The Reestablishment of Sex Balance in *Ophryotrocha puerilis* Through Interactions Between Individuals from Arrhenogenous and Thelygenous Lines

It has been known for a long time that female phase individuals of *Ophryotrocha puerilis* revert to the male phase under the influence of other female phase individuals which have the biggest eggs[1] or have a stronger female genotype[2]. Such reversal is presumably brought about by the activation of the male sex genes by sexual hormone-like substances produced by the stronger female phase individual.

Predominantly male strains (the arrhenogenous strains) and predominantly female strains (the thelygenous strains) were obtained in *Ophryotrocha* through selection for the prolongation of the male and for the anticipation of the female phase[3].

A marked decrease of fertility takes place on the other hand both in the arrhenogenous and in the thelygenous lines after a few generations of selection. Cytological investigation showed that such reduction is largely due to degeneration of germinal elements that takes place not only during the sex phase against which selection was carried out but also in the sex phase that ought to have been favoured by selection[4].

Prolonged selection for either sex phase therefore alters the balance among sex factors in such a way as to alter the expression of both sexes. In other words, the normal expression of the male or female phase can only be attained within certain limits of balance between male and female determining factors.

Such results provided a functional interpretation for the general phenomenon of genetic sex bipotency. According to such interpretation, genes of one sex would be necessary for the normal expression of the genes of the other sex[5].

The idea was advanced, on the other hand, that the degeneration of sex elements in the arrhenogenous and thelygenous lines of *Ophryotrocha* might be due to prolonged inbreeding rather than to the altered balance between sex genes.

A decision between the two interpretations was made possible by comparing the production of fertilized eggs by 'pure' couples of *Ophryotrocha*, which were composed of individuals both from arrhenogenous lines or both from thelygenous lines, with the fertility of 'mixed' couples, which were composed of one individual from an arrhenogenous line and another from a thelygenous line. The components of the 'pure' and of the 'mixed' couples belonged to the same generations and thus showed the same degree of homozygosy.

Couples from the thelygenous strain H produced at generation 9 a mean number of 2.55 fertilized eggs per day and the thelygenous strain R produced at generation 10 a mean number of 2.75 fertilized eggs per day. The total amount of fertilized eggs laid by strain H and by strain R was 4230 and 11,535 respectively. The arrhenogenous strains D and K produced likewise at generation 9 an average number of 2.45 and 2.48 per day; the means are based on a total of 4315 and 3970 eggs for strains D and K respectively.

---

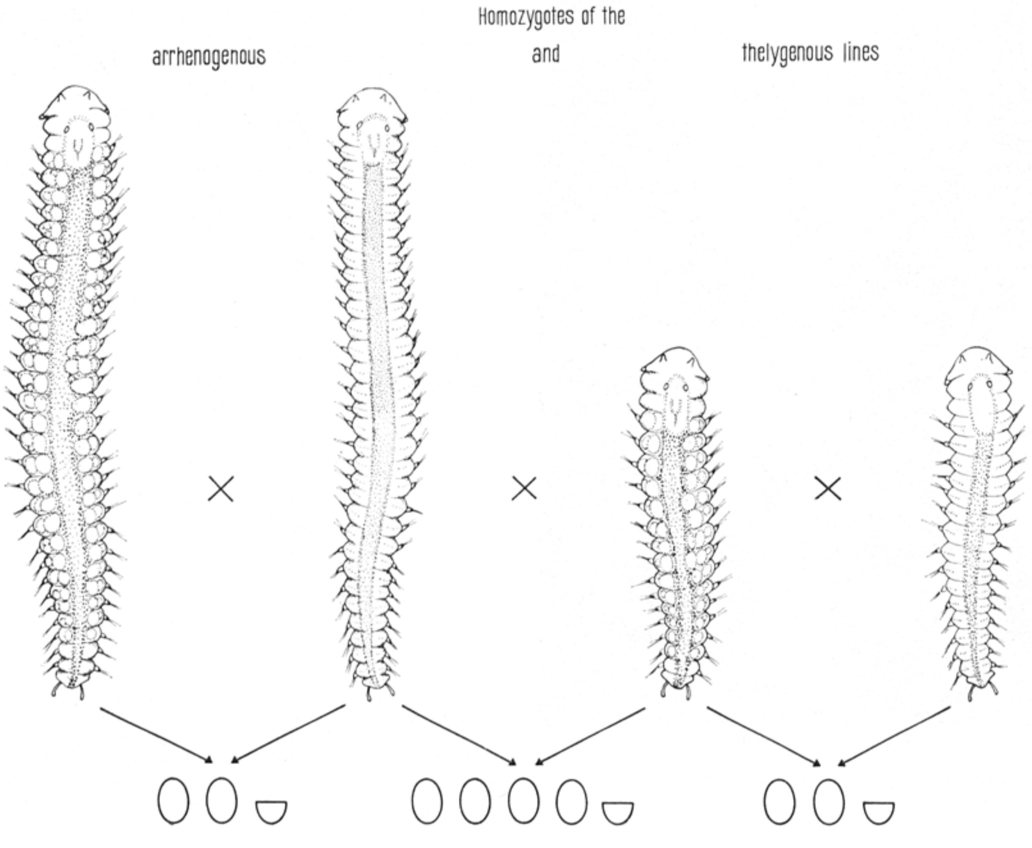
[1] M. HARTMANN and G. LEWINSKI, Zool. Jb. *60*, 1 (1940).

