Though copper, like other heavy metals, may have a beneficial and stimulating effect in infinitesimal amounts, it will in slightly higher concentrations quickly produce cytolysis and death of the oyster larva.

These studies indicate that in the development, distribution and survival of marine animals traces of certain mineral elements in their environment are of considerable biological significance and may constitute some of the chief limiting factors.

By the use of copper in the form of a pure metal or salt, it was possible in 1928 to observe in detail for the first time the setting and metamorphosis of the oyster larva, a brief description of which has been given in Bureau of Fisheries Document No. 1068 (Progress in Biological Inquiries, 1928).

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EXPERIMENTS IN TERMITE CASTE DEVELOPMENT

FOR many years two main theories have been invoked to explain the production of termite castes. According to one set of advocates the important factors are seated in the germ plasm, while an equally illustrious group of investigators maintain that the worker and soldier castes at least owe their origin to environmental agencies. For several months I have been conducting a series of experiments whose results appear to be pertinent, but as some years will probably elapse before the completion of the work this note is published in the hope that students may be induced to study other species, especially those in which the worker caste is represented.

The material serving as a basis of these experiments are the Pacific Slope species, *Termopsis angusticollis* and *T. nevadensis,* in which only soldiers are developed during the first four years. When, in other words, the colony is approximately four years old, and comprises about four hundred soldiers in various stages of development a few winged individuals, representing the reproductive caste, put in an appearance. As the population increases the two classes gradually become equally represented, and often in old nests, where the food supply is running low, the reproductive caste is practically the only one present. Furthermore, the first soldier developed in a new colony is probably in the fifth instar. The second one is undoubtedly in the sixth, and as the community enlarges the number of molts increases until in long established societies the adult soldiers are in the ninth instar. No exception is known to the rule that the winged or perfect insects make their first appearance only at a point where the soldiers are in the eighth instar. Caste development in the case of *Termopsis,* for the first four years at least, is thus a well-ordered, gradual and invariable series of events, judging by a careful examination of scores of colonies.

It has been demonstrated in the case of certain other insects that within limits the number of molts is dependent upon temperature or the food supply. In the present instance temperature appears to be of minor importance. On the other hand, when the colony is small the food administered to the young is obviously limited, and the fact that the increase in the number of molts bears a fairly definite relation to the increasing number of attendants strongly suggests that food is the important factor. The following experiments also lead to the same general conclusion.

Several large colonies of both species of *Termopsis* were selected in which the reproductive and soldier castes were equally represented. In some cases they were headed by the original king and queen, which were isolated and placed in an experimental jar. An examination six months later showed in every instance that these individuals had died without making an effort to construct a burrow. The remaining colonies were headed by from three to twenty-one substitute or neoteinic royal insects. When the number of these was five or less they were removed from each colony and placed in a separate jar; where the number was larger they were divided into groups of not more than five. Thirty-six such lots have been kept under observation for a period of from two to two and one half years. Four of these died during the period of experimentation; the others evidently set to work almost immediately on the construction of burrows, and evidently commenced to produce young during the first six months. From time to time an individual colony was preserved and measurements taken.

The results show conclusively that when these small groups of kings and queens are deprived of attendants they cease abruptly to produce members of the reproductive caste, and develop soldiers only. And furthermore, the important fact appears that the first soldiers are in the fifth and sixth instars, and the number of molts increases in proportion to the growth of the population. In short, the history of the young colony, headed by a few royal neoteinic insects, is exactly the same as that of the young colony normally headed by the winged king and queen. There is nothing obvious in these experiments which suggests germ plasm as an important factor; rather it appears to be a question of quantitative or possibly qualitative feeding.

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