THE EXPERIMENTAL DETERMINATION OF CASTE DIFFERENTIATION IN TERMITES

THE various theories of caste differentiation in termites, both intrinsic and extrinsic, are based entirely on results secured from anatomical and morphometrical studies, supplemented in a few instances by observations on colony development. By using experimental methods I have secured the following results, and from them drawn conclusions, concerning the differentiation of castes in *Zootermopsis angusticollis* Hagen. This work was conducted at the University of California.

In groups of 50 nymphs containing both male and female individuals isolated from functional reproductives, dark straw-colored supplementary reproductives of both sexes develop within from 35 to 50 days after isolation. These supplementary reproductives ordinarily develop from nymphs in the fifth and sixth instars, occasionally from individuals in the fourth or seventh instar. They may be apterous or may bear wing pads which range in size from mere flanges to pads comparable in size to those of the seventh instar nymph approaching alation.

In the presence of one functional reproductive of either sex in such isolated groups no supplmentary reproductives of that sex develop and, conversely, in the absence of a functional reproductive of either sex in such isolated groups supplementary reproductives of that sex develop.

Nymphs of the fifth and sixth instar isolated singly for 45 days exhibited reproductive potentialities, as shown by the increase in the size of the eggs in the ovaries of the females and by the fact that when a male and female previously isolated were later mated they produced eggs from 30 to 35 days sooner than pairs of nymphs which had remained in the presence of functional reproductives prior to mating.

By feeding alcohol or ether extracts of the bodies of functional queens to groups of nymphs in the fifth and sixth instars it was possible to increase materially the time required for the development of female supplementary reproductives in groups isolated from functional reproductives. The time required for the development of male supplementary reproductives from nymphs thus fed in these groups was, however, not at all delayed.

It is evident in the light of these results that differential feeding (*i.e.*, the feeding of a special diet to certain nymphs such as oral or anal contributions from other members of the group) is inadequate to explain the production of supplementary reproductives. Likewise, it is exceedingly improbable that supplementary reproductives are genetically determined as such. The results are, however, in accord with the inhibition theory, put forward by Pickens,[1] which holds that functional reproductives of each sex produce respectively a substance which, when eaten by the nymphs of a group, inhibits the development of the reproductive organs in the nymphs of that sex. This material is thought to be distributed normally throughout the group by grooming.

The results indicate that all members of the colony, except the true pseudo-soldier nymph and the true adult soldier, are potentially reproductive and, with the exception of the wing-padded nymph of the late seventh instar and the first form reproductive, can develop into supplementary reproductives in the proper environment. Supplementary reproductives are examples of neoteny.

In incipient colonies of *Z. angusticollis* only one soldier develops during the first year of colony life. This soldier is always present in the colony within 75 days after the first egg hatches and is always in the fifth instar. By removing the first and successively produced soldiers from such an incipient group it has been possible to secure as many as six such soldiers from one colony during the first year. In incipient colonies to which soldiers were added before the appearance of the first pseudo-soldier nymph no soldiers developed. The presence of older nymphs, added to incipient colonies at the time of establishment, retarded the progression of nymphs through the first four instars and either delayed or inhibited the development of soldiers during the first year.

These results point clearly to the fact that the assumption of the soldier form by one nymph in an incipient colony is closely associated with the relationships which exist between the members of the group. Too much emphasis can not be placed on the importance of recognizing the integrity of a termite community. By removing a certain single individual from the group the balance of the colony may be so disturbed as to result in a change of the normal development of members of the group. Likewise, the addition of a certain single individual at certain stages of development of the colony may alter this balance to such an extent that the course of development of certain individuals may be delayed or even entirely prevented. Such vital modifications of individual development resulting from such slight changes in colony composition illustrate the importance of individual interrelationships in maintaining the delicately balanced unity of a termite community.

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[1] A. L. Pickens, *Pan-Pacific Ent.*, 8: 178–180, 1932.