

OBSERVATIONS ON A UNIQUE MONSTER EMBRYO OF WYEOMYIA SMITHII
(COQUILLET) (DIPTERA: CULICIDAE)¹

ROGER D. PRICE

Department of Entomology and Economic Zoology, University of Minnesota, St. Paul

ABSTRACT

This monster was found in 15 out of 1,570 fertile eggs inspected during the colonization of the pitcher plant mosquito. Each consisted only of two apparently complete abdomens fused in the region of the first abdominal segment of each. The "anterior" abdomen was doubled back and occupied the anterior one-third

of the egg; the "posterior" abdomen was straight and occupied the posterior two-thirds of the egg. A living embryo exhibiting duplication in the longitudinal axis with complete absence of head and thorax is believed to represent a hitherto unreported type of teratological phenomenon.

Studies of spontaneously occurring abnormal or monster individuals in the Culicidae have for the most part been restricted to instances of chaetotaxal variation among larvae and gynandromorphism among adults. The work of Gaud (1957) is typical of a number of preceding ones

which dealt with duplication of larval hairs, especially the clypeal hairs of *Anopheles* larvae. Other larval anomalies have involved those of irregularities of antennal and siphonal structure as well as of a single instance of a unispiraculate condition. Cases of gynandromorphism among mosquitoes have recently been summed up by Kitzmiller (1953). It is the purpose of this work, however, to describe a unique teratological phenomenon encountered with embryos of the pitcher

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plant mosquito, *Wyeomyia smithii* (Coq.). To the knowledge of this writer, the type of monster embryo to be discussed below has been unknown among the Culicidae, and, moreover, has never before been reported among any of the Insecta.

MATERIALS AND METHODS

All embryological and larval materials utilized for this study were derived from apparently normal parent *W. smithii* stock originally obtained from Itasca State Park, Clearwater County, Minnesota, in the summer of 1957. The methods of maintaining the laboratory colony of this species are given elsewhere (Price, in press). The specimens described below all represent members of either the F_1 or F_2 generation of this laboratory colony.

Each monster embryo first was observed in the unhatched state, the rather transparent chorion of the egg allowing those eggs containing monster embryos to be distinguished from those which were infertile or contained normal embryos. In fact, the details of the major setae, such as in figures 3 and 4, can be seen readily when the egg is observed in a hanging drop under a compound microscope. The eggs with monsters in them then were ruptured carefully with dissecting needles and the monster either was gently extricated or at times was allowed to wiggle free itself. Once freed in distilled water, a cursory examination of each was made to confirm the nature of the abnormality and the material was then prepared for permanent study mounts.

Whole mounts of three monster specimens were made; the unusual structure of these monsters made it more convenient to study their external morphology from lateral mounts. For comparative purposes, corresponding lateral mounts of normal first-instar larvae were made. Internal structure was studied from serial sagittal sections of five monsters; these were compared to similarly prepared sections of normal first-instar larvae.

OBSERVATIONS

The monster embryo, after removal from the egg, is seen to consist of two abdomens—one which occupies the anterior one-third of the egg, and the other the posterior two-thirds of the egg—fused together in the region of abdominal segment I of each (fig. 1). The former will hereafter be referred to as the anterior abdomen and the latter as the posterior abdomen. Segmentation is obscured in the region of the junction; however, reference to the chaetotaxy of the normal larva of *W. smithii* (fig. 2) readily reveals the segmental relationships. Each side of abdominal segments I-III bears a pair of long setae and each side of abdominal segments IV-VI bears a single long seta. Abdominal segment VII shows no pronounced long lateral setae. Segments VIII-IX are easily recognizable by various structural elements. Aside from a ventral displacement of

the principal laterals of the first abdominal segment of the monster embryo, the external morphology of each abdomen of the monster agrees in virtually every detail with the comparable abdominal portion of the normal *W. smithii* first-instar larva. There is no external indication of either a head or a thorax.

The appearance of the chorion and the dimensions of an egg containing a monster embryo are similar to those of one containing a normal embryo. The only way to distinguish a monster-bearing egg from a normally embryonated egg in the unhatched state is to observe the structure and chaetotaxy of the enclosed embryo. After incubation for 48 to 72 hours at room temperature, the lateral aspect of the normal fully-embryonated egg invariably appears as shown in figure 3. The most obvious feature is the head, with its conspicuous pair of eyes and dorsal egg burster, located in the blunter anterior third of the egg. The setal arrangement shows four of the major groups of thoracic hairs extending forward along the ventral surface of the embryo, the remaining more dorsal ones extending posteriorly. The long double lateral hairs of abdominal segments I-III as well as the ensuing long single laterals of abdominal segments IV-VI also are appressed to the ventral region of the embryo. The two extremely long hairs of the dorsal brush of the anal segment may be seen extending anteriorly to the cephalic region.

