THE EFFECTS OF ONE-SIDED OVARIOTOMY ON THE SEX OF THE OFFSPRING.

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It is now widely believed that sex is determined not by conditions acting upon the organism after fertilisation, but by determinants or "factors" existing in the gametes themselves. Since this view came into prominence several hypotheses have been put forward, suggesting that gametes bearing the factor for one or the other sex are produced in separate gonads. Some have believed that in vertebrates one testis yields male-producing spermatozoa, the other female-producing, but this has been disproved in rats by Copeman[1]. It is also known to stock breeders that bulls from which one testicle has been removed, give calves of both sexes. Meanwhile evidence has been accumulated that in several groups of animals it is the egg rather than the spermatozoon which plays the more important part in sex-determination, and in accordance with this, the opinion has been held that one ovary produces female eggs, the other male eggs. That this is not a general rule is proved by the case of birds, which have only one ovary, and in Amphibia by the experiments of H. D. King[2], but in a recent book[3] Dr Rumley Dawson has maintained that this hypothesis is valid at least for man, and probably for other mammals. Direct evidence of a con-

[1] Experiments described at the Physiological Society, May 1908.
[2] *Biol. Bulletin*, XVI. p. 27, 1909.
[3] *The Causation of Sex*, London, 1909.

clusive kind is difficult to obtain in man, since even if children of both sexes are born after single ovariotomy, it is rarely possible to prove that the ovary has been completely removed. It therefore seemed worth while to test the matter critically in some other mammal, and with that object the experiments described below were made on rats.

Two female albino rats were taken, and in May 1910 the right ovary with the greater part of the fallopian tube was removed from one of them, and the same parts from the left side of the other. Both animals rapidly recovered from the operation and on being put with a buck, shortly became pregnant. The female from which the right ovary was removed gave birth to seven young on July 8. The young all died soon after birth, and one of them was almost entirely eaten by the mother. The rest were preserved for examination, and it was found on dissection that there were four females, one male, and one was too much decomposed before being preserved for its sex to be determined with certainty; it appeared to be a female.

The rat from which the left ovary had been removed gave birth to five young on July 28; one young died shortly after birth; it was dissected when quite fresh and proved to be a male. The remainder lived until August 22 when they were killed and dissected; there were three females and one male, giving three females and two males in all. On the same day the two rats which had been operated on were killed and dissected. In neither could any trace of ovary or ovarian tissue be found on the side from which the ovary had been removed. In that from which the left ovary was taken out there was about $\frac{1}{4}$ inch of fallopian tube, ending apparently blindly; in the other the right fallopian tube had been cut off at its junction with the uterus. In each case the uteri were normal. They were congested on both sides in the rat lacking the right ovary, which was probably on heat at the time of killing. In the female (left ovary removed) which had suckled its young up to the time of killing all the mammae on both sides were normal and functional. In both rats the remaining ovary was exceedingly large, and had doubtless undergone compensatory hypertrophy in consequence of the removal of the ovary of the other side[1]. The relatively large size of the litters (7 and 5) produced from one ovary may be thus accounted for. That the litters were produced from one ovary in each case is further shown by the fact that on microscopic examination it was found that in the rat from which the right ovary was

[1] Cf. Carmichael and Marshall, *Journal of Physiology*, vol. xxxvi. p. 431.

removed the remaining (left) ovary contained at least seven corpora lutea, and the remaining (right) ovary of the second rat contained at least eight. These corpora lutea were all of similar age in each animal, and clearly distinguishable from the older luteal tissue present in the ovaries.

These facts seem to us to indicate without any doubt that in the rat it is not true that ova determining one sex are produced from one ovary, and those determining the opposite sex from the other, for each rat, with one ovary completely removed, produced young of both sexes. This does not of course prove that the "right and left ovary hypothesis" is not true for man, but its definite disproof for another mammal detracts from its probability. It should be pointed out however that the evidence for alternate male and female ovulations in man, collected by Dr Rumley Dawson and others, is not in any way affected. In our opinion the weakest part of his evidence is that dealing with the production of ova determining different sexes by the two ovaries, and it is not impossible that this hypothesis may be false, and yet that in general alternate ovulations may be of different sex, so making sex-prediction possible. It is very desirable that those who have extensive opportunities of testing this hypothesis—which involves knowing not only the date of birth and whether the child is "full time" in each case, but also whether the menstrual periods are normal and regular—should have the matter in mind and keep records whenever possible.

[*Note.* The operations described were performed by F. H. A. Marshall; the dissections by L. Doncaster.]