BIOLOGICAL AND EMBRYOLOGICAL STUDIES ON FORMICIDAE

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649350841

Biological and Embryological Studies on Formicidae by Maurice Cole Tanquary

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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MAURICE COLE TANQUARY

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Trieste

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BY

MAURICE COLE TANQUARY
A. B., University of Illinois, 1907
A.M., University of Illinois, 1908

THESIS

Submitted in Partial Fulfilment of the Requirements for the

Degree of

DOCTOR OF PHILOSOPHY

IN ENTOMOLOGY

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1912

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ACKNOWLEDGMENTS

The studies upon which this thesis is based have been prosecuted under the direction of Professor S. A. Forbes and Professor J. W. Folsom, the "Biological Studies" having been carried on under the direction of the former and the "Embryological Studies" under the direction of the latter. To both Professor Forbes and Professor Folsom, my sincerest thanks are due for their advice, encouragement, and assistance throughout the progress of the work. I wish also to acknowledge the aid of Mr. W. C. Matthews and Mr. Alvah Peterson in the preparation of the drawings.

VITA

The writer was born at Lawrenceville, Illinois, November 26, 1881. He attended the public schools of Lawrenceville, and in 1899 entered Vincennes University, from which he was graduated in 1903. He taught for four years in the public schools of Lawrence county, Illinois. He entered the University of Illinois in 1905, served for three semesters as undergraduate assistant in General Zoology, and was graduated in 1907. He then entered the Graduate School of the University of Illinois and received the degree of master of arts in 1908. In 1908-1909 he was for half his time assistant to the State Entomologist of Illinois and a laboratory assistant in Vertebrate Embryology. From 1909 to 1912 he was half-time assistant in Entomology in the University of Illinois. During the summer of 1910 he studied in Harvard University, and during the summer of 1911, he was Field Agent for the State Entomologist of Minnesota. He has published a paper in the April number of the Biological Bulletin for 1911, on "Experiments on the Adoption of Lasius, Formica, and Polyergus Queens by Colonies of Alien Species," and one in the Transactions of the Illinois State Academy of Science for 1911, on "A preliminary List of the Ants of Illinois."

BIOLOGICAL STUDIES

I. The Life History of the Corn-field Ant, *Lasius niger* var. *americanus* Emery

Although the common corn-field ant, *Lasius niger* var. *americanus* Emery, is said to be the most abundant of all North American insects, its complete life history has never been worked out. The most that we have on the subject is given in Bulletin 131 of the Illinois Experiment Station by Forbes. He there reports that in four cases the first eggs from young queens were obtained May 8, 9, 10, and 15; that the egg periods were 16, 17, 19, and 23 days; that the pupal stage averaged about 18 days; and that the total number of young produced by a single female in the first year was in three cases 8, 9, and 19 workers. The more extensive data which I have been able to obtain correspond in great measure to those just given.

METHODS

The method followed in this life history study consisted (1) in making observations in the field at all times of the year, (2) in making daily observations on young fertilized and isolated females through one season, (3) in isolating old queens from large nests and getting counts of the eggs they laid, and (4) in keeping large colonies in Fielde nests under daily observation. These young fertilized females were obtained in the fall just after they had descended from their nuptial flight, or after they had formed their cells; or they were taken from their cells in the spring before they had begun to lay eggs. They were kept for the most part in Fielde nests of the ordinary type, or in some cases in Barth nests. The latter are more satisfactory for keeping the ants under natural conditions, but with them one can not make as accurate observations regarding the exact number of eggs and young.

NUPTIAL FLIGHTS

The nuptial flights of *Lasius americanus* usually occur from August to September. The date of a flight mentioned by Forbes is September 14. The earliest date for which I have positive evidence of a flight is September 5. I have noticed, however, in a summer's

collecting, that during August the percentage of nests containing winged forms decreases, so that it is very probable that the flights begin during that month in this latitude. September 5, 1910, I found a large number of young dealated females of *Lasius niger americanus* crawling on the ground in a park in Boston, Mass. This was about five o'clock in the evening. They had all removed their wings, and were crawling around in search of a place to burrow. A number were already beginning their burrows. At one place I saw six beginning to burrow in the same place. There were also many males flying in the air or crawling about, but I saw no couples *in copula*. The same afternoon I found five young dealated queens of *L. latipes* Walsh, a number of winged and dealated females of *Solenopsis molesta* Say, also a few dead males of *Formica fusca* var. *subsericea* Say. This fact indicates that weather conditions probably determine to a large extent the time of a flight. There had been a heavy rain the day before, but on that day it was clear and very warm. The following day, September 6, with the same weather conditions, I found a large number of males and winged females of *Cremastogaster lineolata* Say crawling about on the walks, and two days later I saw a large number of *Solenopsis molesta* flying, many of them *in copula*. September 19, 1910, and on almost every day for the next ten days, I caught winged females of *Lasius niger americanus* flying or saw the young queens crawling over the ground. On the evening of October 4, I found five winged and sixteen dealated queens of *L. niger americanus* crawling on the ground, one dealated queen October 11, and one October 18. The fact that dealated queens of this species are found crawling about is evidence that there has been a flight, since these queens begin to burrow immediately after descending from their flight and do not come to the surface again.

The dates upon which I have actually witnessed the flights of *L. americanus* from the nest are September 9, September 20, and September 18. All the flights of this species I have noticed have been between 3 p. m. and 6 p. m. The best observations were obtained from the one of September 20. In this case the entrance of a large nest was near the edge of a cement walk. At 4:30 p. m. my attention was called to the fact that a very large number of ants were crawling over the walk and grass near the opening. Closer examination showed that there were many males, winged females, and workers there, all running about excitedly, and that every few minutes a male or female rose from the blades of grass or the walk and flew away. They did not all fly away in the same direction, but seemed to take whatever

course they were headed for. I did not see any pairs *in copula* either in the air or on the ground. In fact, I have never found a pair of this species *in copula*, and think it quite likely that fertilization takes place in the nest some time before the flight.

FOUNDING OF THE COLONY

Several methods of founding a colony are now generally recognized. These methods have been designated by Wheeler ('06, pp. 34, 35) as the typical, the redundant, and the defective.

In the first case the female after descending from her nuptial flight, removes her wings and burrows into the ground or enters a cavity beneath the bark of a log, or the like, where she forms a small cell and begins to lay eggs or passes the winter and then begins to lay eggs. When these hatch she feeds the larvæ from her own secretions.

In the second case the female in addition to doing all that is required in the typical method, also cultivates certain fungi for herself and her brood.

The defective method Wheeler has subdivided into (1) temporary social parasitism, (2) permanent social parasitism, and (3) dulosis, or slavery. In temporary social parasitism the female enters a queenless colony of some other species and becomes adopted, thus getting the alien ants to rear her first brood. These alien ants naturally die off in the course of time, leaving a pure colony of the same species as the queen.

It is very well known that the first method mentioned is the one usually employed by *L. niger americanus*, and it is generally believed to be the only one employed. One may find solitary females in their cells a few inches beneath the surface of the ground in October and November; and may also find late in the summer or in the spring a colony consisting of a queen and a few minim workers and larvæ, the product of one year's growth.

November 18 I found in a corn field infested with *Aphis maidiradicis* Forbes, six separate cells, each containing a solitary female. There were no eggs or young. The cells were only a few inches beneath the surface, three of them being beneath clods of earth. On April 5, I found a lone queen in her cell a few inches beneath the surface in a stalk-field, without eggs or young. Eggs may be laid, however, in the fall. On September 5, I picked up thirty-six dealated females that had just descended from their nuptial flights and placed them together in a large Fielde nest. Within the