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The production of two kinds of spermatozoa in phylloxerans —functional "female producing" and rudimentary spermatozoa.

By **T. H. MORGAN.**

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The work of McClung, Stevens, and Wilson has shown in the group of insects that sex-determination is associated with the presence of two kinds of spermatozoa — "male and female producing." From this point of view sex is determined by the sperm and not by the eggs in those species of insects in which parthenogenesis does not occur. Within the group of insects there are other species in which parthenogenesis appears as a part of the regular life-cycle. Such cycles are shown especially in the groups of aphids and phylloxerans. In these, all of the fertilized eggs produce females only, while from the parthenogenetic eggs both males and females develop. Hence it is evident that, in these groups at least, the egg may be sex-determining, but how this could take place has not been discovered.

In several species of Phylloxera that I have studied some facts have come to light that go far towards explaining sex-determination in this group. I shall describe first the spermatogenesis of a species that contains so small a number of chromosomes that the number can be counted accurately, not only in the reduced number of the spermatogenesis but in the somatic cells as well.

The reduced number of chromosomes is three. In the first spermatocyte division two of these divide equally, but the third lags behind the others, and finally in the very last stages of this division it retreats to one of the poles. Thus there are three chromosomes in one of the two daughter cells, and only two in the other. Still more significant is the fact that the cell with the fewer chromosomes is very small; it contains very little cytoplasm and subsequently degenerates without forming a spermatozoon. In the second spermatocyte division all three chromo-

somes of the larger cell divide equally, thus producing two spermatids with three chromosomes each. These spermatids become spermatozoa. They correspond in their mode of development to the "female-producing" spermatozoa of other insects. Hence we can understand why all of the fertilized eggs become females!

The question still remains as to how the males and the sexual females are produced from the parthenogenetic eggs. Here I have some observations to report which seem to indicate how this process takes place.

I find that the somatic cells of the males of the species referred to above contain only five chromosomes. These five give in the spermatogenesis the reduced number three by two uniting with each other and the third having no partner. I find that the somatic cells of the female contain six chromosomes. It follows that at some time in the life-cycle of the parthenogenetic eggs one chromosome disappears in those eggs that become males, while the full number is retained in the female. It seems plausible that this change takes place in the formation of the single polar body given off by the parthenogenetic egg.

The results seem to show that while the sex of the stem-mother is connected with the presence of "female-producing" spermatozoa, the production of males and of sexual females is dependent on a process that takes place in the egg analogous to the same process that takes place in the spermatogenesis of other kinds of insects. Hence it follows that the egg as well as the sperm has the power of determining sex by regulating the number of its chromosomes.

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Physiological problems of the geographical distribution of Partula in Polynesia, with demonstration of specimens.

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The speaker described briefly the geographical features of the distribution of Partulæ in Polynesia, known through the researches of Mayer, Garrett, Cuming, and others, as well as from personal