GENETICAL SOCIETY OF GREAT BRITAIN

ABSTRACTS of Papers read at the HUNDRED AND FORTY-FIFTH MEETING of the Society held on 8th, 9th and 10th JULY, 1964, in the SCHOOL OF AGRICULTURE, DOWNING STREET, CAMBRIDGE

RELATIVE GROWTH RATES : CONVERGENCE AND DIVERGENCE

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In comparing the post-natal growth of lines of fowl selected in opposite directions for size (body weight) or for shape (relative shank length) it has been found that in some instances the ontogenetic allometry lines converge, *i.e.* two lines become *less* different in respect of a measure of shape as growth proceeds. This is the counterpart of the phenomenon of con-concurrence of allometry lines, previously found at the level of individual variation. Other examples of convergence or intersection of allometry lines will be cited from the literature on mammals and arthropods.

In the case of the fowl it is known that genes which increase relative shank length at a particular age are of at least two anatomical types. Some of them also increase relative shank width : others decrease it. Such genes are also of at least two types developmentally : some increase the post-natal relative growth rate, others do not. The hypothesis that the anatomical and developmental types correspond (partially or completely) yields the observed instances of convergence as a necessary consequence. A possible method of generalising and testing hypotheses of this kind, using multivariate longitudinal data, will be discussed.

THE CYTOLOGICAL EVALUATION OF HOMŒOLOGY BETWEEN CHROMOSOMES OF *TRITICUM ÆSTIVUM*

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The genotype of *Ægilops speltoides* ($2n = 14$) suppresses the activity of chromosome 5B of *Triticum æstivum* ($2n = 42$) that normally prevents meiotic pairing between homœologous chromosomes. This was shown by simultaneously marking two chromosomes of T. *æstivum*, by a telocentric condition, in hybrids between the two species. Pairing occurred between the marked homœologous but not between marked non-homœologous chromosomes. A cytological evaluation of homœology is thus permitted. Moreover the relationships of the arms of certain homœologues has been determined by the nature of the configurations in which they participated together as telocentrics.

AN ESTIMATION OF THE NUMBER OF GENES INVOLVED IN THE GENETIC CONTROL OF CYTOLOGICAL DIPLOIDISATION IN WHEAT

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Species of the Sitopsis section of the genus *Ægilops* have been for some time been regarded as the potential donor of the B genome of polyploid wheats. Hybrids within

the section demonstrate a very close cytological and genetical similarity between the species. Hybrids between Sitopsis section species and polyploid wheat fall into two categories ; those with low pairing and those with high pairing at meiosis. The only species that exhibits high pairing is *Ægilops speltoides* and this is the species that is considered as the most probable donor of the B genome.

Regular synapsis and bivalent formation in the polyploid wheats are under the control of a genetical system located on chromosome 5B. The number of genes involved is not known but, for economy of hypothesis, is presumed to be one. Since it has been proposed that the system of 5B arose by mutation from that in *A. speltoides* it is of some interest to see how many genes are involved in the suppression of the effect of 5B. Evidence will be presented to show that, in the appropriate hybrid, the dominant factor of *A. speltoides* segregates as a single gene.

CHROMOSOME ASSAYS IN *TRITICUM ÆSTIVUM*

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The ability to substitute single pairs of chromosomes from one variety of hexaploid wheat (*Triticum æstivum*) into another provides a ready and useful means of undertaking chromosome assays. This is particularly valuable where metrical characters are concerned. Experiments, using a substituted series in which chromosomes from the variety Hope replace those in the variety Chinese Spring, have been conducted and some results will be presented. These include the description, both qualitative and quantitative, of the 21 possible substitutions grown under a range of environmental conditions, a statement of the genetic constants which can be derived from this material, and further experiments which describe crosses between the substituted lines in an attempt to study and estimate between-chromosome interactions.

THE USE OF X-RAY TREATMENT IN INVESTIGATING POTATO CHIMERAS

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Two experimental methods—breeding and eye-excision—have been used extensively in investigating potato chimeras. They both give information on the constitution of LII at the growing point. X-ray treatment of sprouts, on the other hand, may produce some plants which are homogeneous for the constitution of LI of the original chimera, and so may enable information to be obtained about LI in the chimera.

