood of uniform texture irregular cavities are gnawed, again connected with narrow passage ways. Gradually the walls and partitions between the small cavities are gnawed away and the rooms are enlarged into cave-like holes with irregular walls. Mostly the cavities are empty, but faecal pellets are piled up in some parts.

The surface of the wood is always left intact by the termites, but the remain-

ing outer wall may be gnawed away to such an extent that only a very thin shell is left, and, if the wood is tarred or painted, little more than this cover is spared. These paper-thin walls are readily broken through from the outside if the wood is handled or the surface knocked on or rubbed.

Where the surface of the infested wood is still left, it is always pierced in places by neat circular holes which are the outlets of the passage ways and connect the cavities more or less directly with the open air. These holes are used for the ejection of the faecal pellets and by the swarming alates.

The pellets are of various shades, usually corresponding with the colour of the wood, and are often brownish or reddish. Those formed by the digestion of sapwood of teak are white, and those ejected from infested bamboo are nearly black. The formation of black pellets during the infestation of wood is possibly an indication that the conditions for the termites are not favourable. The removal of the pellets is not done continuously but intermittently.

The ejection holes not in use are closed by the termites with fluid faecal matter which hardens to a solid plug. In a similar way small openings within the nest are closed. When infested wood is cut and the cavities are exposed the termites retreat into inner rooms and plug the narrow passages leading to them.

On horizontal surfaces the pellets are heaped around the holes, otherwise they form piles beneath the infested parts on the ground or on projecting edges, etc. Often they are the only sign to betray the presence of a drywood termite colony in the woodwork. In old, cheaply-built houses the pellets not seldom rain down on tables, beds, etc. showing that the wood or bamboo in the ceilings and rafters is infested.

Through the breaking down of the thin outer surface infested balks, boards, and doors may look rather scaly and dilapidated after an infestation of long standing. When most of the wood is consumed by the termites little more is left than a cavernous or honey-combed structure, and a transverse section, cut across grain, will show a number of cells only separated by thin partitions.

Swarming and settling of colonising imagos. The small alates of *cynocephalus* swarm in the early morning soon after sunrise, in Bogor at about 5.45 until 6.30. They leave the nests in small numbers only and the flights are repeated at intervals of 5-10 days from the end of July to the beginning of December. When the nests are in the inner woodwork of houses the alates are attracted to the light coming through the windows or reflected by a mirror, and they may be seen fluttering against the panes or on the curtains in groups of up to 5 or 6 specimens. Similar observations about this exceptional time of the day for the swarming of termites were made in the Philippines by the author of the species, S. F. Light (1921).

Some notes on the subsequent behaviour of the alates, which are as agile as those of *Neotermes tectonae* (Damm.), can be added here. Where there is free access to the open air they rise in their flight, but, as far as could be observed, not much higher than the edges and ridges of the roofs of small houses. Having come down again, the alates are attracted by unpainted wooden parts of structures, sawn timber, billets, etc., where they alight. In the neighbourhood of houses they also alight on white-washed walls adjacent to wood surfaces, so that they appear to be directed by a perception of light and light-coloured surfaces as well as of some odour emitted by the wood.

After alighting they immediately begin to search the surface in all directions and coming upon holes and crevices they stop to explore them and eventually enter them, thereby shedding their wings if they have not lost them already before. During the search the termites often combine in couples, moving tandem-

like, or a single specimen which has found a hole may be joined by a partner afterwards. While moving the slender abdomen is bent down in the middle, and its tip is slightly raised.

Choosing a place to settle the termites are particulary interested in small round holes where they just fit in, like old pin-holes and shot-holes of ambrosia beetles (Scolytidae and Platypodidae), or exit holes of powderpost beetles (Bostrychidae, Lyctidae) and furniture beetles (Anobiidae). In dry bamboo they use the flyholes of a small longicorn *(Chlorophorus annularis)*.

The alates of *dudleyi* appear to swarm in the afternoon and at dusk. They are also attracted to light-coloured surfaces and have often been seen alighting on white clothes. Their swarming season apparently falls in the same time of the year as in *cynocephalus*.

