persons in either the "abstainer" or the "all moderate" group, at all ages from 30 to 100 inclusive.

4. The "moderate steady" class, which is from certain points of view the most important one, shows consistently the highest expectation of life at all ages from 30 to 100 inclusive in the case of the females; and also in the males, except that after 70 the "all moderate" male group has very slightly higher expectations than the "moderate steady" male group.

These conclusions are drawn from what is believed to be demonstrably the most critically adequate material, considering both quality and quantity, which has ever been available for the study of the problem of the influence of alcohol upon the duration of human life.

1 Papers from the Department of Biometry and Vital Statistics, School of Hygiene and Public Health, Johns Hopkins University. No. 102.
4 For the laborious arithmetic involved in the construction of these life tables I am indebted to Dr. John Rice Miner.

TWO EXTRAORDINARY LARVAL MYRMECOPHILES FROM PANAMA

BY WILLIAM MORTON WHEELER

BUSSEY INSTITUTION, HARVARD UNIVERSITY

Communicated, April 10, 1924

The two larvae described in the following pages both belong to the order Diptera and were taken in the nests of two different Dolichoderine ants on the same day, March 25, 1923, in the same locality, Prijoles, C. Z., in a piece of jungle less extensive than a city block and not more than two miles from the recently erected tropical laboratory of the National Research Council on Barro Colorado Island. The first larva (Fig. 1a) was found in the dead petiole of a Panama hat palm (Carludovica palmata Ruiz and Pavon) in the midst of a flourishing colony of Dolichoderus (Hypoclinea) championi trinidadensis Forel var. temniatus Forel. Though recognized as a larval Microdon it was at once seen to be quite unlike any described species in color and ornamentation. It measured only 5.7 mm. and was broadly and regularly elliptical, with flattened creeping-sole and feebly convex dorsal surface, like the well-known Microdon larvae of
temperate America and Europe, but the integument was smooth and of a pale blue color, with the band of minute papillae bordering the creeping-sole carmine red. The dorsal surface bore regular longitudinal rows of large, snow-white, spoon-shaped scales, which under a high power were very finely, transversely regulose. They were largest on the mid-dorsal region, attached to the integument by rather short, thick stalks and curved backward gracefully, with blunt tips. The posterior end of the body bore the usual keg-shaped projection with the spiracles on its truncated terminal surface. This exquisite creature resembled nothing so much as a minute nudibranch mollusk, and vividly recalled the fact that just a century ago (1923, 1924) von Heyden¹ and Spix² had described the larva of the common European *Microdon mutabilis* Meigen as a mollusk.

The larva was carefully separated from the ants and in the laboratory transferred to a Petri dish. After creeping about for a few days it came to rest in the middle of the dish and on the morning of April 1, was found to have pupated during the night. It now had the appearance of Fig. 1b.

The body had contracted, had become much narrower and longitudinally ridged and the integument had hardened and taken on a golden brown tint with purplish peripheral border. Apparently as a result of the strong and sudden contraction of the integument during pupation, the white
scales had been violently thrown to a distance of four to five centimeters from the insect. Rows of small boss-shaped elevations remained to indicate their former insertions. There were no traces of the prominent horn-like prothoracic stigmata seen in so many Microdon puparia, but in other respects the puparium was not unlike that of many other species of the genus. Although it was kept for some weeks under what seemed to be favorable conditions the imaginal fly unfortunately failed to emerge. I nevertheless venture to name the insect, at least provisionally, Microdon æolidiformis sp. nov.

The genus Microdon is represented by an unusual number of diverse and interesting species in the neotropical region. As there are very few records of their larvae I append a brief list of those that have come under my observation:

1. Many years ago (1901) I called attention to some flat Microdon larvae which I found in a nest of Pseudomyrma gracilis Fabr. subsp. mexicana Roger in a hollow acacià limb near Cuernavaca, Morelos, Mexico.

2. During the summer of 1920 Mr. G. Inness Hartley and Dr. Alfred Emerson, at my request, secured one of the huge carton nests of Asteca trigona Emery subsp. mediops Forel, which are common on the trees in the second-growth jungle at Kartabo, British Guiana, and made a census of its inhabitants. The nest had a volume of 29 cubic dcm. and was estimated to contain 377,000 ants and as many larvae and pupae together with many myrmecophilous Clavigerid and Staphylinid beetles, Chalcididae, Lepismidae, etc. and a number of peculiar, large Microdon larvae, with flat or concave dorsal and very convex ventral surfaces and therefore adapted to living on the very concave walls of the nest chambers. The imaginal fly reared from one of these larvae by Dr. Emerson will be described by Dr. Geo. C. Wheeler.

