

**The Abnormal Behavior of *Colobopsis* sp.  
(Hymenoptera: Formicidae)  
Parasitized by *Mermis* (Nematoda) in Papua New Guinea**

by

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ABSTRACT

Part of the colony of *Colobopsis* sp. living in ant-plants (*Anthorrhiza*) were parasitized by *Mermis* sp. (Mermithidae: Nematoda) at Patep in Papua New Guinea. The suicidal behavior of infested ants that entered into the water themselves was observed. After the suicide, *Mermis* sp. crawled out from the cloacas of the abdomens of the ants. It appears that individuals of *Mermis* sp. control the behavior of their host ants. This abnormal suicidal behavior of the parasitized ants is reported here for the first time.

INTRODUCTION

The genus *Mermis* which belongs to the family Mermithidae in Nematoda have been known as endoparasites in various insects, e.g. ants, wasps, bees, mosquitoes, crickets and grasshoppers (Rubtsov 1977, 1978). Some species of *Mermis* are parasitic on ants, infesting the genera *Pheidole*, *Ectatomma*, *Neoponera*, *Odontomachus*, *Pachycondyla*, *Paraponera*, *Camponotus*, *Formica* and *Lasius* (Wheeler 1901, 1910b, 1922; Mrázek 1908; Passera 1975). Wheeler (1901, 1907) described that the transformations induced by the parasites *Mermis* produce a gigantic worker form, and proposed a technical term "mermithergate" which means the worker caste infested by *Mermis*. They are often called intercastes in some ant species because their body size is intermediate between that of a minor and major worker.

Although details about the intercastes and the transformations of the mermithergates have been extensively studied (Wheeler 1901, 1907, 1910a, 1917, 1928a; Crawley *et al.* 1921; Gösswald 1929; Vandel 1930; Passera 1976), little has been known about the behavior of the mermithergates. Wheeler (1928b) showed that the mermithergates of *Pheidole commutata* never excavate the soil nor take care of the brood. They keep running about in a chronic state of hunger and begging their normal nestmates for food. There are few other studies based on the observations of the ants' behavior.

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Recently, we had a chance to observe the behavior of the mermithergates (Fig. 1) of *Colobopsis* sp. (Hymenoptera: Formicidae) which live in the ant-plants *Anthorrhiza echinella*.

#### OBSERVATIONS

*Colobopsis* sp. were found in the ant-plant, *Anthorrhiza echinella*, on trees in secondary forest at Patep about 40 km southwest of Lae in Papua New Guinea. *A. echinella* is epiphytic ant-plant and has very complex cavities occupied by ants in their swollen stem called a "tuber" (Huxley & Jebb 1991). Ants living in the tuber of *A. echinella* are species in *Dolichoderus*, *Philidris*, *Technomyrmex*, *Camponotus*, *Polyrhachis*, *Brachyponera* and *Pheidole* in addition to *Colobopsis* sp. (Maeyama, in prep.).

Because this species of *Colobopsis* sp. was arboreal and polydomous, their colony extended to several ant-plants on one tree. Therefore each ant-plant had a satellite colony of the ant. An individual of the ant-plant *A. echinella* in which *Colobopsis* sp. lived was taken and cultivated in June 1992. To observe the behavior of the ants, the plant was grown in a cage which had nets of fine mesh from which the ants could not escape. Ants were fed honey diluted by water, and a small glass dish (12cm in diameter, 5cm in depth) filled with water was placed for drinking and maintaining moisture. Four castes including minor workers, major workers, female and males alates and mermithergates were seen.

The day after transplantation, we found one mermithergate struggling in the water in the dish. The ant was helped out of the water. However, it entered into the water again by itself. Though it was removed from the water over and over again, the mermithergate continued to

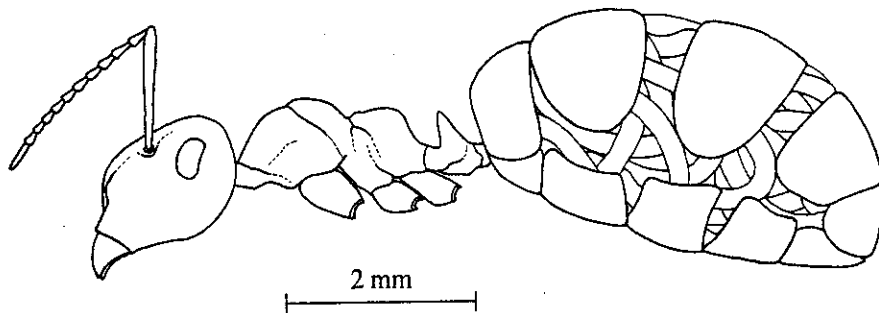


Fig. 1. Mermithergate of *Colobopsis* sp. The body of *Mermis* sp. can be seen inside the abdomen of the mermithergate.

reenter into the water again. It writhed in the water and soon drowned. About 5 minutes later after the ant drowned, one individual of *Mermis* sp. about 5cm long crawled out from the cloaca of the abdomen of the mermithergate.