[2] G. BACCI, Boll. Soc. ital. Biol. sper. *28*, 778 (1952); H. MÜLLER, Z. Morph. Ökol. Tiere *52*, 1 (1962).

[3] G. BACCI, Pubbl. Staz. zool. Napoli *26*, 110 (1955); G. BACCI and O. BORTESI, Experientia *17*, 229 (1961).

[4] O. BORTESI, Boll. Zool. *31*, 1103 (1965).

[5] G. BACCI, Nature *207*, 1208 (1965).



Mixed couples composed of individuals from the thelygenous strain R (generation 10) and by individuals from the arrhenogenous strain K (generation 9) produced, on the other hand, an average number of 4.41 eggs per day. The total amount of fertilized eggs was 4543.

Fertility has thus nearly doubled (Figure) in the mixed couples.

Such markedly different results must be attributed to the above-mentioned sexual interactions. They reestablish in the mixed couples that balance which had been altered by selection within the arrhenogenous and thelygenous lines and cannot be established in couples composed of individuals that have exceedingly similar sex genotypes.

The interpretation advanced previously that a certain dose of genes for one sex is necessary for the normal expression of the genes of the other sex is thus demonstrated in *Ophryotrocha*, and the occurrence of genetic sex bipotency in all kinds of eusexual organisms can be interpreted on a functional basis.

A system of control and feedback mechanism through sex hormones among individuals of both sexes and controlled through different regulating systems has been accordingly proposed[6,7].

Riassunto. Si dimostra che interazioni fra individui che posseggono genotipi sessuali sbilanciati in seguito alla selezione per geni sessuali maschili e femminili portano ad un subitaneo aumento della fertilità a causa del ristabilirsi dell'equilibrio genetico. Ciò dimostra che in *Ophryotrocha* una certa dose di geni di un sesso è necessaria per la normale attivazione dei geni dell'altro sesso e fornisce una interpretazione funzionale al fenomeno della bipotenzialità genetica dei sessi.

G. Bacci and O. Bortesi

Istituto di Zoologia, Università di Torino (Italy), 27th January 1967.

---

[6] G. Bacci, Riv. Biol., in press.

[7] The work has been supported by a grant from the Italian National Research Council.

Differences in Teratogenic Response and in Capacity to Repair in Embryos of Two Inbred Strains of Mice

Studies comparing the susceptibilities of different inbred strains of mice to teratogenic agents have disclosed that in the experimental production of congenital abnormalities, the frequency as well as the pattern of malformations is determined in part by the genetic background of the embryo. Reference is made to the work of Callas[1], Dagg[2,3], Fraser[4,5], and Fraser and Fainstat[6].

The present investigation addressed itself to the question whether the variability in response to a teratogenic agent by inbred strains of mice is related to inherent strain differences in developmental rates, or whether the variability in teratogenic response is a reflection of differences in capacity for repair during embryogenesis.

---

[1] G. Callas, Anat. Rec. *142*, 336 (1962).

[2] C. P. Dagg, Am. J. Anat. *106*, 89 (1960).

[3] C. P. Dagg, Am. Zoologist *3*, 223 (1963).

[4] F. C. Fraser, 1st Int. Conference on Malformations (J. B. Lippincott Co., New York 1961), p. 179.

[5] F. C. Fraser, 2nd Int. Conference on Malformations (Int. Med. Congress, Ltd., New York 1964), p. 277.

[6] F. C. Fraser and T. D. Fainstat, Pediatrics, Springfield *8*, 527 (1951).

Table I. Incidence and pattern of trypan blue induced malformations in C57Bl/6J mice

Group	Age of fetuses[a] at treatment	Age of fetuses[a] on day sacrificed	No. of fetuses recovered	Mean litter size	Mean crown-rump length mm	No. of normal fetuses	No. of abnormal fetuses	% of abnormal fetuses
Controls								
1	7	7	16	8.5 ± 0.35	0.8 ± 0.05	16	0	0.0
2	7	8	26	6.5 ± 0.25	1.6 ± 0.20	26	0	0.0
3	7	9	23	7.7 ± 1.36	2.6 ± 0.24	23	0	0.0
4	7	10	20	5.0 ± 0.79	4.8 ± 0.10	19	1	5.0
5	7	11	19	6.3 ± 1.78	6.7 ± 0.09	19	0	0.0
6	7	12	25	6.3 ± 1.08	7.6 ± 0.23	21	4	16.0
Experimentals								
7	7	10	15	7.5 ± 1.64	2.3 ± 0.01	0	15	100.0
8	7	11	18	5.7 ± 0.54	2.4 ± 0.16	0	18	100.0
9	7	12	18	6.0 ± 0.93	2.3 ± 0.13	0	18	100.0

In breaking down abnormalities into the various categories many cases were listed more than once, whenever more than one type of malformation occurred in the same embryo. This fact should be borne in mind when adding the figures of Table I. [a] The age of the fetus is calculated by counting the day the copulation plug is noted as day 1.