Contrasted to the normal embryo, the monster embryo enclosed in the egg reveals no structural features associated with the head or thorax (fig. 4). Instead, all that are in evidence are the major abdominal laterals lying across what typically would be the dorsal portion of the normal embryo and the hairs of the two terminal anal segments, one group emanating from the posterior portion of the egg and the other from the mid-ventral region. Careful extrication of the monster embryo reveals that the entire specimen occupies an inverted position when compared to the normal position. The ventral region of the abdomen lies along the convex surface of the egg, instead of along the flattened, slightly concave surface as that of the normal embryo does. The posterior abdomen, possibly representing that of an inverted normal abdomen, is arranged in an extended position in the posterior two-thirds of the egg; the anterior abdomen, replacing the head and thorax of the normal embryo, extends forward from the point of union until a doubling back is found at the level of segment VI. The arrangement is thus such that the last three abdominal segments of the anterior abdomen are flexed toward the middle of the egg and come to lie against the preceding segments. Generally the anterior abdomen is slightly more slender than its posterior image, but that is the only difference noted between the two halves.

The internal structure of the embryo monster

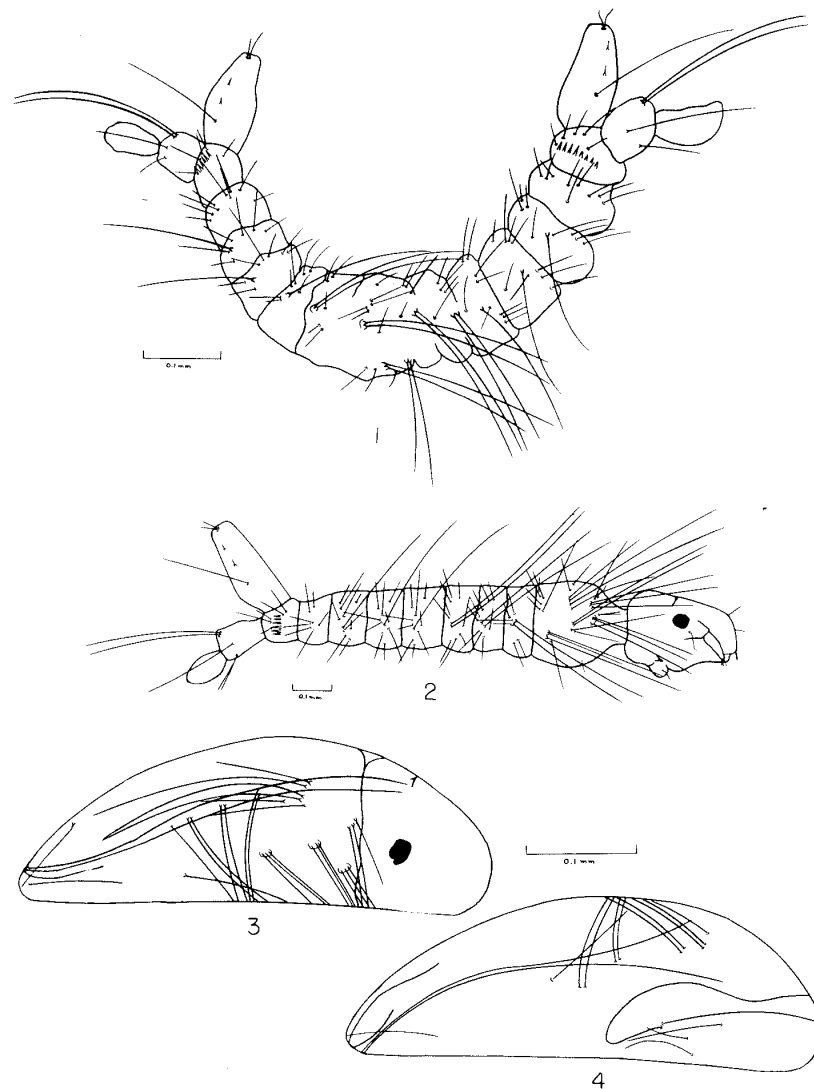


FIG. 1.—Monster embryo of *W. smithii*, lateral view after being freed from the egg. FIG. 2.—Normal first-instar larva of *W. smithii*, lateral view. FIG. 3.—Normal embryo of *W. smithii* as it appears within the egg, lateral view. FIG. 4.—Monster embryo of *W. smithii* as it appears within the egg, lateral view.

verified what was indicated externally. The mid-gut, demonstrating excellent cellular detail, is wide and continuous from the level of abdominal segment V of one abdomen to segment V of the other abdomen. At those points, it narrows and convolutes, giving evidence of hind-gut structure. Unfortunately it was not possible to follow the details of the hind gut, but it is believed that the digestive tract of this monster very likely runs from anus to anus. Indications of malpighian tubules are also present in the terminal portions of both abdomens. The ventral ganglia of abdominal segment I of one abdomen are apparently fused with those of segment I of the other abdomen to form a proportionately larger ganglionic mass; this is followed in each direction by a discernible series of six to seven normal-appearing pairs of ventral abdominal ganglia. Comparison of this morphological pattern with that of a normal first-instar larva shows close agreement between the two. Thus, both the external and internal morphology, when compared to that of a normal individual, lead to the opinion that this embryo monster is composed of two fused, apparently morphologically complete, abdomens with no indication of any portion of a head or thorax.

