

Table 2. RECOMBINATION VALUES FOR THE GROUP VII MARKERS AND SEX

Pairs of factors	Phase balance	<i>n</i>	<i>r</i>	$\chi^2$ (1:1)	$\frac{r}{r+n}$
<i>vt-wa-2</i>	<i>U</i>	1,346	459	435.88*	25.429
<i>vt-sex</i>	<i>B</i>	386	383	0.01	49.805
<i>vt-sex†</i>	<i>B</i>	606	594	0.12	49.500
<i>wa-2-sex</i>	<i>B</i>	370	353	0.40	48.824
<i>wa-2-sex†</i>	<i>B</i>	525	557	0.95	51.479
<i>Re-sex</i>	<i>U</i>	78	90	0.86	53.571

The data not involving *Tm* are twice as large as the rest because they include all the mice that were classified at birth for sex, *wa-2*, *vt* and *Re* and which died before classification for *Tm* was possible.

\* Significant at the 1 per cent probability-level.

† Data from heterozygous females.

culty should be cleared up when repulsion-phase linkage data are available.

The experiments also give data on the partial sex-linkage of group VII (Table 2), a matter about which there has been some doubt. There is no indication of partial sex-linkage such as Wallace<sup>5</sup> found for *wa-2* and shaker-2 (*sh-2*) or as Carter and Phillips<sup>6</sup> found mimicked in the offspring of heterozygous females.

More detailed discussion and analysis of these results are to be published elsewhere.

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<sup>2</sup> Heston, W. E., Deringer, M. K., Hughes, I. R., and Cornfield, J., *J. Nat. Cancer Inst.*, **12**, 1141 (1952).

<sup>3</sup> Burdette, W. J., *J. Thorac. Surg.*, **24**, 427 (1952).

<sup>4</sup> Heston, W. E., *Nature*, **172**, 1007 (1953).

<sup>5</sup> Wallace, M. E. (= Wright), *Heredity*, **1**, 349 (1947).

<sup>6</sup> Carter, T. C., and Phillips, R. J. S., *Z. indukt. Abstamm.-u. Vererb.-Lehre*, **85**, 564 (1953).

### Existence of Multiple Sex Genotypes in the Hermaphrodite Polychaete Worm *Ophryotrocha puerilis siberti*

It was demonstrated in 1951 that *Ophryotrocha puerilis* shows a marked sex variability, as the age when each individual passes from the male to the female sex phase is highly variable. *O. puerilis* can thus be considered as an unbalanced hermaphroditic species<sup>1</sup>.

It was shown later that individuals of *Ophryotrocha puerilis* collected in the Bay of Naples and individuals of the same species collected in Plymouth Sound belong to two different sub-species<sup>2</sup>. Small oocytes first appear in isolated Naples individuals at a mean size of eighteen chaetigerous segments, whereas in isolated Plymouth individuals they appear at a mean size of twenty chaetigerous segments and therefore the two sub-species differ in the relative duration of the male and female phases. The former hypothesis of a genetical basis for sex variability inside each population is thus strongly supported.

The genetic nature of such variability was later demonstrated by the successful selection for the prolongation of the male phase and for the anticipation of the female phase<sup>3</sup>. Individuals that never passed to the female phase or which began to show oocytes at the mean length of 25 segments only were obtained at the fourth generation from a strain which passed to the female phase at a mean length of about 18 segments in the first generation. Selection against duration of the male phase produced individuals which began to show oocytes at 11 segments in a generation

the individuals of which passed to the female phase at a mean length of 13 segments.

This series of experiments, which was interrupted in 1955, lead to a revision of the traditional interpretation of sex determination in hermaphrodites, and it has been resumed using the same technique but examining groups of more numerous individuals in each generation. Individuals have been examined three times a week.

Experiments are still going on, and their results are confirming and extending results obtained in the first series of experiments.

Crosses have started from one pair of individuals which were collected at Roscoff and thus belong to the Atlantic sub-species *O. puerilis siberti*. Their sons ( $n=148$ ), which form the 0 generation, pass from the male to the female phase at a mean length of 18.8 segments, which is a little lower than the mean which is characteristic for the sub-species. In the following generation the sons of the specimens that were selected for maleness ( $n=350$ ) begin to show oocytes at mean values of 20.9 segments, the sons of the specimens selected for femaleness ( $n=340$ ) pass to the female phase at about 18 segments and the mean falls a little below 17 segments in the second generation ( $n=285$ ,  $\bar{m}=16.85$ ). Selection for the anticipation of the female phase at generation 3 has given a mean value of 16.44 in 170 individuals examined so far.

The mean lengths for the appearance of oocytes in the groups selected for the duration of male phase rise in generation 2 to about 22 segments ( $n=291$ ,  $m=21.75$ ) and they rise again very nearly 23 segments at generation 3.

Crosses between individuals of the second generation, which showed oocytes at 15 segments, and individuals of the first generation, which showed oocytes at 23 segments, produced groups of individuals (370 individuals altogether) which passed to the female phase at mean lengths between 18.64 and 18.69 segments, which scarcely differ from the mean obtained in the 0 generation (18.79).

This last result was to be expected on the basis of the crosses published in 1955. It falls in line with results obtained in classical research work on polygenic determination. Present experiments are showing the efficiency of selection in the next generations, which are now being investigated.

The various types of crosses and the various results inside the two lines selected for maleness and for femaleness, which may be called arrhenogenous and thelygenous lines<sup>4</sup>, will be discussed in detail in a forthcoming paper. The existence of multiple sex genotypes is nevertheless wholly confirmed in *Ophryotrocha*. The so-called polyfactorial sex determination was demonstrated some time ago for some gonochoric cyprinodont species by Breider and by Kosswig<sup>5</sup>, for the hermaphrodite polychaete worm *Ophryotrocha* in 1955. This mechanism now awaits application to the phenomena of sex variability in heterogonic cycles<sup>4</sup>, and also to the phenomena of relative sexuality as defined by Hartmann.

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