One to 8 mermithergates per day entered the water and drowned during 37 days of observation. Whenever each of these mermithergates was taken out of the water, it always reentered into the water again and drowned eventually. The individual of *Mermis* sp. always crawled out from the cloaca of ant about 5-10 minutes later. In the case that the plural individuals of *Mermis* sp. existed at the bottom of the water, they gathered and twined about one another. After about one month, no more mermithergates were present. No normal ants entered into the water. The total number of mermithergates which entered into the water and drowned was 179 of which 159 (89%) had only 1 individual of *Mermis* sp. in their abdomens, 9 (16%) had 2 of *Mermis* sp. and 2 (4%) had 3 of *Mermis* sp. Therefore,  $\frac{183}{203}$  individuals of *Mermis* sp. appeared from the abdomens of 179 mermithergates.

Later, the ant-plant was cut out, and all ants which occupied the plant were counted, resulting in 1489 minor workers, 126 major workers, 22 female alates, 65 male alates and no mermithergates. The width of head of each caste is shown in Table 1.

The length of the bodies of *Mermis* sp. average 4.68cm (0.49cm Standard Deviation), and the width of bodies average 0.29mm (0.03 mm S. D.). The abdomens of mermithergates were abnormally enormous to contain the big body of *Mermis* sp. The internal organs in those abdomens were remarkably shrunken. The abdomens of mermithergates retained little vestiges of fat, reproductive organs and other viscera.

## DISCUSSION

The behavior observed in this time is the suicide of the mermithergates. It appears that the individual of *Mermis* sp. compels its host to enter the aquatic habitat, i. e., puddle, pool and marsh in the natural field. It is known that the individuals of many species in Mermithidae mate

Table 1. Width of heads of mermithergates and other castes of *Colobopsis* sp.

	mermithergate	minor worker	major worker	alate female	alate male
No. of individuals	179	1489	126	22	65
Width of Head (mm)	1.51 (0.04)*	0.98 (0.06)	1.71 (0.07)	1.86 (0.05)	0.89 (0.04)

\*Standard deviations are indicated in the parentheses.

in the water (Rubtsov 1977, 1978). The behavior of the mermithergates of *Colobopsis* sp. should be of sufficiently adaptive significance for *Mermis* sp. to survive. If the mermithergates gather in the same place in the same time and commit suicide in the water, the individuals of *Mermis* sp. would be able to find easily a partner for mating. The individuals of *Mermis* sp. may control their host ants through the secretion of some substance physiologically acting as hormones, or by physically stimulating the nerve of the host.

This is the first report of the abnormal suicidal behavior of the mermithergates. There is a possibility that other ant species also commit suicide by being controlled by their parasites *Mermis* spp. but to prove this, it is necessary to study the behavior of the mermithergates of the other ant species.

Although nothing is known about the manner of infection of the ants by this *Mermis* sp., it is expected to be similar to other ant species. In *Pheidole*, the infections with *Mermis* sp. are established at the end of the 3rd larval stage of the ants (Passera 1976). This period corresponds to the differentiation phase when the larvae in healthy nests become oriented towards the minor or major worker castes. The *Mermis* larva develops within the alimentary tract of the ant larva and appropriates a portion of the food (Wheeler 1910b). Wheeler (1910b, 1928a) states that they unduly stimulate the appetite of ant larva to be fed excessively, so that it becomes markedly large at the time of pupation, as the result, the intercaste appears in the imaginal instar. The mermithergates of *Colobopsis* sp. that committed suicide, were also intercastes because their head width was intermediate between those of minor and major workers.

It is impressive and interesting that the suicidal behavior of mermithergates should be greatly advantageous for individuals of *Mermis* sp. Detailed physiological and epidemiological study is needed on the interactions between ants and the *Mermis* sp.

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