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PREVIEW

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PREVIEW

SEX-DETERMINATION  
IN ASPLANCHNA AMPHORA

BY

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A Thesis

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Doctor of Philosophy.

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PREVIEW

SEX-DETERMINATION IN ASPLANCHNA AMPHORA<sup>1</sup>

CLAUDE W. MITCHELL

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INTRODUCTION

While studying the polymorphic rotifer, *Asplanchna amphora*, and while seeking to ascertain the factors which determine its remarkable transitions of form, attention was directed again and again to the value of this species as material for the study of sex-determination in rotifers. It was in the genus *Asplanchna* that male rotifers were first discovered and few other genera produce them in so great numbers. The species in question is hardy, easily reared, and capable of being subjected to a great variety of conditions. Especially in the matter of feeding, its polyphagous habits are well known, and are productive of marked physiological and morphological results. Of special significance is the fact that the polymorphic character of the species itself, mirroring as it does marked underlying differences, it is of utmost use in following any and all effects of controlled conditions. Thus the production or non-production of males does not occur as a fact which stands alone but as the concomitant of morphological changes which may be of much value in determining its cause.

Finding the material thus favorable it was suggested by Dr. J. H. Powers that experiment be undertaken along this line, in the hope that work upon this unstudied species might aid materially the solution of the problem which has hitherto been attempted solely upon a single rotifer, namely, *Hydatina senta*. I wish again to thank Dr. Powers for his valuable suggestions and aid, but above all for the interest shown in each experiment and in the results of the entire work.

<sup>1</sup>Studies from the Zoölogical Laboratory, University of Nebraska, No. 109.

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In brief, the results of the work previously done upon the problem of sex-determination in rotifers is as follows: The well known work of Maupas upon *Hydatina senta* led him to the conclusion that a rise in temperature results in an increase of male production. Following Maupas, Nussbaum found the factor of temperature negative, while he attributed to starvation alone the fact of male production. Punnett discarded the factors of both temperature and starvation, finding, as he thought, that high or low male production ran in given lines or strains, which latter fact he attributed to an internal factor, 'zygotic constitution.' Whitney again concludes that sex-determination is controlled by external conditions, male production being favored by the presence of some substance in solution, the nature of which is undetermined, but the absence of which predisposed to the production of parthenogenetic females only. Shull at first also maintained that sex is determined by external conditions—lack of certain chemical matter in solution—though later, finding that different strains of the same species produce varying numbers of males even under identical conditions, he returns to the assumption of some internal factor inherent in lines or races. In progeny of a cross between different lines of high and low male-producers he finds the potentiality of male production increased in some instances and lowered in others. In a later work he returns to the assumption of 'genotypic constitution' as the determining factor, which is in essence a return to the position of Punnett. The relation of such internal factors to the influence of external conditions remains quite unexplained. It seems plain, therefore, that additional work is much needed before final conclusions can be reached.

Before proceeding further it is necessary to justify briefly the use of the phrase 'sex-determination' in its application to the phenomena we are studying. Shull and writers in allied fields have maintained that the phenomena in question are not really matters of sex-determination as such, but represent transitions from parthenogenetic reproduction on the one hand to sexual reproduction on the other. Viewed broadly this contention at first seems natural; but under analysis we fail to agree with it.

In typical parthenogenetic reproduction in rotifers it is plain that all the individuals are females<sup>2</sup> and all the eggs which develop into females are, in a true if somewhat special sense of the word, female eggs. They must certainly contain the full anlage of one type of female constitution. The mere fact that they do not require fertilization for their development can not rob these eggs of their character as female gametes any more than it can rob the resulting parthenogenetic adults of their character as females. In short in any series of purely parthenogenetic generations the entire race is female. Now whenever this typical parthenogenetic reproduction is so changed that certain eggs become male producers or males, it seems plain to us that sex has been determined—namely that an exclusive female production has become in part a male production. In point of fact, viewing the phenomena more closely, we may see exactly what takes place: the egg or reproductive cell of certain young females becomes modified (either in the course of one or two generations) so as to determine—without fertilization—the production of a male. These eggs therefore have become male eggs and whatever factor has determined this, their character, is a factor of sex-determination. It is true that these same eggs, in the event of fertilization, are again redetermined as female eggs, becoming resting eggs, which always hatch as typical females. It can not be too clearly understood that the factor we are seeking is something which modifies an egg, determining its inherent tendency towards the development of a male or a female. It matters not in the least whether we conceive the determining factor as acting directly upon the egg in its earlier or later growth period or whether its influence may have been indirect, having been cumulative through one or more generations preceding its development. In any case we have phenomena which it seems can appropriately be designated as those of sex-determination.<sup>3</sup>

<sup>2</sup> It is curious that in the discussion of sex-determination this fact seems usually forgotten or quite neglected, despite the fact that the same writers in all other connections habitually designate parthenogenetic individuals as female.

<sup>3</sup> In advocating the view opposite to the one which we are here defending Shull has claimed that the source of confusion in the case of rotifers lies in the fact that there is no outward distinction between the parthenogenetic female and the