The procedure of closing the entrance of the hole has been observed for *cynocephalus* under the binocular microscope and is as follows: One of the termites, moving backwards, with the tip of its abdomen feels all around the edges of the opening and starts to place here and there drops of a thick, black fluid, which are pressed down a little and almost immediately solidify. The substance is extruded from a longitudinal slit between a pair of valves which are in constant motion, the whole operation taking about 5 seconds. Gradually a first rim is completed and the termite continues to enlarge it towards the centre, constantly feeling around for the extent of the opening not yet closed. When, after some time, it slackens, it is pushed aside and replaced by its mate. Ultimately the entrance is closed, but the film still shows very fine perforations. These are also stopped and plugged from the inner side and finally a smooth, somewhat glossy black crust is formed. The whole procedure may be completed in some 30-60 minutes.

Behaviour of the soldiers. The method of defence of the nest by the *Cryptotermes* soldiers—viz. the plugging of the surface holes with their truncate head, which exactly fits in the opening—has already often been mentioned in the literature and recognized as a nice example of phragmosis. They appear to act purely defensively and have no inclination to thrust forward when approached by a strange object. When moving among the other nest inhabitants in the galleries the soldiers present a very sluggish appearance. Their reaction to disturbance of the nest is dealt with in a later paragraph.

Growth and size of the colonies. The initial development of a colony appears to be extremely slow. Two months after a couple of *cynocephalus* had settled in a hole and closed the entrance the gallery was only extended for one cm. and a single egg was found. However, further rearing of the colonies in the laboratory did not meet with success, and it may be that the conditions in some way were unfavourable though it was not understood in what respect they could be lacking.

S. F. LIGHT (1929) records a similarly slow development in young colonies of *C. dudleyi*.

No attempts have been made to count the number of individuals in a colony. In most instances the infested material investigated was inhabited by more than one colony and very often by colonies of two species, their galleries criss-crossing through the wood and intermingling with each other. In these cases it was not possible to separate the population of a single nest. It has become certain, however, that one colony may consist of several hundreds, and probably even of a few thousands of individuals. Soldiers are present in comparatively small numbers. The largest number of eggs found in what appeared to be one colony is 25 specimens.

It should also be mentioned, that no substitute reproductive specimens (neotenics) have been observed in the nests.

Observations on nests in the laboratory. As may be understood it is very easy to keep colonies inhabiting small pieces of wood in a jar or other container. This is particularly worth while as after some time the termites begin to feed on the outer side of the wood and will retreat into their galleries only when disturbed. The light shining through the glass of the container does not hinder them. Tapping the container will cause them to flee into their recesses, but does not disturb them so much as the taking off of the lid of the container. Apparently they need an absolutely quiet atmosphere and even the slightest air current makes them restless and impels them to "stream away" into their holes. Shortly after the workers have disappeared a few soldiers make their appearance to scan the surface.

When there is no disturbance the parent termites may be seen sometimes moving freely among the brood. The female has a distinctly distended abdomen and has been observed a few times to move around with an egg protruding from the tip of the abdomen. No particular attention is given to the parents, but the workers (in fact the larvae and nymphs having the function of workers) have been seen "grooming" each other, and all the nest inhabitants make the jerking motion now and then which is so characteristic of termites.

Whitish specimens, their colour indicating that they were awaiting or just had passed through an ecdysis, were found clustered under the wood sample, apparently seeking a secluded place.

The eggs may be deposited or left in any place, but they are tended by the workers after gathering them into small clusters of 3 to 5.

Most of the activity of the workers is, of course, bestowed on feeding and on tunneling the wood. When they are gnawing the wood surface it can be observed that they elaborately tear very small fragments, twisting their heads, and after a small bit is detached they continue to chew it for some time.

Once a colony of some hundreds of individuals, which had been removed from their nest and collected in a dish, was poured out on a new intact piece of very soft wood—that of the kapok tree, *Ceiba pentandra*—and placed in a glass container. The workers spread over the surface and soon quieted down, starting to feed on the surface and also beginning to gnaw tunnels in the wood, where the more active gradually disappeared from sight. In the next weeks the wood was steadily gnawed away on the inner as well as the outer side, its volume—originally some 50 cubic cm.—decreasing in size perceptibly. After a month it was nearly consumed and a new piece had to be supplied.

Although the termites carry out their normal activities on the free surface of the wood, if this is enclosed in a not too large container, they are still inclined to confine their living room by the building of small walls at the edges of inhabited pieces, forming connections with any adjacent parts. A similar fencing-in has been noticed under natural conditions, where the termites had extended their galleries from an originally infested piece of wood into another one, adjacent to it but not fully in touch with it. Here rings had been formed around the place where the termites had crossed the open space. The material used for these walls appears to consist of faecal matter voided in drops but also in part of a black substance resembling that produced by the colonising imagos in closing their holes.