3. During the same summer I found in a hollow twig at Kartabo a flourishing colony of a Crematogaster (near brevispinosa Mayr) containing four singular Microdon larvae. They were pure white, cylindrical, caterpillar-like and covered with rather long tentacles. Unfortunately the ants and their guests had been blown out of the twig into a vial of alcohol, so that the larvae could not be reared. They will also be described and figured by Dr. Wheeler.

4. At Red Tank, C. Z., March 10, 1923 I took from a caulinary swelling of an interesting myrmecophyte (Cordia gerascanthus Jacq.) a small colony of Crematogaster brevispinosa Mayr subsp. tumulifera Forel containing four small, smooth, amber-yellow, cylindrical Microdon puparia and by March 27–28, succeeded in rearing the imagines, which were scarcely larger than house-flies. They will be described by Dr. W. M. Mann.

5. During March and April 1923 Mr. James Zetek and I repeatedly
observed in various localities in the Canal Zone small narrow Microdon puparia of the usual type in the chambers of termitaria occupied by ants (Camponotus (Neomyrmamblys) novogrenadensis Mayr). These ants regularly take possession of the chambers adjacent to the tree trunk supporting the termitarium and permit the termites to inhabit the remainder of the structure.

6. At Las Sabanas, in the Panamanian Republic, I found small slender puparia of a Microdon very similar to the preceding in a most unusual situation, the thorns of bull-horn acacias (A. penonomensis Safford) occupied by the typical Pseudomyrma gracilis Fabr.

The nature of the food of the Microdon larvae in the ant nests was for a long time problematical till Donisthorpe succeeded in proving that the British species, M. mutabilis, which lives with ants of the genera Formica, Lasius or Myrmica, is a scavenger and feeds on the minute pellets expelled by its hosts from their infrabuccal pockets. More recently Borgmeier has shown that certain Microdon larvae living with the common Brazilian fire-ant, Solenopsis savissima F. Smith, attack and devour the coccids which the ants keep as milch cows in their nests. I believe that the Panamanian species which I took from the caulinary swelling of Cordia gerascanthus may have similar habits, but the other species cited above, including M. acolidiformis, must feed on refuse, like the European and Nearctic forms.

The other larva from Frijoles is much more remarkable than the Microdon guest of Dolichoderus tanitatus. I found suspended from the branch of a large tree that had just been felled by the negroes a rather small carton nest of the typical Azteca trigona Emery. It was about a foot broad through its base and about ten inches long. I hastily cut off the greater portion of the structure and enclosed it with its infuriated inhabitants in a cloth bag, which was taken to Mr. Zetek's laboratory in Ancon and on the following day placed in a large jar with some chloroform. I was then able to break the nest into small fragments and to examine its contents in comfort. Besides hundreds of Azteca workers and their brood I found in the chambers a single small wingless Braconid myrmecophile and more than a hundred small, hard, rather shining, dark brown, lenticular objects which I at first took to be seeds. They were scattered through the chambers of all parts of the nest and were lying freely among the brood. More careful examination showed that they were Dipteron larvae, all in the same apparently adult stage of development and of very nearly the same size (3.5–4 mm. long, 2.6–2.8 mm. wide). Unfortunately none of these larva recovered from the effects of the chloroform so that I was unable to rear them.

Fig. 2 shows the dorsal and ventral aspects of the insect under a low magnification. The body consists of a larger, broad, flattened carapace-
like, suboctagonal abdominal and a smaller, narrow, anterior cephalothoracic portion, which can be drawn into the abdomen. The dorsal surface of the latter is feebly convex, with two rather deep, transverse grooves near the middle and a small rounded tubercle at the posterior end. The ventral surface is flat, with a pair of longitudinal, lateral furrows, or impressions which widen posteriorly and nearly meet at a small circular area and pit, which represent the anus. The anterior portion of the abdomen above is divided by T-shaped sutures into a median triangular plate and two lateral suboblong plates, each of which bears a clearer, thinner, slightly elevated, elliptical area which evidently represents the point of future extrusion of the prothoracic stigmal horn of the pupa. One of the lateral plates is shown under a somewhat higher magnification in Fig. 3a. De Meijere⁶ and Metcalf⁷ have found that in the Syrphidae and closely allied families of Diptera the region of the larva bearing the two preformed, thin areas for the extrusion of the pupal prothoracic stigmal horns is the first abdominal segment. The T-shaped sutures, like the similar structures in the late Microdon larva and puparium are, of course, a prearrangement for the emergence of the adult fly.

