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Continuous Observation of Termites in Laboratory Cultures.[1]

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Introduction.

The study of behaviour in social insects is dependent upon breeding methods which allow a continuous observation of the insect colonies. For a long time suitable observation nests have been in use for the study of ants and bees, but the devices which are generally used for rearing termites are not satisfactory for a continuous observation. Most of these methods utilize tubes, jars or Petri-dishes as containers for the termites. Such glass containers allow observation until the glass is obscured with faecal deposits and wood or soil particles. The glass will be completely obscured after periods varying from a few days to several months according to the species of termites used. So far as I know, the only method which has been developed to keep termites under close and continuous observation has been described by *Adamson*. This author keeps the termites in a narrow space between two glass plates, the distance between the plates being approximately equal to the height of the insects, so that the termites cannot disappear in wood or soil and cannot construct covered passages. The cover plate is not made of a single large piece of glass, but of several pieces such as microscope slides. As soon as these are obscured, they can be exchanged one at a time without much disturbance of the colony as a whole

The method which will be described in this paper is based on *Adamson*'s device. It has the advantage that the nests are closed and waterproofed save at a tiny opening for aeration. A constantly high humidity in the nest can therefore be secured and maintained by adding a few drops of water every month.

Description of the Method.

Narrow glass strips the thickness of which corresponds to the size of the termites which are to be kept[2] are glued with Canada balsam on a 9×12 cm. glass plate (washed photographic plate), so that two communicating chambers result. The disposition of the glass strips is shown in Fig. 1. A larger chamber forms the actual nest which will contain the termites and their food, while a smaller chamber serves as water supply.

As soon as the Canada balsam is completely dry, the termite colony may be installed. The opening between the two chambers is choked with glass wool which is not attacked by termites. The nest chamber is filled to one third with fine clean sand which will be used by the termites for constructions. Some pieces of wood not thicker than the glass strips used are then stuck into the sand. The wood which is preferred by the termites is *Celtis australis* (nettle tree) for *Kalotermes flavicollis*, Scotch pine or Monterey pine for *Reticulitermes* and *Zoo-*

[1] Aided by a subvention of the Swiss Confederation.

[2] The convenient thickness of the glass strips is for *Reticulitermes lucifugus* 1.5 mm., *Reticulitermes hesperus* 1.5 mm., *Kalotermes flavicollis* 2 mm., *Zootermopsis angusticollis* 4 mm.

