NOTES ON A NEW METHOD OF COLONY FORMATION EMPLOYED BY POLYERGUS LUCIDUS LUCIDUS MAYR (HYMENOPTERA: FORMICIDAE

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ABSTRACT.—*Polyergus lucidus lucidus* Mayr founds new colonies by budding as opposed to adoption, which is recognized as the method employed by the genus *Polyergus*.

The obligatory slave making ants of the genus *Polyergus* are found in Europe and North America. This genus is considered a classic by myrmecologists because of their beauty and the efficiency with which they conduct raids. Extensive biological studies of the European *Polyergus rufescens rufescens* Latreille have been completed making its habits well known. However, the American *Polyergus*, *rufescens* ssp. and *lucidus* ssp., have not been extensively studied. Most observers are content to assign the habits of the European *rufescens* to the American forms.

There are several short works on the colony formation of the American *Polyergus*, but few are comprehensive. Wheeler (1910, p. 471-487) described in detail the habits of the known species and questioned the assumption that *lucidus* founds colonies by adoption. Creighton (1950, p. 552-560) supplied the most recent taxonomic revision of the genus and described a *lucidus* raid. He stated that adoption is the method employed by *Polyergus* females to found colonies.

The purpose of this paper is to present budding as a method employed by *Polyergus lucidus lucidus* Mayr in colony founding. This discovery is significant because budding is reported only in the subfamilies Dorylinae, Myrmicinae, and Dolichoderinae. This is assumed to be the first instance documented in Formicinae.

MATERIALS AND METHODS. — Previous reports on *lucidus* and most other American *Polyergus* are based on short term studies and chance observations, which often caused conclusions to be drawn from over-extended data. The data used for this report are based on observations made by myself over a four summer period. Ten *lucidus* nests, five located on the same lot in Washington, Ill., were observed. Seven other colonies, five newly founded by budding, did not survive long enough for effective observation.

Direct observation, often for four or five hour stretches, was used in order to secure accurate raiding records. Nests were marked and their position plotted on graph paper. Lines originating on a dead stump on the lot served as the horizontal and vertical axes. By this method I was able to keep yearly records of colony locations.

Identifications were made by G. L. Rotramel, University of California (formerly with the Illinois Natural History Survey); and D. R. Smith, U. S. Department of Agriculture, U. S. National Museum, Washington, D. C. I am indebted to these men for their assistance and encouragement.

RESULTS

Dealate *lucidus* queens return to a *lucidus* nest after mating. They mill about the mound and cling to grass blades. Frequently eight or more dealates are perched around a formicary after a mating flight. Some wander off into the grass, others dart into the entrance, while others attempt to caress slaves and *lucidus* workers which are usually hostile. It appears that the dealates from one nest sometimes seek out other nests, since dealates were found near a nest that had had no mating flight.

Budding takes place when a fertile queen leaves a mother colony with a troop of workers and begins a new colony. A *lucidus* queen and her workers must capture an established *nitidiventris* formicary in order to obtain ma-

ture slaves. I observed three types of budding.

I first observed budding on 28 July 1964, when a column of *lucidus* with a large number of young, orange workers attacked a *nitidiventris* colony. The raid proceeded normally and the attackers began to leave with captured larvae and pupae. Three dealate *lucidus* queens then approached the nest and began milling among the remaining *lucidus* workers. Most of the young workers and some of the older attackers then perched on grass blades near the entrance. Most of the attackers returned in the usual manner. A number of older *lucidus* remained inside the nest and threw uncooperative workers out. Many of the *nitidiventris* were maimed or killed. The other *lucidus* workers and queens milled outside the nest and entered a few at a time. Three days later only a few young *lucidus* remained outside, and these were carried inside by conquered *nitidiventris* workers. This new colony attempted its first raid four days after being established and completed a raid on the fifth.

The second type of budding nearly paralleled the first. Some *lucidus* workers and a dealate milled about a raided nest. But no attackers remained inside the nest after the main force left with the larvae and pupae. Some of the *nitidiventris* workers approached the milling *lucidus* and carried them into an abandoned spider burrow two yards from the nest entrance. The *nitidiventris* also carried many of their own exhausted comrades and rescued larvae and pupae into the burrow. A possible explanation for the unusual behavior of the *nitidiventris* is that immediately after the main body of *lucidus* left, about 100 *Myrmica sabuleti americana* Weber workers attacked the *nitidiventris* workers that were trying to regroup. This formicary was raided again by the same *lucidus* colony two days later.

