

tin-positive Klinefelter's syndrome with a colour-blind mother and a colour-normal father⁵. Defects of spermatogenesis in the chromosomal intersexes may be related to the unequal size of the X and Y chromosomes with consequent failure of pairing leading to non-disjunction during meiosis. In oogenesis all chromosomes are paired, but a similar causal mechanism might operate for a chromosomal aberration such as inversion could lead to failure of pairing and non-disjunction. A chromosomal aberration of this sort might be inherited or it might be caused by environmental influences. A possible clue to the mechanism is provided in the reports that mongolism is associated with increased maternal age but not with increased paternal age¹, and that there is little increase in the number of female germ cells after birth⁷. Environmental influences, including temperature, hormones and those such as radiation which cause genetic change, may predispose to defects of oogenesis but not to defects of spermatogenesis if old women have old eggs but old men have young sperm.

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¹ Penrose, L. S., Symposium (in the press) (abstract, *Lancet*, ii, 448 (1959)).

² Lenz, W., Nowackowski, H., Prader, A., and Schirren, C., *Swiss med. Woch.*, **89**, 727 (1959).

³ Stewart, J. S. S., *Lancet*, ii, 833 (1959).

⁴ Stewart, J. S. S., *Proc. Roy. Soc. Med.*, **52**, 817 (1959) (abstract, *J. Endocrinol.*, **18**, 29 (1959)).

⁵ Stewart, J. S. S., Symposium (in the press) (abstract, *Lancet*, ii, 448 (1959)).

⁶ Stern, C., *Nature*, **183**, 1452 (1959).

⁷ Zukerman, S., Ciba Colloquium on Ageing, **2**, 31 (1956).

It is useful at this stage of human cytogenetics to keep in mind the whole spectrum of possibilities of chromosomal behaviour. In this sense Dr. Stewart's emphasis on the possibility of non-disjunction during the second meiotic division is valuable. His discussion rests on the assumption that non-disjunction is preceded by crossing-over between homologous chromosomes. In my discussion of second division non-disjunction I had specified absence of crossing-over (and, thus, made no assumption as to closeness of the locus for colour blindness to the kinetochore). According to Dr. Stewart's scheme it would follow that genes distantly located would less often become homozygous than proximal genes. This is the opposite to what is well established in *Drosophila*, although it cannot be excluded, of course, that human chromosomes may behave differently. In *Drosophila* the more frequent homozygosity for distal than proximal genes signifies that non-disjunction preceded by crossing-over occurs during the first meiotic division.

Apart from the question whether non-disjunction occurs during the first or second meiotic division, Ford's suggestion that it may also occur in early cleavage cannot be dismissed¹. This suggestion accounts for homozygosity of the locus for colour-blindness by mitotic non-disjunction without reference to crossing-over or of gene location.

I wish to add two minor points in reference to my earlier communication: (1) The statement about a 'maximum' of recessive homozygosity of 16.7 per cent was in error; instead this frequency follows from random assortment. (2) The choice of 0.5 per cent

as the incidence of colour-blind women was made for the sake of a round number; 0.45 or 0.4 per cent are more accurate values.

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¹ Ford, C. A., *Amer. J. Hum. Genet.*, **12**, 104 (1960).

Effect of Variations in Temperature on Meiosis in *Gagea reticulata* Schultes

PREVIOUS cytological investigations on the genus *Gagea* have been confined to eight species¹. Recently, Malik and Sehgal² contributed to the cytology of one more species, *Gagea reticulata* Schultes. The haploid chromosome number determined was twelve. The meiotic behaviour of chromosomes, as seen from the dividing pollen mother cells, was regular in plants growing in their normal season (February). The pairing of the chromosomes was perfectly normal, followed by regular anaphasic separations, and resulted in a high degree of fertility.

A few plants of *G. reticulata* were collected from the same locality growing late in the season (May). A number of meiotic irregularities were recorded in these individuals. These comprised non-pairing of chromosomes, early disjunction, the presence of bridges and laggards with unequal distribution of chromosomes at anaphases. As a result of all these irregularities, quantitatively equal or unequal tetrads, pentads and even configurations above this level were formed. Pollen-grains thus formed were extremely variable in size.

These meiotic irregularities could not be due to the fixative, for in both cases this was kept constant.

Several workers have artificially induced many meiotic abnormalities such as desynapsis, stickiness, laggardism and formation of diploid spores. Sax³ has described such meiotic aberrations after subjection to various temperatures in *Tradescantia patulosa*. Similar effects of temperature on pollen formation and meiosis in *Hieracium robustum* have been reported by Gustafsson and Nygren⁴. Such chromosomal irregularities are also reported to be caused by various environmental conditions. Matsuura and Haga⁵ reported that normal meiosis occurred in *Trillium kamtschaticum* during winter. When these plants were grown in warmer temperatures, they showed a breakdown in meiosis. The course of meiosis was normal in buds of *G. reticulata* plants collected in February. The abnormalities described above were from plants collected in May and apparently due to the reaction of the plant to its environmental factors. Since these aberrations were observed in the hot months of May, it is reasonable to assume that the extreme heat could be responsible for the disturbances in meiosis. In this connexion, it is pertinent to compare the average maximum temperature in these months in the same locality, which during February was 18°C. and in May 38°C. It is tempting to suggest that the course of meiosis in flowers of plants in May was modified by high temperature to which the plant is ordinarily not adapted; and ever since the observations of Malik and Tandon^{6,7} on *Asparagus curillus* Ham. and *Suaeda fruticosa* Forsk., it has become increasingly clear that there is a correlation between temperature