The Question of Parthenogenesis in the Greater Wax Moth[1,2]

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ABSTRACT

Females of 3 strains of *Galleria mellonella* (L.) were observed for oviposition and parthenogenesis. Virgin females produced fewer eggs than mated females. No embryonic development was observed in eggs from virgin females, and no eggs hatched.

Release of males sterilized by irradiation (Knipling 1955) is being considered as a method of controlling the greater wax moth, *Galleria mellonella* (L.). The moth is reared easily in the laboratory and has seemed a likely candidate for the new technique. However, if parthenogenesis occurs in the wax moth, then the sterilized male control method may not be effective.

Parthenogenetic development does occur in some insect species, e.g., male honey bees, *Apis mellifera* L., develop from unfertilized eggs, and aphids (Aphididae) reproduce for many generations without mating. However, parthenogenesis is rare in Lepidoptera and usually it is caused by fusion of the egg nucleus with the 2nd polar nucleus, 2 polar nuclei, or 2 cleavage-nuclei (Suomalainen 1962). Nevertheless, parthenogenesis in the wax moth was reported as early as 1858 by Dönhoff (1858) who found 2 larvae developing in the beeswax placed with isolated virgin females. Also, Yung-Taï and Caullery (1925) reported similar findings and concluded that the moth could develop parthenogenetically, but Yung-Taï (1930) refuted this finding and noted that strict isolation had not been maintained in the earlier study. Smith (1938) reported that when he isolated genetically marked females on sterilized beeswax, 10% of the moths produced offspring that had the same genetic markers; thus, he concluded that parthenogenesis was proved and that contamination had not occurred. Also, Stejskal (1960) isolated 55 virgin females on sterilized brood comb and observed 35 ♀ and 20 ♂ which developed in the containers. However, El-Sawaf (1950), in a paper on the morphology of the wax moth, reported that he had never seen hatch in eggs that were laid by unmated females.

Since these reports concerning parthenogenesis were so conflicting the question needed to be resolved.

Methods and Materials.—To determine whether parthenogenesis occurs in the greater wax moth, moths of 3 strains were observed. The "Laboratory" strain has been cultured for many years at the Insect Pathology Laboratory, Beltsville, Md., and also was used in studies at Baton Rouge, La. The "Wild" strain was started with moths taken from the natural population of wax moths at Baton Rouge. The "Röller" strain was obtained from Dr. H. A. Röller, Texas A&M University, College Station. With all 3 strains, the female pupae that were to be observed for parthenogenesis were placed in individual 3-dr cotton-stoppered vials to emerge.

The emerged virgin females of the Laboratory strain were then handled as follows:

1. 10 ♀ were placed with 10 ♂ in a 1-gal jar; 10 replicates.
2. 10 ♀ were placed in a 1-gal jar; 10 replicates.
3. 50 ♀ were placed in a 1-gal jar; 2 replicates.
4. 1000 ♀ were placed in individual 3-dr vials.
5. 41,140 ♀ were placed in individual 3-dr vials.
6. 50–60 ♀ pupae were placed in a 1-pint mason jar.

Tests 1–4 were all made with moths from a simple rearing group that emerged as adults on the same day. In these tests, the numbers of eggs laid and the numbers hatched were recorded. Test 5 was made with moths from other rearing groups that emerged during a period of nearly 1 year. Eggs from these females were observed for embryonic development and hatch. Test 6 was made with insects from the original Laboratory culture at Beltsville. The eggs from these females were placed in petri dishes plugged with cotton and observed for hatch.

The procedure with the emerged virgin females of the Wild strain was similar: Tests 1–4 were identical. Test 5 was made with 4800 ♀. Test 6 was not done with the Wild strain.

The Röller strain was exposed only to Test 5 (2100 ♀).

Observations.—In our experiments and in the present study we did not observe hatch from any eggs laid by virgin female moths. Moreover, although the developing embryo can be seen within the eggs several days before eggs from mated females hatch, we did not observe any embryonic development within the eggs laid by virgin females.

Specifically, with the Wild strain, the 100 mated females produced 594 eggs/♀; 98% of them hatched. The 100 virgin females that were placed in 1-gal jars in groups of 10 ♀/jar produced 9.88 eggs/♀, and the 50 virgin females in 1-gal jars produced only 3.11 eggs/♀. The virgin females from the same rearing group that were held in individual vials averaged 10.2 eggs/♀ with as many as 227 eggs laid by some females and none by 36.6%.

The 100 mated females of the Laboratory strain produced 702 eggs/♀; 99% hatched. In contrast, the 100 virgin females that were placed in 1-gal jars in groups of 10♀/jar produced 7.13 eggs/♀, and the 50 virgin females in 1-gal jars averaged only 2.59 eggs/♀. The virgin females from the same rearing group that were held in individual vials averaged 6.85 eggs/♀ with as many as 44 eggs produced by some females, and none by 24.7%. (When conditions were even more crowded, that is with 50–60 virgin females in a 1-pint jar, they averaged less than 2 eggs/♀.) We thus observed more than 220,000 eggs from virgin females of the Laboratory strain, more

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than 48,000 eggs from virgins of the Wild strain, and ca. 14,000 eggs from virgins of the Röller strain, and we found no evidence of parthenogenesis in these strains of the greater wax moth.

Virgin female moths of the Laboratory strain produced from 0 to 44 eggs compared with 0–125 by virgin females of the Röller strain and 0–227 by virgin females of the Wild strain. Thus, virgin females of the Laboratory strain produced fewer eggs than those of the Wild strain or the Röller strain. However, there was less variability in the number of eggs produced by the Laboratory strain. The virgin females observed by Stejskal (1960) laid from 0 to 200 eggs; Yung Taï (1930) reported that his virgin females produced as many as 300–400 eggs.

DISCUSSION.—In every instance in which parthenogenesis is reported in the literature, beeswax had been placed with the virgin females. This beeswax could have caused error, because it might be the means of introducing eggs or young larvae. (We observed young larvae trying to enter cotton-stoppered vials that contained pieces of beeswax.) Also, none of the investigators reported that they had observed even 1 hatched egg. Dönhoff (1858) observed only 2 larvae which could have invaded the container to feed on the wax. Yung-Taï (1930), when he refuted his earlier observations, noted that he and his co-workers had not maintained strict isolation. Stejskal (1960) may have allowed young larvae to enter the containers when he was ventilating his moths. Smith's (1938) case for parthenogenesis is stronger, since it is difficult to see how larvae that contained specific genetic markers could have invaded the right vials. Thus, although we observed no parthenogenesis in 3 strains, and Yung-Taï (1930) and El-Sawaf (1950) observed none in their strain, parthenogenesis may occur in some strains. Therefore, care should be taken in releasing sterile-male moths in any control effort. Released moths should have an abundance of viable sperm to fertilize the eggs and to induce lethality in the embryos; then there would be little possibility that unfertilized eggs might develop parthenogenetically.

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