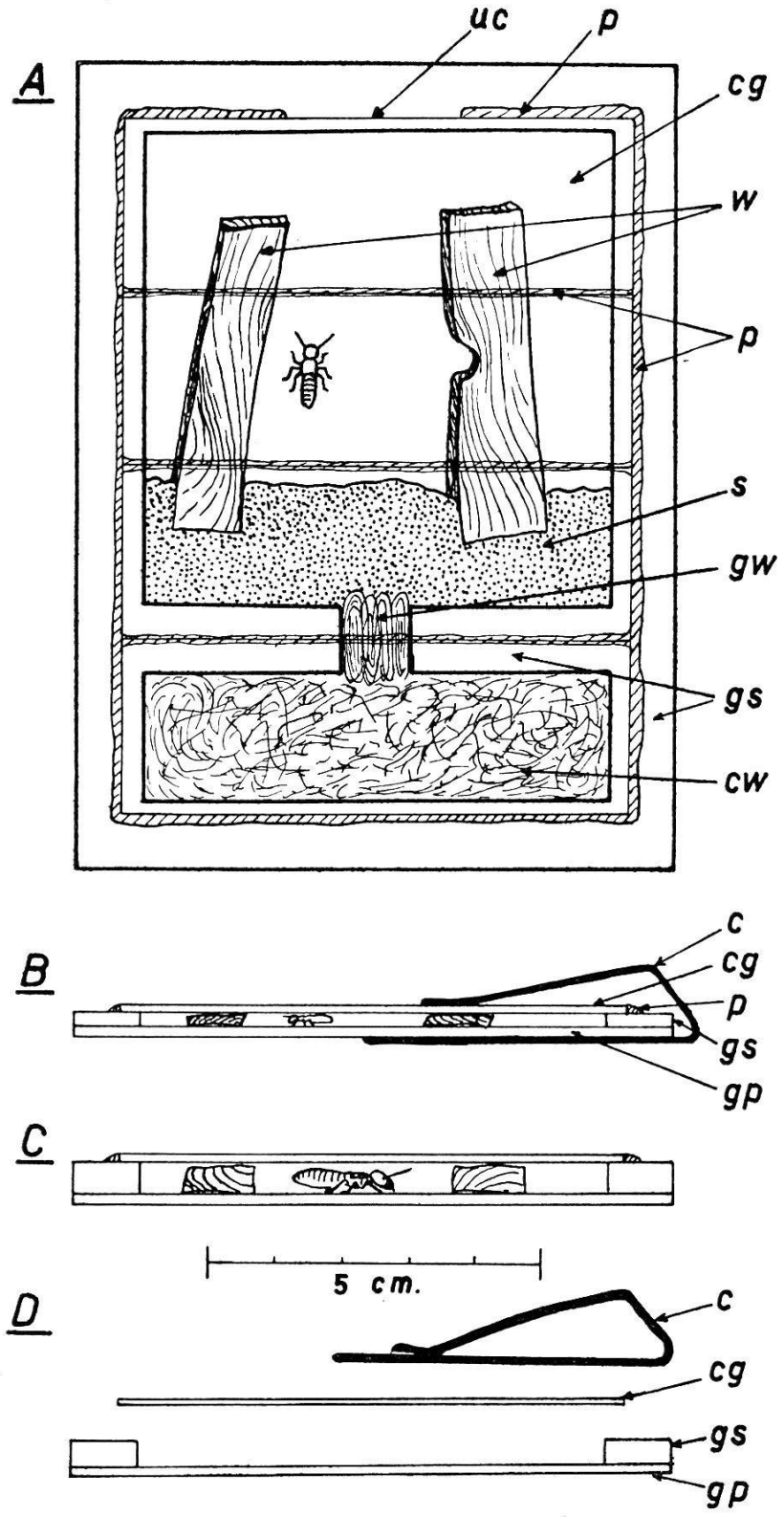

Fig. 1. Diagram of a flat termite nest. A. Plan of the nest. B. Section through nest for *Kalotermes flavicollis* (height = 2 mm.). C. Section through nest for *Zootermopsis angusticollis* (height = 4 mm.). D. Details of a nest in section. cg = cover glass (microscope slide), c = clamp made of hairpin, cw = cotton wool, gp = glass plate (washed photographic plate), gs = glass strips, gw = glass wool, p = paraffin wax for waterproofing, s = sand, uc = unsealed crack for aeration, w = pieces of wood.

Fig. 2. Photograph of a flat nest 4 weeks after installation of a colony of *Kalotermes flavicollis*

termopsis. The nest is now ready to receive the termites which have been transferred from the wood or soil into a small dish some hours before. The termites have to be handled gently, and carefully selected. Only perfectly healthy and active specimens are placed into the nest chamber. In order to have functional supplementary reproductives within a short time, not less than 30 individuals of *Zootermopsis angusticollis*, 50 of *Kalotermes flavicollis* or 100 of *Reticulitermes lucifugus* should be installed in one nest. After the termites have been brought into the nest, their chamber is covered with three 76 × 26 mm. (3 × 1 in.) microscope slides fixed to the nest provisionally with clamps made of hairpins (see Fig. 1). The smaller chamber is filled with moistened cotton wool. The water will then be drawn by capillarity through the glass wool into the sand of the nest chamber. The water-supply chamber is then also covered with a microscope slide. All cracks between the microscope slides and the nest are now waterproofed with paraffin wax and the clamps are removed.

The first nests of this design which were used, had an opening choked with glass wool for aeration (see Fig. 2). It has since then been shown that termites need very little air and that it is sufficient to leave a short crack between a microscope slide and the nest unsealed for aeration (see Fig. 1).

After 4 to 6 weeks the nest chamber will begin to dry up. This is shown by the colour of the sand and the faecal deposits. Without disturbing the colony, the cover of the water-supply chamber is then removed and a few drops of water are added to the cotton wool. Then the cover is replaced and sealed again with paraffin wax.

As pointed out above, the termites have the habit of lining their galleries with faeces, soil or wood particles, so that after some time the microscope slides may be obscured. They are then exchanged one at a time. When one cover-glass is removed, all termites will migrate under the remaining cover-glasses, so that one part of the nest at a time can be thoroughly cleaned without much disturbance of the social life in the colony. At the same time new pieces of wood can be introduced into the nest.

The two European species *Kalotermes flavicollis* and *Reticulitermes lucifugus* have been kept in these flat nests for more than 14 months, and they are still in excellent condition. They have produced supplementary reproductives, soldiers and alates. Eggs are being continuously laid and the young larvae are brought up normally. Young pairs of dealates of *Kalotermes flavicollis* have been installed in flat nests and the development of the young colonies was generally normal. After 9 months they are still in good condition and contain nymphs and nanitic soldiers.

Two North-American species *Zootermopsis angusticollis* and *Reticulitermes hesperus* which have been kindly sent to us by Dr. *H. Kirby* (Berkeley) have been kept in flat nests for several months and seem to develop normally.

For some experiments the method of *Light* and *Weesner* using a standardized food of Monterey pine sawdust in 3% agar has proved to be very useful. The agar-sawdust mass is poured into the nest which in this case consists of only one chamber. After solidification of the agar mass a small channel is cut out in which the termites are placed. The nest is then covered with microscope slides and waterproofed with paraffin wax.

Excessive growth of micro-organisms has to be prevented by rinsing the nests under the hot water tap. Prolonged washing would cause the Canada balsam to melt. The slides and the sand used can be autoclaved. Many termites are dependent upon certain fungi as food complement. The wood generally contains these fungi and should therefore not be sterilized.

Uses of the Method.

The nests described in this paper allow a continuous observation of small groups of termites. They therefore may be of some importance for all investigations on the behaviour of these highly socialized insects.

The method is also indicated for demonstrating termites and their social behaviour to pupils and students. The flat nests may be directly projected in the episcope, but care has to be taken that the projection is not prolonged for more than 2—3 minutes, since the strong illumination and the heat may be harmful to the termites. It seems that a diffuse illumination does not disturb the termites and the nests may be kept almost indefinitely in diffuse daylight.

The flat termite nests have proved to be very useful for the study of the problem of caste determination in *Kalotermes flavicollis*, since for these investigations it was very important to observe single individuals of small groups of termites for prolonged periods. The results of this study will be published elsewhere.

The termite nests described in this paper have been used extensively for testing the relative resistance of timbers and other materials to termite attack. Small pieces of material of equal size may be arranged in a row in the nest for preference tests. The method has the obvious advantage that material and termites can be continuously observed.

References:

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