The most purposeful type of budding was the third, which always occurred late in the raiding season. A single queen was accompanied by about 30 workers on these attacks. The queen spent much time milling about the mound and among the workers before the attack began. A column slowly formed and proceeded toward the victim nest. During the march the queen continually milled among the attackers and was frequently at the column's head. The entire phalanx swarmed into a *nitidiventris* formicary and were met with unusual resistance. The *nitidiventris* were soon defeated. The queen and most of the attackers remained inside the nest.

Queens accompanying columns do not always receive a troop of workers. If a queen cannot induce some attackers to remain at a raided nest, she enters it alone, wanders off, or returns to the *lucidus* nest with the workers.

One evening a *lucidus* colony attacked the same formicary four times. Several *lucidus* dealates appeared and milled about the nest entrance. Some entered. All *lucidus* workers left the area. Some *nitidiventris* workers began carrying their comrades into a small hole two feet from the nest entrance. A *nitidiventris* approached this hole carrying one of the *lucidus* queens. I separated them, and the worker began rubbing antennae with the queen. The worker grasped the queen by the mandible; she assumed pupal posture and was carried into the hole.

I observed lone *lucidus* queens wandering in large arcs over fields. One alate milled about the entrance to a *nitidiventris* formicary for over an hour and entered frequently. Another time a dealate wandered aimlessly for 50 yds. before I lost track of her.

Discussion

Other authors generally agree that *Polyergus* founds colonies by adoption. This is known to be true for *rufescens* ssp. Creighton (1950, p. 555) described the adoption process. A lone *rufescens* queen enters a slave nest, gradually becomes accepted, kills the queen mother, and is then cared for by the workers. The queens meet considerable opposition when introduced into artificial *Formica fusca* nests and must often kill defenders. Wheeler (1916, p. 108) found a *rufescens breviceps* queen in an incipient *fusca* colony. I made a similar observation.

Wheeler (1910, p. 486) conducted a series of experiments with *lucidus* queens which caused him to leave the question of *lucidus* colony formation unanswered in his book. In 1964 I conducted similar experiments in three jars containing *nitidiventris* workers and pupae from a raided nest. A dealate *lucidus* queen was placed inside each jar. Immediately the queens approached the workers and stroked them with their antennae. Workers killed the first

queen. In the second jar the queen killed the workers. And in the third, the queen and workers huddled together peacefully. Though most attempts at artificially causing *lucidus* queens to seek adoption are negative, field observations indicate that *lucidus* either does or did use this method. But the instances of *lucidus* queens being carried off by harrassed *nitidiventris* workers are much more passive than the standard *rufescens* method of adoption. Queens which enter *nitidiventris* nests alone may actually become adopted, or they may end up like those in the jars. More field and laboratory observations are needed before the questions connected with *lucidus* adoption can be answered.

Wheeler (1916, p. 110 & 114) saw dealate *rufescens breviceps* queens accompany workers on raids and then return to their formicaries. He also stated that queens of the European *rufescens* sometimes accompany attackers. He suggested that these queens either seek immediate adoption into the raided nest while the defenders are still disorganized, or that they are scouting area slave nests.

The different forms of *Polyergus* evolved closely. Smith (1947), Creighton (1950), and Forbes and Brassel (1962) all reported the difficulties connected with the taxonomic identification of the various forms. The biology of the different forms is also nearly parallel. The main difference between the raids of *lucidus* and *rufescens* is that *lucidus* is more precise, while *rufescens* uses much larger armies. The colony founding activities of the queens is another indication of close evolution.

The fact that *rufescens* queens follow raiding columns is an indication that this species may bud. This is unlikely since *rufescens* has been well studied. The queens probably follow the columns in obedience to an instinct that is no longer prominent in *rufescen's* colony founding activities. Similarly *lucidus'* strong inclination toward adoption indicates an evolution in its colony founding activities. More field work will eventually bring more evidence to light.

Budding occurs early in June and during the mating season (mid-July—early Sept.). The results of budding expeditions are difficult to verify since the new colonies have a tendency to be inactive for several weeks after establishment and sometimes relocate. Of seven budding attempts, I am sure that one succeeded and one failed. The progress of the others could not be followed. However, in a 1500 sq. ft. area where there were three witnessed attempts between 1964 and 1965, three new *lucidus* colonies appeared in 1966. These formicaries were all at least ten feet from the original bud-nests. While this observation does not prove the success of budding, it does show that *lucidus* colonies are prolific.

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