Most normally-embryonated eggs hatch after an incubation period of 3 days. One should bear in mind at this point that the eggs of *W. smithii* are generally laid singly and usually directly upon the water surface. The eggs float in such a manner that the ventral side of the embryo is uppermost; in other words, the eggs float in a position inverse to that shown in figures 3 and 4. The egg burster splits the dorsal surface of the egg approximately one-fourth of the way from the anterior end and the cap opens along a spiral line. The larva frees itself into the water from the dorsal side. The necessity of an egg burster for hatching of *W. smithii* makes it evident that the discovery of a monster such as that just described is dependent upon dissection of unhatched eggs. It has been a routine procedure in the establishment of the laboratory colony of this species to inspect all unhatched eggs to determine the possible reason for their not hatching. As a result of this, the first four monster embryos were found in a batch of 34 eggs laid on February 23, 1958. It was at first thought that this was probably an isolated and extremely rare occurrence; however, an additional 11 similar monsters occurred over the next 2 months, making a total to date of 15 monster embryos from eggs laid on at least 8 different days. When one considers that these 15 similar anomalies occurred in a total of 1,570 fertile eggs laid over that period, there is a rate of occurrence of 0.96 percent. These abnormal embryos were most certainly derived from at least three different females, and probably more were involved. Of the remaining fertile eggs, 1,490 hatched normally; 25 remained

unhatched, yet were alive and apparently normal; 19 more unhatched eggs were fertile and normal, yet dead; and 21 comprised a group of unhatched embryos, both dead and alive, showing various abnormalities, yet bearing no obvious relationship to the two-tailed monster described above. These individuals were either improperly oriented in the egg or else had a misplaced eye, egg burster, or some other cephalic anomaly. Only 227 eggs were infertile, a lower percentage of infertile eggs than that reported elsewhere (Price, In press).

All 15 of the two-tailed monster embryos were alive when extricated from the egg. They typically demonstrated a thrashing movement of each abdomen; when prodded with a needle, they would snap the tips of their two abdomens together. In one instance, a monster was carefully freed from the egg and allowed to remain in isotonic saline. It remained alive and capable of movement for 24 hours, at which time it was so feeble that it was killed and fixed for further study. With no means for feeding, coupled with the dangers inherent with forced hatching of embryos, it is doubtful if these embryos would ever survive much beyond this.

DISCUSSION

The discovery of the monster embryo of *W. smithii* poses a number of interesting, and as yet unanswered, questions. The existence of a living mosquito embryo composed of a fusion of a virtually complete posterior and a similar anterior abdomen, with no evidence of cephalic or thoracic structure, presents an abnormality that, to the knowledge of this writer, has not been encountered previously in any insect. When one consults the literature reported to date on the teratology of insects, it becomes evident that there are papers dealing with numerous different phenomena distributed among many orders of insects. It is beyond the scope of this study to go into a review of this material, but these reports deal primarily with an anomalous appendage or other external or internal body structure or even with twinning of anterior portions or entire individuals. In all naturally occurring monsters, the head and thorax are still represented at least to some degree. Cappe de Baillon (1927) has presented a classification of monsters and nothing in his summary of this subject is comparable to the two-tailed mosquito embryo. He has noted symmetrical embryos with opposed cephalic extremities, an instance which is opposite to that noted in the present study. Cappe de Baillon makes the statement that the double monster with a doubled abdomen is very rare, the only one encountered by him being an orthopteran completely doubled and joined along the dorsal surface. It is doubtful if he had in mind a situation of a monster consisting only of two abdomens.

Specimens that demonstrate a doubling of major body regions invariably possess indications

of head and thorax and the doubling is generally on a transverse plane. Richards and Miller (1937), in reviewing the work of Seidel on *Platycnemis*, state that duplication never occurs in the longitudinal axis, seldom in the dorso-ventral axis, but commonly in the transverse axis. This statement, of course, refers primarily to knowledge derived from a study of indeterminate eggs, such as those of *Platycnemis* and *Tachycines*.

Based upon the study of a few species of higher Diptera, the generalization has been made that the eggs of Diptera represent a determinate or mosaic type. If this also applies to the lower Diptera, including the mosquitoes, then the embryonic parts of this monster are mapped out before the egg is fertilized. In other words, the malformation is a result of some maternal influence, and whether this is of genetic nature or a result of some other phenomenon can not yet be said. If this is genetically controlled, the continued inbreeding in the laboratory might result in a higher percentage of monsters.

The regions of the head and thorax are believed to be so important in the development of the insect embryo that the question arises as to how this monster embryo can develop as it does and become an intact living entity with apparent absence of these vital regions. A differentiation gradient seems to emanate at the level of the first

abdominal segment and pass anteriorly and posteriorly from this point.

The repeated formation of such a monster at the relatively high rate of approximately 1 percent makes one wonder whether he is dealing here with a chance phenomenon limited only to *W. smithii*, and possibly only to those of the Itasca State Park region, or whether this might involve a more widespread occurrence among other mosquito species as well as, possibly, other insects. It will await the colonization of *W. smithii* obtained from other regions, as well as inspection of unhatched eggs of other species, to contribute information on this.

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