

VESTIGIAL WINGS IN DIACAMMA

(Hymenoptera: Formicidae)

GEORGE S. TULLOCH,
Brooklyn College, Brooklyn, New York

The genus *Diacamma* includes thirteen or more species of Ponerine ants which are geographically confined to India, Ceylon, southern China, the Malay Archipelago, New Guinea and the northern portion of Australia. Most of the species have large black or bronzy workers and pale yellow or reddish yellow males. The workers have a pair of spines on the pedicel directed backward and an oval cavity in the pleural region between the first and second thoracic spiracles. Emery monographed this genus in 1897 and it was an examination of his paper which prompted further investigation by the writer.

There is illustrated on the plate accompanying Emery's (1897) paper a portion of the thorax of a worker of *Diacamma rugosum*. In his explanation of this plate, he designated a peculiar circular ridged structure in the anterior portion of the pleural cavity as the first spiracle, viz., the mesothoracic spiracle. The writer's investigation has shown that Emery was mistaken in this interpretation. More important, however, is the fact that during this study a phenomenon hitherto unknown among the ants has been revealed.

At first glance, the so-called "spiracle" designated by Emery does resemble a spiracular opening in some respects. Upon closer examination it is found that this "spiracle" has no tracheal connection opening through the body wall, thus disproving Emery's assumption. Upon dissecting a large number of individuals, the true mesothoracic spiracle was found to be in the normal position in the membranous intra-segmental region between the pro- and mesothorax and covered by a lobe of the pronotum.

As structures present in an organism are usually of some significance at some time, an explanation for the presence of this so-called "spiracle" was sought. Practically all the described species and varieties¹ were available for study and

¹The writer wishes to thank Professor William M. Wheeler, of Harvard University, for his kind permission to examine the species of *Diacamma* present in his collection of ants.

in these this "spiracle" appeared without exception; yet, no indication as to its function became evident. Since the immature stages of holometabolous insects often offer some evidence as to the possible function of an apparently functionless structure appearing in the adult insect, an examination of various pupal stages was made. This examination revealed the presence of vestigial wings attached to the "spiracles" of Emery. Further examination of adult workers revealed two individuals in which these vestigial wings were present neatly fitted into the pleural cavity. The general absence of the vestigial wings in the adult workers is readily explained by the facts that being of a fragile nature, they would be broken off

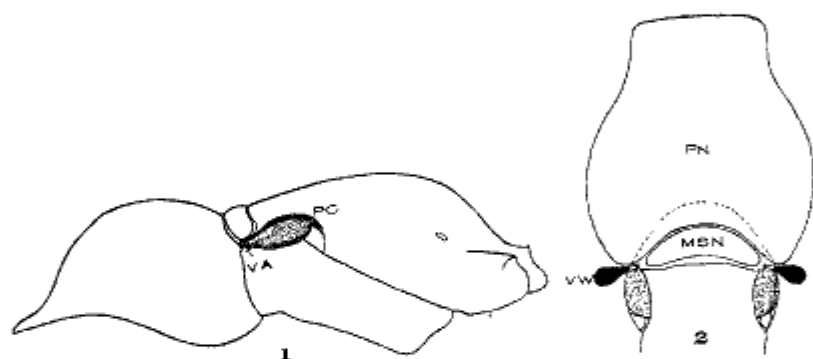


FIG. 1. Lateral view of thorax of *Diacamma australe* worker.

FIG. 2. Dorsal view of thorax of a mature pupa of *D. australe* worker showing vestigial wings.

MSN—mesonotum.

PN—pronotum.

VA—vestigial wing articulation.

VW—vestigial wing.

easily in the emergence from the cocoon, or during the mutual stroking of their bodies with the antennae, to which the ants devote so much of their time.

The structure of these vestigial wings is similar to a flattened hollow sac, the upper surface of which is sclerotized and the lower surface membranous. In the early pupal stages a tracheal tube passes from the thorax to the wing. The worker, when it emerges from the cocoon, is of light color and its body wall soft. Evidently these vestigial wings usually are broken off shortly after or during the emergence from the cocoon, and the point where they were attached to the body wall remains as a minute opening exposing the tissue below. As

the worker becomes older, the color becomes darker, the integument hard and the opening where the wings were attached becomes filled with chitin secreted by the underlying hypodermis. The circular ridged structure remaining, here designated as the vestigial wing articulation, is what Emery called the "spiracle." During the pupal stage, the vestigial wings are of the same color as the body wall varying from white in the earlier periods to yellow or brown in the later periods. In the adult worker, they are white or light yellow in striking contrast to the dark body wall.

The thorax of *D. australe* (Fig. 1) is similar to some of the other Ponerinae except for the presence of the pleural cavity (PC, Fig. 1). The vestigial wing articulation (VA) is clearly visible. If the pronotum is removed, the first spiracle is found in the membranous region between the pro- and mesothorax. The second thoracic spiracle is situated at the posterior region of the pleural cavity and is covered by a lobe, probably the remains of the epimeron. The vestigial wings (VW) of a mature pupa are represented in Figure 2. They usually are extended outwardly from the body wall during the pupal stage, but in the adult they are fitted neatly into the pleural cavity.

