# GENETICAL SOCIETY OF GREAT BRITAIN

## ABSTRACTS of Papers read at the HUNDRED AND THIRTY-SECOND MEETING of the Society held on 24th and 25th MARCH 1960, at UNIVERSITY COLLEGE OF NORTH STAFFORDSHIRE, KEELE

### INTER-RELATIONS BETWEEN GENOTYPE, DEVELOPMENT AND ECOLOGY IN THE GROWTH OF *DROSOPHILA*

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At first sight genetic variation of body size appears amenable only to statistical description and analysis. When treated as an aspect of growth and studied in different controlled conditions, along with other relevant criteria, such as development time, physiological differences in response to selection and genetic behaviour have to be considered together. Some interesting examples have turned up in experiments relating to gene-environment interaction in *Drosophila*. Thus changes either in growth rate or duration of the growth period may contribute to differences in final body size and such physiological differences have to be allowed for when interpreting genetic differences in reaction to particular environmental changes. When small strains, created by selection for either small body size or small cell size, are back-crossed to the unselected population, the position of the $F_1$ with respect to the parent sizes is quite different in the two cases and also varies characteristically when the composition of the synthetic diet is altered. By selection under appropriate conditions, the ability to regulate body-size on protein-deficient diets has been greatly increased. These and other data suggest that the inter-relations between genotype and ecological conditions can be best studied by combining the techniques and concepts of both quantitative and physiological genetics.

### THE GENETICS OF A PATTERN IN *DROSOPHILA SUBOBSCURA*

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An attempt has been made to analyse the genetic mechanisms responsible for the pattern of 3 ocelli and 3 pairs of bristles on the top of the head in *D. suboscura*, by selecting for two different patterns, one symmetrical and one asymmetrical, in a population homozygous for the mutant *ocelliless*, which removes one or more of these nine structures.

The results can be explained if it is assumed that the wild-type pattern depends on two genetic systems, the first responsible for a " prepattern ", determining the positions of the ocelli and bristles, and the second for the formation of a common " precursor " of ocelli and bristles. The wild-type allele of *oc* forms part of the second system, so that in ocelliless flies the precursor is abnormal in amount and distribution. Selection can alter the amount of the precursor, and its distribution along an antero-posterior gradient, but cannot modify its distribution along a gradient from left to right.

## INDUCTION OF CHROMATID ABERRATIONS IN *VICIA* WITH ALKYLATING AGENTS IN RELATION TO INTERPHASE CHROMOSOME ARRANGEMENT

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Chromatid aberrations induced by a single treatment of either TEM or $HN_2$ have been studied at different recovery times. Aberrations appear in treated cells from 16-36 hours; this indicates an early interphase sensitive period. The proportion of interchanges decreases while that of intrachanges increases as interphase progresses. Changes in the relative proportions of the different types of intrachange indicate that the size of the chromosome loops involved in the aberrations decrease as interphase advances.

During the early part of interphase aberrations are less localised in certain regions than at later periods. Distribution of the aberrations is never at random however. The regions where aberrations are concentrated can be recognised in cold treated cells as dark staining segments and are often adjacent to the pale staining regions generally referred to as heterochromatin.

The anaphase arrangement of chromosomes appears to be retained throughout early interphase. The sensitivity of the cells during this period depends on several factors some of which control contact between and within chromosomes. The most important of these are degree of coiling, change in nuclear volume, and the amount and relative position of heterochromatin in the chromosomes. There appears to be a two stage process in the production of chromatid aberrations with these agents.

## SPERMATOGENESIS IN MAN WITH SPECIAL REFERENCE TO ANEUPLOIDY

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Normal human spermatogenesis was studied by Ford in 1957 using histological methods which enabled him to describe accurately the appearance of the chromosomes at meiosis. Using the same techniques the present investigators examined spermatogenesis and meiosis in known instances of aneuploidy. Three were cases of Klinefelter's syndrome, four were cases of mongolism and one was a case of Klinefelter mongolism. Spermatogenesis was shown to be completely inhibited in all the Klinefelter (XXY) cases.

In the four cases of uncomplicated mongolism (trisomic 21) spermatogenesis was present as was previously found by Mittwoch in 1952. Among the new cases varying degrees of spermatogenesic arrest were observed which were correlated with abnormal chromosomal features. These features included aneuploid and polyploid cells containing from 33 to 92 chromosomal bodies. At diaknesis and meiotic metaphase, cells were seen containing 22, 23 and 24 distinguishable ichromosomal bodies, usually 23. Configurations were found which could be easily interpreted as trivalents but univalents and even multivalents appeared to be present in some cells.

## MUTAGENIC ACTION OF TRETAMINE IN RATS AND MICE

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Tretamine (otherwise known as TEM) is administered i.p. to males which are then mated, and the dominant lethals scored in the pregnancies.

The relative ease with which effects are induced in post-meiotic and pre-meiotic germ cells differs greatly from X-rays. Thus, whilst 500r X-rays produces about

50 per cent. dominant lethals in sperm, it completely sterilises spermatocytes and the later spermatogonial generations (producing sterility of the male for about 2 months), yet a dose of TEM to produce the same mutation rate in sperm has no detectable effect on the fertility of pre-meiotic germ cells.

There is also a species difference in the response of rats and mice to TEM. Rat and mouse spermatids are both hypersensitive to X-rays, yet while rat spermatids are also hypersensitive to TEM, mouse spermatids are highly resistant.

The rat data, in which a wide dose range was used, suggest a threshold effect. It is argued that threshold effects might be characteristic of chemical mutagens.

