

organs of a mature drone would have more virility than those of a drone larva or pupa.

That the active principle in the fluid contained in the procreative organs of the drones attains a degree of activity at a very early stage in their development is evident from the effect produced by exposing the larval queens to its influence. Continuing the experiment we caused more queen cells to be built. Removing the testes and seminal sack from mature drones with a pair of pliers, the contents were pressed upon the larval queens. The bees removed the uncapped larvæ as before. Most of the pupa queens so treated and placed in nursery cages for hatching died in the cell after assuming the imago state and after being partly colored. We hope to be able yet to discover what principles and practice are essential to success which seems possible, for many possible opportunities remain untried. While possessing possibilities of the greatest interest and value to the embryologist and entomologist, it is doubtful whether a demonstrated method of what may be called parthenogenetical fecundation would possess the essentials of certainty and permanence in such a degree as to make the method serviceable to beekeepers. It remains to be tried whether a sufficient number of active spermatozoa may be received into the spermatheca of queens while in the larva, pupa, or imago state to render them serviceable for any practicable purpose, even if some of the reported successes were true. Failing to succeed by these methods it appears more reasonable that the best time to fecundate a queen is when she wants to be fecundated, or when orgasm appears. Orgasm takes place in from five to seven days, unusually in five days, after the queen leaves the cell, and continues for eight or ten days, and a few instances are reported where queens have been fertilized as late as twenty-three days after leaving the cell.

When orgasm takes place the generative organs of the queen are highly excited and much distended. We confined a queenless colony in their hive and gave them a queen-cell which had not been disturbed while maturing, and allowed the queen to hatch. When the virgin queen was six days old orgasm occurred, and on the seventh day we removed her from the hive and placed drops of male sperm upon the open vulva as she was held back downwards, by gently grasping the thorax between the thumb and forefinger. The instant the male sperm was pressed from the testes and seminal sack of a mature drone upon the excited and distended vulva, it was curious to observed the effect. The action of the abdomen and vulva resembled that of young birds being fed. There was the

reaching up after the seminal fluid, and an action of the parts resembling the opening of the mouth and swallowing food. As much seminal fluid as could be obtained, by the imperfect method employed, from three or four drones, was utilized and readily absorbed by the queen, after which she was dropped on a frame covered with bees and returned to the hive, and the bees were liberated. Up to this time her appearance and action was that of a virgin queen. The next morning, twelve hours after exposure to the seminal fluid, her abdomen was distended, and her appearance and action in all respects was that common to fertile, laying queens. She was moving about slowly over the combs and peering into the cells, and in twenty-four hours afterward she had 400 or 500 eggs in worker cells. We watched the development of larvæ from those eggs. In due time worker larvæ appeared, and at this date, November 13, worker bees in considerable numbers are being hatched. We then reared two queens from the eggs laid by this artificially fecundated queen, in queenless colonies, and as soon as they were hatched I clipped their wings, and when orgasm appeared they were treated as before described, and in three days one laid a few eggs in worker cells. The other has the appearance and action of a fertile queen, but has laid no eggs, and the lateness of the season forbids advantageous continuance of the experiments.

Fully realizing the necessity for exactness and certainty in all details, before tabulating the results of any method so revolutionary, I have endeavored to effectually guard against all possibility of the test being abortive. Instances have been reported where fecundation had taken place in the hive; but as many examinations proved that there were no drones in these hives, and judging from the lateness of the season and severity of the weather, probably none in the country, except a few which had been preserved in a queenless nucleus colony by frequently feeding the bees, and confining them in the hive, and from the further fact that the experiments were conducted when few bees at my time attempted to leave the hive, and from the fact that these queens' wings were clipped when they were removed from the nursery cage, we cannot confidently assert that fecundation by the natural method did not take place. These later experiments in fecundation have been conducted through the months of October and November, during the prevalence of most unpropitious weather, and those acquainted with the habits and instinct of bees will understand the difficulties under which we have had to labor. With the return of spring and the advantageous conditions attend-