PROOF OF HYBRID ENZYME FORMATION IN A CASE OF INTER-ALLELIC COMPLEMENTATION

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Mutant forms of glutamate dehydrogenase have been isolated from the *Neurospora crassa* mutants am^1 and am^3, which complement each other in a heterocaryon. The mutant proteins will react together *in vitro* with the formation of a more enzymically active product. By carrying out *in vitro* complementation experiments with each protein in turn labelled with ^{35}S it has been possible to show that the active product is a hybrid containing close to a one to one ratio of the two mutant components.

GENETIC CONTROL OF NITRATE REDUCTION IN *ASPERGILLUS NIDULANS*

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A group of mutants of *A. nidulans*, unable to grow on nitrate but able to grow on nitrite, are under investigation. It was thought that the majority of these mutants could not utilise nitrate because they were abnormal with respect to a co-factor essential for both nitrate reductase (NR) and xanthine dehydrogenase (XDH) activities, J. A. Pateman, D. J. Cove, B. M. Rever and D. B. Roberts, *Nature* 201, 58 (1964). It has now been found that some of these mutants are able to use nitrate in the presence of high concentrations of molybdenum. In addition mutants have been obtained which are able to use nitrate, but are unable to use hypoxanthine as a sole source of nitrogen. These findings confirm the previous hypothesis that the two enzymes, NR and XDH, share a co-factor which contains molybdenum.

Previous work indicated that the absence of this co-factor resulted in the constitutive synthesis of the NR protein. Further investigations of the enzyme levels of cells grown in the presence of ammonium salts have been made. It appears that the mutants are constitutive for the nitrate reductase protein because of their inability to produce the complete wild type nitrate reductase enzyme, rather than the co-factor alone.

MECHANISM OF FORMALDEHYDE-INDUCED MUTAGENESIS

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It has been shown by the larval feeding method in *Drosophila melanogaster* that the mutagenic activity of formaldehyde is completely dependent on the presence of adenylic acid (or adenosine) in the treatment medium. A monohydroxymethylated reaction product(s) of formaldehyde with adenylic acid has been shown to produce an effective mutagenic derivative, which is both the necessary and sufficient condition for the mediation of the mutagenic activity of formaldehyde ; dihydroxymethylation of adenylic acid by formaldehyde does not appear to produce an effective mutagenic product.

Although the actual form of the monohydroxymethyl grouping remains to be determined, indirect and direct evidence is discussed which implicates a formaldehyde-induced methylene-bridged dimeric product of adenosine-5′-phosphate, methylene-bis (adenosine-5′-phosphate), as the mediator of the mutagenic activity of formaldehyde. The results are discussed in relation to the germ cell stage through which formaldehyde is mutagenically effective, and the apparent mediation of its activity via RNA synthesis.

A MATERNALLY HERITABLE, NUCLEAR EFFECT, MANIFEST IN THE ABSENCE OF THE NUCLEAR GENE(S) OVER THREE OR MORE GENERATIONS

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Gibson and Thoday have described a population of *Drosophila melanogaster* in which there is little ordinary genetic variance for sternopleural chaeta number but a large maternally inherited difference between two lines. There is a nuclear gene(s) on chromosome II which has no effect on the chaeta number of its possessors but is manifest only in that the progeny of females possessing this gene(s) have high chaeta numbers.

Since chaeta number is modifiable late in development, it seemed possible that this gene(s) might produce in the mother some rather persistent cytoplasmic intermediate. A backcrossing programme showed that the influence of the gene(s) could be transmitted through mothers that lacked the gene(s) to grandchildren lacking it. The effect of the gene(s) has disappeared in three generations although it often persists considerably longer.

STUDIES ON THE BASIDIOMYCETE *COLLYBIA VELUTIPES*

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Collybia, unlike most basidiomycetes, produces monokaryotic oidia on both monokaryotic and dikaryotic mycelia. It is therefore particularly useful for studying changes which occur in dikaryons. The plating of oidia from dikaryons has shown that only one of the components may be represented in the oidial progeny. The behaviour of nuclei during conjugate nuclear divisions together with nuclear migration may account for this. The timing of nuclear divisions in the basidium and the subsequent migration of the nuclei can also explain several of the abnormalities found in spore tetrads. These include 3 : 1 ratios and spontaneous dikaryotisation. Mutant strains and new techniques developed during the course of the study will be described.

