[*EXTRACT.*]

THE FECUNDITY OF MORMONIELLA AND SOME PROBLEMS IN PARTHENOGENESIS.

By G. H. HARDY, Research Fellow, Queensland University.*

About a year ago, in a short paper, I summarised the conclusions arising from certain experiments dealing with the hymenopteous parasites of blowflies and two species of *Chalcididae* were referred to in that address. One of these wasps, *Mormoniella,* has been followed up with the object of determining how many eggs are laid by the female. The experiments gave averages of 182, 156, 222, and over 400, and not less than 35 puparia succumbed to the attack of each female parent parasite and yielded this progeny. All these numbers were in excess of those previously considered attainable and, moreover, the conditions under which these earlier experiments were conducted were such as to cause excessive losses occasioned by the overloading of puparia with eggs and by puparia of unsuitable age being used.

Up to that time, the ideas expressed upon this subject of progeny were summed up by Johnston and Tiegs in 1921 as follows:—"Observations by Girault and Sanders and by Froggatt and McCarthy showed that on an average one female may deposit 113 eggs, but, unfortunately, she distributes them only amongst 17 to 20 pupae (on an average), so that her destructive action is strictly limited."

Judging from my own experiments, it seemed that the number of eggs deposited by each female should not be less than five times the number given by previous authors, and if my estimate be correct, the value of *Mormoniella* might be enhanced fivefold.

The parasite lays its minute eggs in the comparatively large puparia of blowflies and to find and count these eggs is impracticable, so the only chance of verifying this estimate of the progeny is to rear for the adults. Already, as indicated in my previous address, there seemed to be sufficient knowledge gained to enable practically all the eggs deposited to be reared to maturity. Not only was the host of suitable age needed, but care had to be taken that not too many eggs were deposited in any one puparium.

In a subsequent test carried out on these lines, from one female, instead of about 113 parasites being reared from about 20 puparia, as was originally thought would be the case, no less than 550 parasites emerged from 86 puparia. Although this conformed with recent expectations, nevertheless, as will be indicated later, I now doubt if it has reached even the approximate maximum progeny obtainable.

Johnston and Tiegs further recorded:—"Unfertilised females also oviposit quite readily, the offspring being entirely males." This case of parthenogenesis I have also experienced and can vouch for, but there was no information available to indicate why this should be so, nor yet to show what bearing the phenomenon might have upon a subsequent generation. On this account, whilst breeding from a paired *Mormoniella,* an experiment was conducted by treating a virgin specimen under identical conditions.

The parthenogenetically produced progeny reached only 288 parasites, which number is thirteen in excess of half that reared from the paired specimen, whilst 57 puparia yielded these parasites against 86 being effectively parasitised by the fertilised female, thus the parthenogenetically producing parasites are two-thirds as efficient as the others.

It is a very simple explanation that I would read into the results of this comparative test. The known proportion of the sexes is considered to be approximately equal, one sex not exceeding 5 per cent. in number above the other. This suggests that the males only were reared parthenogenetically, the male eggs being fertile, the female eggs requiring the male sperm to germinate them. If this assumption be correct, it will have a far-reaching effect upon methods to be adopted in the breeding of blowfly parasites on a large scale, and it will affect future experiments dealing with the fecundity of *Mormoniella* in a like manner.

* In an address before the Entomological Society, Brisbane, 16th September, 1925.

Bovčik

The sexes were together at the beginning of the experiments so far conducted, except in that parthenogenetic case, referred to above, where no males were used; and whilst the female lives as long as forty days, the males died within a few days and were not replaced. In consequence of this, the females may have exhausted their sperm-cells received from the males during the earlier portion of their egg-laying activities, and being without sperm-cells during the latter period would render the female eggs then deposited infertile. Hence there may have been considerable loss of female eggs during the latter portion of every experiment, indicating that as many as 200 more female eggs were deposited than there were adults reared.

If this interpretation of parthenogenesis in Chalcid wasps be proved, it may have a very important bearing on the question in relation to other insects, calling for a readjustment of certain views that are somewhat contentious though widely held. The phenomenon of parthenogenesis amongst hymenoptera is exhibited in several ways. There are a few insects such as certain saw-flies and gall-flies in which the male is unknown and it is suggested that these are perpetually parthenogenetic. Again, amongst insects that are known to reproduce in the ordinary way parthenogenesis may also occur, resulting usually in the production of only one sex, either females or males, the former called "thelotoky" the latter "arrhenotoky," whilst in those rarer cases where both sexes are so produced it is called "deuterotoky."

In gall-flies parthenogenesis may take the form of alteration of generations, the first generation of two sexes being followed by a generation of only females, this being followed again by both sexes and so on, thus "deuterotokous" parthenogenesis is established as part of the economy of the species.

In the honey-bee, unfertilised eggs are popularly credited with producing only drones. It has been assumed that the eggs are male till fertilised and then become female. Hence it is supposed that the sex is determined by the act of or the lack of fertilisation. On this account it has been confidently stated, and as confidently believed, that no male honey-bee has a father. These views are not necessarily favoured by the modern biologists, but it is very difficult once such ideas have taken hold, to force some better and sounder observations in their stead. The ideas expressed concerning the parthenogenesis of bees have fostered similar views with regard to that of other insects, and I think that some similar beliefs have been held in relation to the Chalcid parasites, but apparently they have not been expressed in print.

It seems possible that "arrhenotokous" parthenogenesis may have become part of the economy of blowfly parasites much in the same way as "deuterotokous" parthenogenesis is within certain gall-flies. It has yet to be proved that the female *Mormoniella* needs copulation with more than one male during her relatively long life of activity if all her female eggs are to be fertile. This polyandry, if it exists, would necessitate a larger proportion of males, which would naturally be induced with any insect having parthenogenesis resulting in a male progeny, so what at first sight appears to be an unnecessary overproduction of the male sex may really act as a counterbalance assuring a much larger female progeny in the following generation. In this way what has been considered a rather useless accomplishment may ultimately prove exceedingly advantageous if not vital to the wellbeing of the race possessing it.

The question now arises as to whether polyandry is necessary to procure the maximum progeny of *Mormoniella*, and, if so, it is reasonable to conclude that "arrhenotoky," being advantageous to any polyandrous race, has become a factor in the economy of *Mormoniella*.

ANTHONY JAMES CUMMING, Government Printer, Brisbane.