Another feature to be mentioned is the way a colony appears to cling to a small piece of wood on which they feed. Even when very little is left and a new piece of wood of the same kind is available close by, the workers will crowd in a very narrow space on their first feeding ground. The same has been

observed in colonies of *Cryptotermes havilandi* and *C. brevis,* kept in captivity at the R. Institute for the Tropics in Amsterdam in recent years.

With regard to the development of alates it was observed that a colony consisting mainly of workers (wing-pads not visible) and put in a small piece of wood in a jar in the month of July, contained numerous young imagos in November. Most of these alates became active, rising on their wings, as soon as the jar was opened.

Enemies. No predatory insects have ever been found in the nests of *Cryptotermes* in Java nor any other termitophilous species, as may be present in such interesting variety in the nests of many further evolutionized termite species.

The ubiquitous ants, several species of which have their hunting grounds in houses and other dry places cannot penetrate into well established and undisturbed *Cryptotermes* nests, thanks to the effective plugging of all holes not in use and the defence method of the soldiers.

That even the smallest cracks in the walls of a nest may be disastrous for a colony was proved by an, alas too successful, raid by a small, black ant, *Paratrachina longicornis,* on a colony which was kept in a glass container in the laboratory. Although the glass box was covered by a lid fitted with a ground-in groove, the ants had detected a small gap, which was just large enough for them to squeeze through but did not allow them to drag their victims to the outside. Still they had managed to kill the larger part of the colony before their activities could be stopped. Of course the presence of soldiers is of no use to the colony under these circumstances.

Some of the habitual insect hunters which so readily turn to chasing termite alates, have also been observed during the swarming time of *Cryptotermes cynocephalus.* On the wall and wood surfaces where they alighted the alates fell an easy prey to small ants, particularly *Monomorium* and *Tapinoma* species, and several specimens were found to be captured by the spiders which inhabit holes and crevices in walls, and spin their webs around the opening.

As regards birds, once specimens of *Copsychus saularis* were observed catching the alates of *cynocephalus* in flight in the early morning, and probably swifts, which were cruising low over the roofs at the time the alates were rising in the air, may also have hunted them.

It may be taken for granted that various birds and other insect-feeding animals will also take their toll of the alates of *dudleyi* swarming in the late afternoon.

Adverse conditions. Very little can be said about any physical conditions which affect the drywood termites in Java. It has only been observed that in some of the initial holes, closed with a black crust, the colonising couple was found dead, owing to some unknown cause.

Where colonies are established in pieces of wood of small volume it is evident that shortage of food must put an early end to their development. Presumably the change of the larvae via the nymphal stage into alates may be quickened under these conditions. This involves that the normal functioning of the colony will stop as a result of the decline in numbers of individuals which act as workers.

Timbers and materials attacked. It can be safely stated that most timbers may serve for food for the drywood termites. The light coloured timbers of low specific gravity may be consumed to any depth, and in timbers with a very durable heartwood the sapwood may still be destroyed completely. Therefore the list of woods susceptible to attack would be an extremely long one

and it might be of greater advantage to have a list of light-weight timbers which are more or less immune to the infestation. So far as experience goes in Java, the wood of *Albizzia chinensis*—which has a peculiar odour—is an example of the latter category. Teak wood is not free from attack if it contains sapwood or has wide annual rings, and the infestation may even be found in the outer parts of solid balks already long in use. The timber of the rasamala tree, *Altingia excelsa,* one of the most valuable species in W. Java, is also susceptible to attack with the exception of the inner heartwood of old trees. With regards to the European woods of better quality used in the tropics, the observations in Java have shown that beach and common oak may be hollowed out by *Cryptotermes.* Dry wood of palm trees and low-grade sticks of rattan—originating from climbing palms—are also suitable for the establishment of the colonies, as are various kinds of bamboo.

Therefore any parts in the structure of buildings which are made of material of low quality, and similar pieces of furniture may in the course of time become infested and destroyed by the drywood termite. Even pieces of highly finished cabinet work are not safe from infestation, as has been shown by the occurrence of the termites in pianos. They have even been detected in the sound-board of a grand piano.