Normally the workers of ants do not possess wings, yet the investigations of Dewitz (1878) have shown that they once possessed wings like the true females. He found that the mature larvae of workers possess well developed imaginal disks like those which, in the males and females, develop into wings. In the worker larvae these disks generally become atrophied and disappear during the pupal stage. Occasionally these disks develop producing certain abnormal, winged individuals known as pterergates. This study by the writer has revealed that in the entire genus *Diacamma* the imaginal disks develop normally to a certain degree resulting in the formation of vestigial wings which persist until after emergence from the pupal case.

Diacamma is one of the few genera of ants in which myrmecologists have failed to find any form corresponding to the winged fertile female or queen of other ants. The repeated failures of many collectors to obtain this form led Emery (1911) to conclude that, "we must suppose that the female *Diacamma* resembles the workers so closely as to be confused

with it." Later Wheeler, after examining dozens of nests of these ants in Northern Queensland and not finding any of the desired queens, concluded (1915) that, "as I failed to find any differentiated queen and as all the pupae were of the same size, I feel confident that in *Diacamma* the egg-laying function must be usurped by one or more fertile workers during the breeding season." In 1922 Wheeler and Chapman reported a case in which a male of *D. geometricum* was found copulating with a worker. A portion of their account follows: "Externally the worker found *in copula* differs neither in size nor structure from any of her sisters. * * * Dissection of a number of *Diacamma* workers and especially of the mating worker supports the inference that only one individual assumes the reproductive function at a time. Unfortunately the material had been in rather weak alcohol for several months and the very hard chitinous integument had prevented penetration, so that the internal organs were considerably decomposed. In many of the workers, of which more than 20, belonging to three colonies, were dissected, no ovaries could be detected. In one, however, two ovarioles were clearly seen, * * *. Such undeveloped ovaries were probably present in all the specimens but could not be detected on account of defective preservation. * * * Fortunately the mating worker was in a somewhat better state of preservation. The ovaries were found very far forward in the large first gastric segment and applied to the sides of the crop. There were five ovarioles in each ovary, * * *." This evidence strongly indicates that only one individual of the colony assumes the reproductive function at a time.

The entire absence of the usual winged female and the presence of vestigial wings among all the workers suggests the possibility that a general suppression of the female phase has resulted in the production of a group of individual in which the usual differentiation into the fertile winged and sterile wingless castes has failed to take place. If such has been the case, it is highly probable that all the workers are fertile and able to carry on the reproductive activities of the colony. The evidence given by Wheeler and Chapman would appear to indicate that only one individual was selected to carry on these activities at a time.

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CHARLES DARWIN'S DIARY OF THE VOYAGE OF H. M. S. "BEAGLE," edited from the MS. by NORA BARLOW. Pages i-xxx and 1-443, a portrait and two maps. Published at the University Press, Cambridge. (The MacMillan Company, New York.) Price, \$6.50.

Written during the years 1831 to 1836 the first edition appeared in 1839 and the second in 1845. Both were revised by Darwin himself. In the earlier editions one-third of the diary was deleted to give space to comments and correlated scientific observations. This, the third edition, is printed without deletions or changes except a few in punctuation. It is the first publication of the complete journal. The first thirty pages of this volume by the Editor, Mrs. Nora Barlow, Darwin's granddaughter, give the circumstances of Darwin's education, tendencies in thought, selection as Naturalist and notes on the persons with whom he was associated in the undertaking.

He started the four-year voyage with his main interest in geology, especially palaeontology. The first volume of Lyell's *Geology* had just appeared and the second volume reached Darwin in Brazil. Lyell was the first to emphasize the historical value of fossils. Darwin's second interest was the collection of natural history specimens, both plants and animals. In the later years of the voyage he became much interested in the geographical distribution of species especially after his visits to the Galapagos Islands.

Being Naturalist, he was invited to live in Captain Robert Fitzroy's cabin. The latter was a brilliant man, a scientist interested in meteorology and oceanography but a rabid fundamentalist. Apparently the voyage was a matter of four years of argument, as much as was discreet between a guest and the Captain of a war vessel. Darwin became keenly interested in the problems raised by the great number of fossils in the South American beds and the curious distribution of animals and plants in the Southern Hemisphere, even suggesting facetiously (p. 383) that there may have been two Creators. Captain Fitzroy believed the Bible was scientifically correct. In this controversial atmosphere Darwin began the orderly arrangement of the facts supporting a theory of the transmutation of species, the explanation of which he was to give later in his theory of the origin of species by natural selection.

Darwin lives again in the pages of the diary. We find him a solemn and very earnest young man who spent four years at very hard work. A walk of twenty-five miles in a day or a horse-back ride of one hundred miles a day, living on the country, was mere routine. A university graduate, English country gentleman, and one who planned a quiet life in the Church of England, he jots down to the very end of the diary his astonishment that human beings could live as they do in these other parts of the world. Speaking of the convict settlements of Australia he writes, "The tone of society . . . with such habits and without intellectual pursuits, can . . . hardly fail to deteriorate and become like that of the people of the United States." (This for our great-grandfathers.) The diary is fascinating from beginning to end as the reader never knows what curious fact will appear in the next sentence or in what manner it will be commented upon.

The "Voyage of the Beagle" is one of the foundation stones in any education in biology. As such we insist that all of our graduate students read it. Those who have not followed this keen young man around the world in the eighteenth-thirties have missed several evenings of delightful reading.—C. H. K.