The anterior portion of the body, shown more clearly in Fig. 3a as seen from the ventral side, consists of the retracted pseudocephalon with the
mouth-hooks projecting from its orifice but without distinct traces of antennæ, and three short segments representing the thorax. The first of these bears a pair of cylindrical appendages, the prothoracic spiracles. The remaining segments bear no appendages and are readily telescoped into one another when the anterior portion of the body is retracted.

The dark brown abdominal integument is very tough and leathery, neither thinner nor more flexible on the ventral than on the dorsal surface and consists of a beautiful mosaic (more regular than in the figures) of usually hexagonal chitinous plates, which tend to disintegrate when boiled in caustic potash. On both surfaces very near the posterior end of the

body there are two transverse areas, each consisting of a series of narrow, elongate plates. The dorsal surface also has a number of scattered but regularly arranged sense organs (shown as black dots in Fig. 2a), each lying between two contiguous polygonal plates and having the appear-
ance of Fig. 3d under a higher magnification. These organs seem to be Hicksian sensillae and to be the same as those seen in many other Dipteron larvæ, notably in Itoniæ (Cecidomyiæ), Syrphidæ (Microdon) and Lonchopteridæ (de Meijere⁸, Maria Andries⁹). The integument of the pseudocephalon and thoracic segments is much thinner, more yellowish and consists of smaller polygonal plates than that of the abdomen. The stigmal areas on the first abdominal segment are finely areolated (Fig. 3c). The posterior tubercle (Fig. 3b) bears a pair of very small reniform stigmal plates, separated by a slit-like structure, the significance of which is by no means clear. Each stigmal plate has four small triangular spiracular openings and in front of it lies a structure that seems to correspond to the small "circular plate" of many Cyclorrhaph Dipteron larvæ. The cephalo-pharyngeal apparatus is so extremely small that I have been unable to obtain a satisfactory knowledge of its structure. The internal structure has not been studied.

I find it impossible to refer this singular larva to any of the recognized families of Diptera, and two accomplished specialists in this order, Prof. C. L. Metcalf and Mr. C. W. Johnson, who have examined some of my specimens, confess to the same embarrassment. There would seem to be little doubt that the creature must belong to the section Cyclorrhapha Aschizia of Brauer.¹⁰ In this group he included four families, the Syrphidæ, Pipunculidæ, Phoridæ and Platypizidæ, and more recently de Meijere⁸ has added a fifth, the Lonchopteridæ. But the larvæ of all these families are very different from the one described above. It certainly shows a vague kinship to the Syrphid Microdon, especially in the shape of the abdomen, the T-shaped sutures of its first segment, the plates for the extrusion of the prothoracic stigmal horns of the pupa, the caudal tubercle with its closely approximated stigmal plates, and the areolation of the integument, which is somewhat like that described by Maria Andries⁹ for Microdon. On the other hand the rigidity of the integument on the ventral surface and absence of a creeping-sole, the proportionally much greater development of the thoracic segments, the large, cylindrical and undoubtedly functional prothoracic stigmata, the finer structure of the posterior stigmata, etc., are all characters which separate the larva under discussion from the Syrphidæ and other known aschizous Cyclorrhapha. Since it in all probability represents a new genus and may even represent a new family of Diptera, I propose to call it Nothomicodon aztecarum gen. nov. et sp. nov.

What the larvæ do in the carton nests of Asteca trigona must remain a mystery till they are again encountered by some observer who can study the behavior of both ants and guests in an artificial nest. The powers of locomotion of the larvæ must be nil or limited merely to slowly dragging themselves about by means of their feeble mouth-hooks. Per-
haps they are actually carried about the nest by the ants. That they may feed on the ant larvae is suggested by the fact that the brood was much less abundant in the nest in which they occurred than in several uninfested nests of the same ant which I examined in the avocado orchard of Mr. John English at Frijoles.

Perhaps I may be censured by some of my confrères for giving scientific names to larval insects, whose imaginal forms are presumably unknown and likely to remain so for many years, but there is good precedent for my procedure. To cite only one example, Silvestri\textsuperscript{11} has recently named a long series of very interesting larval termitophiles. In these as in the case of the immature Diptera described above, the larval is far and away the most significant stage of the insect from an ethological or ecological point of view. Moreover, failure on my part to name the two peculiar larval myrmecophiles would sooner or later almost certainly tempt some other entomologist to tack names of his own to my descriptions—and we are advised not to lead others into temptation.

\textsuperscript{1} von Heyden, C. H. G. “Ueber ein sonderbar gestaltetes Thierchen.” \textit{Isis}, 12 and 13, 1823, p. 1247-1249, 1 fig.
\textsuperscript{3} Wheeler, W. M. “Microdon Larvae in Pseudomyrma Nests.” \textit{Psyche}, July 1901, p. 222-224, 1 fig.