Since drywood termites can start their colonies in small pieces of wood, various small articles also may become infested, for instance the frames of pictures, woodwork of wall clocks, inner parts of radio sets, cabinets of instruments, toys, the hood of a sewing machine, stacks of plywood, models in museums, and so on. Drywood termites may also occasionally damage non-wooden objects which consist of plant fibre, such as piles of cardboard, books, archives, rolls of textiles. But in these instances it has always appeared that the colonies were infesting racks and cupboards where the goods were kept, and had extended their galleries from the wood into the material resting upon it. In books the text may be pierced by the galleries from cover to cover, and larger cavities may also be formed in the paper and the binding (KALSHOVEN 1940).

Outdoor occurrence. In our records only two instances are mentioned where drywood termites have been found in the field, both relating to the finding of *cynocephalus* in the dry wood of coconut-palms. Similar records about the outdoor occurrence of *Cryptotermes* species appear to be equally scarce in the literature. KEMNER (1930) also drew special attention to the fact that his *C. sumatrensis* had been collected in the field from galleries in dead branches (leg. JACOBSON in Fort de Kock, the present Bukittinggi, at 920 m.). Probably the colonies could be met more frequently if a thorough search was made for them. It is of interest, however, that during extensive examinations of dry limbs of teak trees in a search for initial colonies of *Neotermes tectonae* (KALSHOVEN 1959), no finds of *Cryptotermes* were reported. Yet, poles of teak-wood used under roof are frequently infested by the species. Though it may be taken for granted that dry branches, trunks, stumps and similar places in the field and forests constitute the original habitat of *Cryptotermes,* it is also evident that since time immemorial they have found their great opportunity for multiplication in man-made structures.

Vernacular names. As has already been remarked in the introduction the drywood termites are well known to the Indonesians and it is worth notice that the people distinguish them as a separate group, as is evident from the special names applied to them. A more or less collective name in Java is "werangas" or "rangas", which may include other termite species making their nest cavities

in the wood and have elongated bodies, like *Glyptotermes* and *Neotermes,* while the term "rinyu" (W. Java) and "rayap" (C. and E. Java) is used for the common, more thick-set, soil-inhabiting species like *Macrotermes* c.s. In W. Java the name "rangas rasamala" was heard for *Cryptotermes,* specifying that the termite can even infest the durable reddish wood of *Altingia excelsa,* which is not susceptible to other drywood borers. Other more or less exclusive names for *Cryptotermes* are: in the Priangan district of W. Java "barikbik" or "bribik", and in the teak area of Central Java: "teter", "totor" or "oter-oter". In the district of Japara the term "lentoro tjilik" (small l. species) was found for *Cryptotermes* and "lentoro gedé" (large l. species) for the Kalotermitids living in trunks and branches, like *Neotermes tectonae.* In a report received from S.E. Borneo the name "djèpor" was mentioned for the drywood termites.

For the alates of *Cryptotermes* the expression "sulung" is used in C. Java, which is a collective name for the small and agile imagos of the Kalotermitidae and Rhinotermitidae, in contradistinction of the large (and edible!) "laron" of the Macrotermitidae.

S. F. LIGHT (1929) was also struck by the distinction between some types of termites as made by the Filippinos. But there the signs of *Cryptotermes* infestation were often confused with the work of the larvae of drywood boring beetles ("gorgojo", or "buc-buc").

Transport outside the distribution area. Since the drywood termites are of so common occurrence in their native habitat and may have their colonies in movable objects made of any cheap wood, it will be easily understood that they are liable to be carried to other countries in shipments of commercial goods and other commodities and that they can establish themselves there. A few species already have a circumtropical distribution and it must be feared that a further extension of the area of these and other species will follow.

Two examples may be mentioned here of the unexpected ways in which *Cryptotermes* colonies can travel. Thus infestation has been detected in an oakwood chair, forming part of the furniture of a ship plying between Indonesia and the neighbouring countries. Secondly some sampels of wood with exposed tunnels of boring insects brought to the Netherlands for demonstration, when being unpacked some time after their arrival, appeared to be hollowed out by drywood termites *(C. cynocephalus).* Although piles of faecal pellets were found the colonies had not survived, fortunately, and only shrivelled-up specimens were found in the cavities.

