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SHORT NOTES

XXY MICE

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Welshons & Russell (1959) have presented data to show that the XO chromosomal constitution in the mouse is female. This conclusion was based on results of genetical tests with sex-linked markers and on chromosome counts. All XO females were matroclinous, that is, they had inherited their X-chromosome from their mother. Females of this type will arise when non-disjunction occurs in the meiotic divisions of the father and results in spermatozoa without a sex-chromosome. Alternatively, the paternal sex-chromosome may be lost from the fertilized ovum if non-disjunction of sister-chromatids occurs during the first cleavage division. This latter explanation has been urged by Ohno, Kaplan & Kinosita (1959), who found no evidence for non-disjunction of the X- and Y-chromosome in an extensive cytological examination of the mouse testis.

While the occurrence of matroclinous XO females does not provide definitive proof for non-disjunction in the male, such proof can be furnished by the occurrence of XXY animals with one paternal X-chromosome, for these must have arisen through fertilization with XY-spermatozoa. Welshons & Russell (1959) failed to obtain this type of animal, but postulated that it would be male or intersex if it occurs at all. This is in keeping with the situation in man, where males exhibiting Klinefelter's syndrome have been shown to possess two X's and a Y (Jacobs & Strong, 1959; Ford *et al.*, 1959).

A presumptive case of an XXY male mouse was found by McLaren (1960) in crosses with marked X-chromosomes. Unfortunately this animal died at an early age before it could be tested for fertility or examined cytologically. The present note is a report on two sterile males which on genetical and cytological grounds were shown to be XXY.

As a marker of the X-chromosome a rearrangement causing a variegated-type position effect was employed, the origin and inheritance of which will be described in a separate paper. The males which sired these exceptional animals carried a piece of autosome (linkage group I), with the wild-type alleles of pink-eye and chinchilla, attached to, or inserted into, their X-chromosome. In addition they either possessed two complete autosomes, bearing the recessive genes pink-eye and chinchilla, or albino, or only one complete and one deficient for the piece transposed to the X. In females of the equivalent constitution, the heterozygous transposition causes a variegation for the recessive genes; the transposition and the phenotype it produces have been denoted flecked. Males with the transposition do not show the variegation and are wild type. When such flecked-bearing males are crossed with pink-eye, chinchilla, or albino females all the daughters are flecked, while the sons that do not receive the father's X are of the recessive type.

Among 810 offspring of such crosses there appeared two phenotypically flecked males, both of which were sterile. Since very large numbers of flecked-bearing males had been shown not to show the variegation, the exceptional animals were presumed to be XXY in sex-chromosome constitution, having received from their father both the Y and the X bearing the flecked transposition. They copulated readily with females, but produced no offspring. Cytological studies of the extremely small testes showed the presence of tubules but no spermatogenic cells. Chromosome counts in cells of the corneal epithelium

by the method of Fechheimer (1960) and of the spleen by a modification of the method of Ford & Hamerton (1956) showed that both males had 41 chromosomes.

In the same crosses, there appeared five non-flecked females, i.e. recessive type, which were presumed to lack the paternal X-chromosome. Two of them have been examined for chromosome number so far; both had only 39 chromosomes. It is reasonable to assume that some, or all, of these females arose from eggs fertilized by O-bearing sperm in crosses in which the complementary type XY-bearing sperm has been shown to occur. The XO-constitution of some of these females has been confirmed in crosses with males bearing the sex-linked gene, Tabby (*Ta*), when hemizygous *Ta* daughters were produced.

A point of interest is that the variegated-type position effect is expressed in XX and XXY animals but not in XY ones. This indicates that its expression does not depend on sex or the absence of the Y, but requires the presence of two X-chromosomes. This complements the finding of Russell & Bangham (1960) that XO females do not show position-effect variegation.

Two more presumptive XO females arose in crosses designed to test for linkage between *Ta* and the flecked-transposition. Both were matroclinous in regard to their X-chromosome and may have arisen by non-disjunction in the father. A third XO was patroclinous, for it was phenotypically hemizygous *Ta* and arose in a cross of a *Ta* male with a wild-type female. Genetical tests indicated that it possessed only one X-chromosome. McLaren (1960) has described a similar case, but Welshons & Russell (1959) found none in 275 females which might have included it. In the last two cases it is possible that the mothers of the XO females were themselves XO types, so that the exceptional daughters were produced by normal segregation. This could also explain the appearance of a homozygous-type Tabby female observed by Falconer (1953) in a similar cross. In the present case the exceptional female was one of eighteen daughters. This suggests that the mother was not an XO type, for a 1 : 1 ratio of exceptional to normal daughters would be expected from normal segregation. However, as the XO class appears to be relatively inviable (Welshons & Russell, 1959), there is still a possibility that the mother was an XO type. So far, therefore, there is no clear genetical evidence for non-disjunction in the female mouse.

The overall frequency of non-disjunction in flecked-bearing males was almost 1%, and the few data from the *Ta* crosses suggested a similar frequency of non-disjunction. If the XO females are taken as evidence of non-disjunction in the male, it would appear that this occurrence is no less frequent in normal males than in flecked-bearing males.

A striking feature of the combined data for all males is that, of the nine exceptional offspring (omitting the possible patroclinous female), all but one arose in first or second litters, when the males siring them were less than $4\frac{1}{2}$ months old. The other was found in a litter that had been sired by a 23-week-old male. In addition, the frequency of exceptional offspring decreased from litters sired between weeks 6 and 12 to litters sired between weeks 12 and 18. As yet the numbers are too small to make these observations more than suggestive. It would be of interest if the age of the male were found to influence the frequency of non-disjunction, and this is now being investigated.

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Modifying the sternopleural hair pattern in *Drosophila* by selection

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Two apparently very similar quantitative characters, the numbers of hairs on the sternopleural region and on the abdominal sternites of *Drosophila melanogaster*, show unexpected differences in their genetic behaviour. In particular, the amount of left-right asymmetry of the sternopleurals (i.e. the mean absolute difference in numbers of hairs on the two sides of the fly) tends to decline when inbred lines are intercrossed, and can be both increased and decreased by straightforward selection; the corresponding index for the sternite hairs—the uncorrelated variance between two sternites, or the mean absolute difference between the numbers of hairs on each—appears, on the other hand, to be susceptible neither to selection nor to change when inbred lines are crossed (Mather, 1953; Reeve & Robertson, 1954; Reeve, 1959).

In discussing these differences, Reeve (1959) suggested that they might partly be explained by anatomical differences between the two characters, in that the region covered by the sternite hairs is strictly delimited by the extent of the sternites which they cover, while the sternopleural hairs cover a much more indefinite region with no obvious boundaries. The pattern of the sternopleurals is also less restricted than that of the sternite hairs, which give a fairly even coverage of a definite sclerotized area. Variation in sternopleural asymmetry might thus result from variation in the precision with which the sternopleural region is defined, or in the precision with which the general pattern of the sternopleural hairs is determined, two factors which do not seem likely to affect the sternite hairs.

In order to throw some light on this problem, a selection experiment has been carried out to test how far the sternopleural hair pattern is modifiable genetically without the intervention of major mutations. Typically the sternopleural hairs form a variable dorso-ventral row, with two much larger and more stable bristles, one at each side near its dorsal end, and additional hairs occurring sporadically near them. An imaginary straight line drawn through the bases of the two large bristles divides the hairs into