SOME DATA ON MUTAGEN SPECIFICITY IN NEUROSPORA

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Mutagen specificity is commonly defined as a significant difference between loci and sites in response to different mutagens, and is commonly interpreted as reflecting specificities of chemical reactions between mutagens and regions or sites in DNA. *A priori*, it is however likely that mutagen specificity may arise at any one of the steps that lead from the reaction of a mutagen with DNA to the emergence of a mutated clone. If this is true, mutagen specificity should prove an excellent tool for analysing these intermediate steps in the mutation process. With these considerations in mind, we are analysing mutagen specificity in one of the earliest and best-known systems, Kølmark's *ad*$^{-}$*inos*$^{-}$ strain of Neurospora. Reversions of these two alleles have been shown to differ not only in their overall response to mutagens but also in dose-effect curves, response to environmental conditions and response to combination treatments. So far, this work is purely descriptive, but it suggests that in this case—as probably in many others—mutagen specificity cannot be attributed solely to differences in the base sequences of the mutated loci.

MUTANT EXPRESSION DELAY IN A NITROUS ACID FORWARD-MUTATION SYSTEM IN SCHIZOSACCHAROMYCES POMBE

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A study has been made of mutation expression delay following nitrous acid treatment of the haploid uninucleate fission yeast *Schizosaccharomyces pombe*. The system used has been that analysed by H. Heslot of forward mutation at any one of five adenine loci (*adn*-1, -3, -4, -5, or -9) in an *adn*-6 or -7 mutant. The *adn*-6 or -7 mutants form red colonies on media supplemented with limiting concentrations of adenine. The *adn*-1, -3, -4, -5 or -9, *adn*-6 or -7 double mutants, however, form white or pale pink colonies. Thus forward mutations occurring in the *adn*-6 or -7 strain at the other adenine loci can be scored as white colonies or sectors.

Experiments with nitrous acid over a survival range of 100 per cent. down to 1 per cent. show that most nitrous acid-induced forward mutations appear as sectors. The proportion of induced mutants which appear as complete whites does not increase with decreasing survival. Besides regular, $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{8}$ colony sector types many other mutant sector types occur.

The relationship of these results to those already published for nitrous acid mutagenesis in bacteriophages T2 and T4, *Escherichia coli*, *Aspergillus nidulans* and *Neurospora crassa* will be discussed.

CHROMOSOME ANOMALIES IN PARENTS OF MONGOLS

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It is well known that there are apparently normal parents predisposed to produce mongol children, because of the presence either of a structural chromosome anomaly (usually a centric fusion of a large acrocentric and a 21st chromosome), or a mosaic condition (46 normal/47 trisomy 21). The frequency of abnormal conditions in parents of mongol children can be assessed only after a large number of cases have been examined and reported upon. A small series will be reported.

In one out of twenty cases where the mother was under thirty years old, she had a few cells (2 : 140) where there was an extra 21st chromosome (lymphocyte culture). In one case, only the child had a centric fusion 21/13. In one case the child was a 46/47 mosaic. In two out of eleven cases where the mother was over thirty years old, structural abnormality was found in mother and child.

These results will be compared with other published work.

THE DOSE-FREQUENCY RELATIONSHIP FOR INDUCED SPERMATOGONIAL MUTATIONS OF *DROSOPHILA MELANOGASTER*

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Much information has been published on the relationship between radiation dose and induced mutation frequency. This work led to the formulation of the basic principle that mutation frequency is linearly related to dose. Most of the experiments, however, were conducted with post-meiotic germ cell stages in *Drosophila* and the type of mutation commonly scored was the sex-linked recessive lethal.

Data presented here concern the production of IInd chromosome recessive lethal mutations following irradiation of spermatogonia with ^{60}Co gamma rays over a dose range 200-800 rad.

Oftedal has recently published evidence for a non-linear dose response for sex-linked recessive lethal mutations using very low doses of X-rays. He interpreted these data in terms of differential cell killing in heterogeneous populations of spermatogonia. Abrahamson and Friedman, however, found a linear dose response for sex-linked recessive lethals using high doses of X-rays. The present data, which suggest a linear dose response, cover a range intermediate between these two studies.