It may well be imagined, however, that in certain cases where the conditions during transport and after arrival are favourable the colonies may survive in the infested and stored goods, and that even new colonies can be established. In countries with a temperate climate this might occur in places where a hot and moist atmosphere is kept as in hot houses. As a matter of fact this has repeatedly been done on purpose in recent years to use the colonies in laboratories for testing treated and untreated materials on their susceptibility to attack. However, so far as known, no instances of a completely successful and lasting breeding of the drywood termites in the laboratories in Europe have been published.

Control. Although somewhat out of the scope of this article a few lines may be added on this subject. Little experience has been gained in Java concerning the direct control measures against the drywood termites in furniture and the timber of buildings. On two occasions infested pianos were treated successfully with carbon bisulphide in fumigation chambers. After the war methylbromid has been used for similar purposes. The treatment of woodwork in buildings

with chlorinated hydrocarbons has been applied with some good results where infested joists and boards were of not too large dimensions (KALSHOVEN 1934).

As well-established colonies may inhabit deep-sited cavities and are able to plug the narrow passages leading to them, it will be clear that chemicals used against them must have very good penetrating properties in order to kill the termites in balks and similar pieces of large size, even if holes are bored previously for pouring in the fluid.

References.

HARRIS, W. V. (1958). More about drywood termites. — E. Afric. J., *28,* 161.

HAVILAND, G. D. and D. SHARP (1896). Termites in captivity in England. Trans. ent. Soc. London, part 4, 589.

HAVILAND, G. D. (1898). Observations on termites. — J. Linn. Soc. Zool., *26,* 358.

HOLMGREN, N. (1913). Termiten aus Java und Sumatra, gesammelt von Edward Jacobson. — Tijds. Ent., *56,* 13.

KALSHOVEN, L. G. E. (1924a), in HALL, C. C. J. VAN. Ziekten en plagen der cultuurgewassen in Nederlandsch Indië in 1923, Houtvernielende insecten. — Meded. Inst. Plantenziekten, nr. 64, 13.

— (1924b). Schade door houtboeboek, speciaal in verband met de theecultuur. — Handel. Theecongres (Bandung), p. 58.

— (1924c). Iets over het onderzoek van schadelijke bosch- en houtinsecten. — Tectona, *17,* 1130.

— (1933). Nieuwe gegevens over stam- en houtboorders. — Verslag 13de Bijeenk. Ver. Proefst. Personeel (Buitenzorg), p. 91.

— (1934). Een nieuw middel voor houtconserveering, het Xylamon. — Bergcultures, *7,* 1006.

— (1939). Phasen van ontwikkeling bij de nestvormen en bouwwijzen van Ned. Indische termieten. — Handel. 17de Ned. Nat. Geneesk. Congres.

— (1940). De beschadigingen van papier en boeken door insecten. — Nieuwsbl. v. d. Boekhandel in Ned. Indië, *1.*

— (1950). De Plagen van de Cultuurgewassen in Indonesië, *1,* 156.

— (1959). Investigations of the initial infestation of new teak plantations by the trunk-inhabiting termite, *Neotermes tectonae* (Damm.) in Java. — Ent. Ber., *19,* 138.

— (1960). Data on the occurrence of *Glyptotermes* and *Neotermes* in Java and Sumatra. — Ent. Ber., *20.*

KEMNER, N. A. (1930). Fauna sumatrensis, Termitidae. — T. Ent., *73,* 298.

— (1934). Systematische und biologische Studien über die Termiten Javas und Celebes. — K. Sv. Vet. Handl., *13,* nr. 4.

KIRBY, H. (1941). Devescovine Flagellates of termites. I. Genus *Devescovina.* — Univ. Cal. Publ. Zool., *45,* 1.

— (1942). Idem III. The genera *Foaina* and *Parajoenia.* — Univ. Cal. Publ. Zool., *45,* 167.

LIGHT, S. F. (1921). Notes on Philippine termites II. — Philipp. J. Sci., *29,* 23.

— (1929). Idem III. — Philipp. J. Sci., *40,* 441.

— (1937). A collection of termites from Ceylon and Java. — Pan. Pac. Ent., *13,* 15.

RIDLEY, H. N. (1900). Insect pests. Neuroptera. — Agric. Bull. Mal. Pen., nr. 9, 252.

ROBINSON, H. C. (1905). Report on *Termes gestroi* as affecting Para Rubber. – J. Fed. Mal. St. Mus., *1,* 3.