## INCIPIENT SPECIATION IN *LATHYRUS CLYMENUM*

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*Lathyrus clymenum* grows wild throughout the Mediterranean region, and seed has been received from various botanic gardens in Europe. Cultures of different origins show minor but constant differences in gross morphology, and attempts to make crosses between cultures are much less successful than crosses within cultures. Cultures also differ in their affinity with the closely related species *L. articulatus*. The evidence indicates that *L. clymenum* is in process of dividing into reproductively isolated sections by the establishment of physiological differences which either prevent cross-fertilisation or lead to embryo abortion if cross-fertilisation occurs.

## MALE STERILITY IN LABIATAE

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Male sterile forms occur in a proportion of up to 50 per cent. in wild populations of many species of the Labiatae, constituting an outbreeding system.

The presence of the females in the population requires some selective advantage of the female form over the hermaphrodite, but this is less if the inheritance is cytoplasmically controlled than if controlled by a nuclear gene. In all the species examined it has been found that the two sexes are similar in general vigour and the differential floral characters are dependent on the production of a hormone by the anthers of the hermaphrodite. The only difference which seems genetically significant is a greater fertility of the female compared with the hermaphrodite form.

The possible modes of inheritance of the male sterility have not been exhausted in the schemes previously published. The majority of those investigated are determined by nuclear genes, but the mode of inheritance is complex and has not been elucidated. In no case could a single gene be the determinant and it seems that some hypothesis involving selective fertilisation or zygotic lethality is required.

## PROGRESS IN THE GENETICS OF DEFECTIVE COLOUR VISION

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Interest by geneticists in colour blindness has recently been revived by its possible uses in the interpretation of sex chromosomal anomalies in man. It is therefore desirable (1) to bring up to date prevalent notions concerning the biochemistry and localisation of colour defect, (2) to revise the current ideas concerning the allelism of the sex linked genes responsible and (3) to mention and to discuss cases of defective colour vision, which do not fit the accepted pattern of inheritance.

## THE DEVELOPMENT OF SYNDACTYLISM IN THE MOUSE

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The recessive gene for syndactylism in the mouse (*sm/sm*) regularly leads to fusions between digits 3 and 4 on all four feet ; digit 2 is also often involved. In addition, some *sm/sm* animals have tail kinks. Contrary to what one might expect, the skeleton in this case is only secondarily affected. The earliest manifestation discovered is a hyperplasia of the epidermis of the feet (and sometimes of the tail). This includes the apical ectodermal ridge of the limb buds which is regarded as a stimulatory organ for limb outgrowth by experimental embryologists. Hyperplasia of the ridge is presumably responsible for overgrowth and subsequent deformation of the limb buds which in turn leads to syndactylism. Hyperplasia of the tail epidermis similarly leads to irregularities of tail development. Some general conclusions arising from this situation will be discussed.

## LITTER SIZE, OVULATION RATE AND FOETAL MORTALITY IN INBRED MICE

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Litter size in mice characteristically declines on inbreeding. In the absence of selection at any stage, the mean of the original outbred population should be restored when the inbred lines are crossed. The results from one such study will be presented.

When the constituent factors of litter size were examined, ovulation rate had remained unaffected by inbreeding. By implantation, however, significant differences were apparent between inbred and outbred females, but no further differences in foetal mortality emerged.

## ASSESSMENT OF THE COMBINING ABILITY OF WINTER WHEAT VARIETIES IN BREEDING FOR YIELD

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Analysis of the yield components of a diallel series of crosses involving six varieties of *Triticum aestivum*, grown in yield trials from $F_1$ to $F_4$ is described.

The trials in $F_1$ and $F_2$ comprised unselected bulks of each cross, together with the parental varieties. Those in $F_3$ and $F_4$ consisted of random selections from each cross, with replicated plots of the parental varieties.

Predictions made from analysis of the results of the $F_1$ and $F_2$ trials are compared with estimates of the mean yield and variance in yielding capacity observed in the trials in $F_3$ and $F_4$. The value of the analysis of early generation bulk of diallel crosses as a tool in the assessment of the combining ability of varieties of self-pollinating crop is discussed.

## NON-COMPLEMENTARITY BETWEEN METHIONINE-SUPPRESSOR MUTANTS WITH 20 PER CENT. RECOMBINATION IN *COPRINUS*

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A series of recessive mutants, which suppress the requirement of *met-1* cultures for methionine have been tested for recombination and complementarity. The mutants fall into 4-5 loci. All mutants at loci 1 and 2 are non-complementary

between the mutants within each locus, but complementary between mutants from different loci and with mutants from the other 3 loci.

Mutants grouped in the last three loci also agree in general with the rule that non-complementarity only occurs between mutants of the same or very close loci. But some exceptions were found in which the suppressor mutants that are some 20 units apart by recombination do not complement when the + alleles of the two loci are in different haploid nuclei of a dicaryon.

## THE USE OF THE ELECTRONIC COMPUTER IN GENETICS TEACHING

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The form of the number in the electronic computer allows precise analogies with genetic systems. Units of the computer may be provided with " chromosomes ", and their " genotypes " given phenotypic expression ; they can reproduce by self- or cross-fertilisation, and their reproduction affected by chance as it would be in nature. Dominance, independent assortment, linkage and crossing-over are easily arranged ; meiosis in structural heterozygotes presents no difficulty. Breeding populations can be simulated in a way which in essential genetic aspects is closely analogous to reality.

Genetic experiments, of essentially the same character as those with living organisms, may be performed with the pseudo-organisms of the computer. Families or populations may be scored by students in the same way that real families would be ; such student participation forms a valuable supplement to more orthodox practical work ; it stimulates imagination and gives an alternative approach to an understanding of genetic systems.

Experiments have included the construction of a chromosome map with eleven genes, by a series of three-point linkage tests (with end, centromere, and chiasma interference); demonstration of the Sewall Wright effect; comparison of evolution (by natural selection) in inbreeding and outbreeding populations; and the evolution of dominance.